REPORT

Northern Gateway Container Terminal

Environmental Impact Assessment Report

Client: PD Teesport

Reference: PB8270-RHD-ZZ-XX-RP-0001

Status: 0.1/S0

Date: 10 February 2020

Royal HaskoningDHV
Enhancing Society Together

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Disclaimer

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APPENDICES

1 INTRODUCTION AND BACKGROUND

1.1 Introduction

PD Teesport (PDT) applied for a Harbour Revision Order (HRO) for the Northern Gateway Container Terminal (NGCT) under Section 14 of the Harbours Act 1964 in 2006. An application for planning permission under the Town and Country Planning Act 1990 was also submitted to Redcar and Cleveland Borough Council (RCBC) at the same time. In support of these applications, Royal Haskoning carried out an Environmental Impact Assessment (EIA) and produced the NGCT Environmental Statement (ES) in 2006 (Royal Haskoning, 2006) (referred to as the 2006 ES) and the NGCT ES Supplement in 2007 (referred to as the 2007 Supplement).

The Teesport HRO (referred to as the 2008 HRO) (Statutory Instrument (SI) 2008 No. 1160) was made on 18th April 2008, coming into force on 8th May 2008. The 2008 HRO is included in Appendix 1. The 2008 HRO was due to expire on 8th May 2018. In anticipation, PDT applied to the Marine Management Organisation (MMO) for a 10-year time extension to the 2008 HRO. PDT did not apply for a marine licence concurrently with the application to extend the 2008 HRO.

Given that the planning permission for the NGCT (R/2006/0433/00) has been implemented, the 2006 ES and 2007 Supplement were submitted in support of the 2008 HRO extension application to demonstrate to the MMO that landside impacts had been appropriately assessed. In addition, a Supplementary Environmental Information Report (2018 SEIR), which assessed the effect of any material changes which had occurred to the baseline environment or legislative requirements since the 2006 ES and 2007 Supplement were produced, was also submitted. The approach to the 2018 SEIR was agreed with the MMO via submission of a scoping report (Royal HaskoningDHV, 2017) and receipt of a scoping opinion.
The MMO approved the requested 10-year extension to the 2008 HRO and the new expiry date is, therefore, 7th May 2028 (Appendix 1).

The marine elements of the NGCT have not yet been implemented; however, as noted above, the planning permission has been implemented. The NGCT scheme is, therefore, authorised by RCBC under planning permission R/2006/0433/00 (Appendix 2) and by The Teesport HRO 2008 (SI 2008 No. 1160) (with the amended expiry date of 7th May 2028). PDT is submitting a marine licence application to the MMO to allow the construction of the marine elements of the proposed scheme.

The works assessed and subsequently authorised by the 2008 HRO and planning permission are defined in full within Section 3; however, in summary, the NGCT scheme comprises:

- Capital dredging of the approach channel to the proposed NGCT as well as creation of a new berth pocket (equating to dredging of up to 4.8 million m^3 of material). Realignment of the existing approach channel in the vicinity of the proposed terminal and deepening of the two existing turning circles (Tees Dock turning circle and Seaton Channel turning circle) in the Tees estuary
- Disposal of dredged material (through a combination of beneficial re-use (localised reclamation and raising land levels within the proposed terminal site) and offshore disposal).
- Construction of a container terminal facility.
- Construction of various landside elements (buildings, rail terminal, road access, lighting, drainage and a pumping station).

1.2 Background to this report

A meeting was held with the MMO in October 2018 to discuss the nature of the environmental information that would be required to support the marine licence application. In summary, it was agreed that the 2018 SEIR would be updated and developed into an EIA Report suitable to support the marine licence application.

1.3 Structure of this report

Following this introduction, Section 2 presents the need for the scheme whilst Section 3 presents the scheme description. Section 4 presents the legislative framework and Section 5 provides detail on the EIA methodology used during the production of this report. Sections 6 to 26 contain the technical assessments of the potential impacts of the proposed scheme. These sections describe the nature of the existing (baseline) environment for the various parameters considered during the EIA process. The potential impacts of the proposed scheme during the construction and operational phases on each of these parameters are then identified and assessed and, where appropriate and practicable, mitigation measures are defined. The residual impacts (potential impacts remaining assuming the proposed mitigation measures are effectively implemented) are then assessed.

Section 27 presents the findings of a cumulative impact assessment (CIA). Section 28 presents a summary of the Water Framework Directive (WFD) compliance assessment. Section 29 presents the Habitats Regulations Assessment (HRA). Section 30 lists the references used during production of this report.

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2 NEED FOR THE PROPOSED SCHEME

Section 2 of the 2006 ES presents a thorough and comprehensive description of the need for the NGCT scheme, in the context of UK wide container traffic. In summary, the 2006 ES stated that container traffic in the UK was predicted to double by 2015, providing clear justification (at the time) for the need for further container terminal capacity in the UK. The 2006 ES went on to state that in 2006, only 6% of the deep-sea traffic entered the UK via a port in the north of England (namely Liverpool), with the rest of the twenty-foot equivalent units (TEU) northern market handled in the south-east and continental Europe. This implied that a large amount of container traffic destined for the north needed to be transported on rail or road from the south, contributing to congestion throughout the south-east and Midlands.

Without a substantial increase in deep sea container capacity in the north, it was predicted that this situation would only worsen (Royal Haskoning, 2006). The 2006 ES also stated that existing medium-term deep-sea capacity developments are all located in the south-east, increasing consolidation and congestion in those regions (Royal Haskoning, 2006).

A review of the UK's container market since production of the 2006 ES has determined that the situation regarding the handling of containers in the UK remains similar to that previously reported. The UK container market has been growing at a steady pace of approximately 2.3% per annum (on average) since 2000, with a total market size of approximately 10 million TEU (Department for Transport, 2017).

Approximately 80% of the container market in the UK is handled by the three main deep-sea ports in the UK (Southampton, Felixstowe and London Gateway) and two ports (Tilbury and Liverpool) serving regional trades. Southampton, Felixstowe and London Gateway have a combined capacity of 8.9 million TEU, and during 2017, these ports handled 8 million TEU combined. These three main ports for UK container terminal traffic are all located in the south of England. Due to the growing vessel size and liner alliances, the container market trade has been consolidating into fewer services and fewer ports. Although the global financial recession impacted on the timescales for implementation of the NGCT (and other major container terminals across the UK), the fundamental need for additional deep-sea container terminal capacity in the north (as presented in the 2006 ES) remains.

Figure 2.1 illustrates the actual container throughput at Teesport from December 2007 to December 2018 (green line), against container capacity at Teesport (red line). Figure 2.1 also shows the predicted throughput up to August 2026. It is evident that container throughput at Teesport has generally increased since 2007, from approximately 80,000 containers in December 2007 to approximately 230,000 containers in 2018 (equating to an increase of 11% year on year, compared to the UK average of 2% over the same period). As shown in Figure 2.1, the throughput of containers at Teesport is now very close to capacity; in the absence of the NGCT scheme, it is predicted that Teesport would be at full capacity by approximately 2024, preventing the future growth of the port for container cargo. The implementation of the NGCT scheme would therefore provide the additional capacity required by PDT to accommodate the predicted increases in throughput at Teesport.

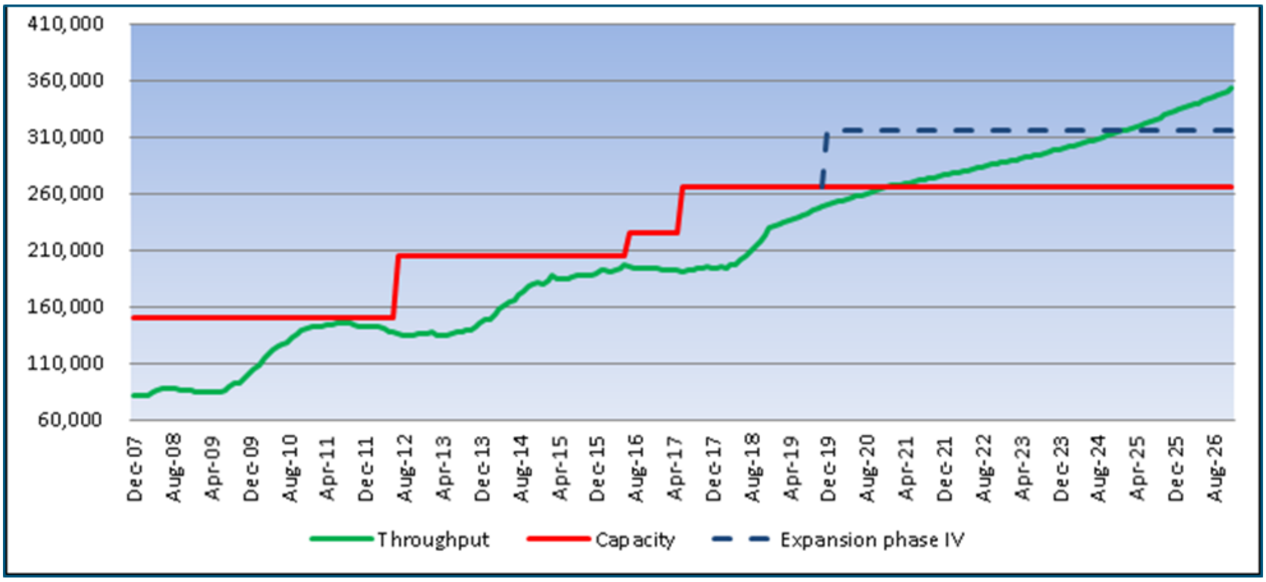

Figure 2.1 Container terminal throughout and capacity at Teesport since 2007 (Expansion phase IV refers to works currently being undertaken by PDT to increase capacity at the existing Teesport Container Terminal 2 (TCT2))

3 DESCRIPTION OF THE PROPOSED SCHEME

As noted in Section 1, the proposed scheme involves the following elements which are discussed in turn below:

- Capital dredging of the approach channel to the NGCT as well as creation of a new berth pocket (up to 4.8 million m^3 of material).
- Disposal of dredged material.
- Construction of a piled quay structure (overall length of 1,035m, as defined in the 2008 HRO), with the potential for reclamation with dredged material and beneficial re-use of dredged material for raising of land levels within the proposed terminal site.
- Construction of various landside elements (buildings, rail terminal, road access, lighting, drainage and a pumping station).

Although the landside elements of the proposed scheme are already consented by the existing planning permission (which has been implemented) and therefore further assessment of the landside elements of the proposed scheme is not required (as agreed with the MMO in October 2018 (Appendix 3)), the scheme description presented below includes the landside works as well as the marine elements for completeness and to demonstrate that the potential environmental impact of the whole project has been sufficiently assessed.

3.1 Construction phase

3.1.1 Capital dredging of the approach channel

The footprint of the proposed capital dredging is illustrated in Figure 3.1. For the purposes of describing the proposed changes in depth of the various dredge areas, the dredge footprint has been divided into sections (as shown on Figure 3.2). Table 3.1 below summarises the existing channel depth in the various sections and the proposed declared depth following the capital dredging.

The total volume of material that will arise from the capital dredging will be up to 4.8 million m^3. Based on previous investigations and capital dredging in the estuary, it is expected that, broadly, three material types would be dredged; relatively soft alluvial deposits (silt, clay and sand), Mercia mudstone (marl) and boulder clay.

In Area C and most of Area D only soft alluvial deposits will need to be removed. This is because the channel and Seaton Channel turning circle have previously been dredged to a greater depth than the presently maintained depth of 14.1m below CD.

Additionally, there is a backlog of maintenance dredging in these areas with some parts of the channel at depths above 14.1m below CD. There is also some overlying granular material to be removed from upstream locations before the mudstone is encountered. The total volume of alluvial deposits (silt, clay and sand) to be dredged is expected to be small relative to the overall volume of the dredge given that the channel is already subject to maintenance dredging.

The dredging work can be divided into two phases as follows:

- Phase 1 involves the removal of granular superficial material in Areas C and D using a Trailing Suction Hopper Dredger (TSHD). The material arising from the dredging would be used for reclamation.

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- Phase 2 of the dredging involves the removal of mudstone using a Cutter Suction Dredger (CSD) and/or Backhoe Dredger (BD) loading into hopper barges. The material arising from this dredging would be disposed offshore at the existing licensed disposal sites. As part of this phase 20m wide, 1m deep trenches would be dredged on the inside of the edge of the dredged channel in Area E. The trenches will be dredged 1m deeper than the main channel; therefore, their total depth will be 15.5m below chart datum. The purpose of these trenches is to allow maintenance material to accumulate without affecting channel depth; at present, PDT observes that maintenance material accumulates along the edges of the channel. Figure 3.3 demonstrates a typical cross section of the trench.

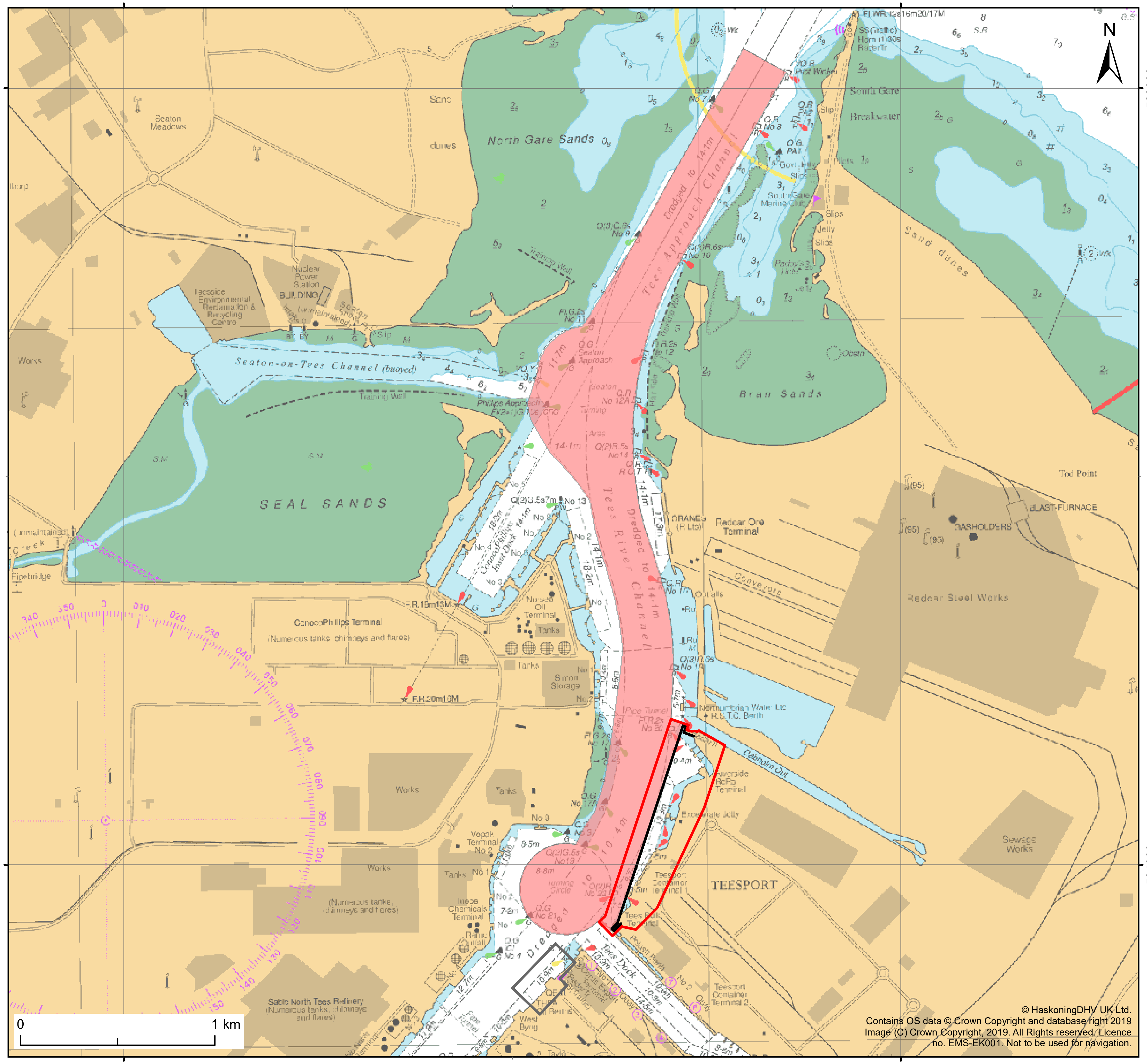
Due to the high production rates required for the dredging, it is likely that the majority of the dredging would be undertaken by either a TSHD or CSD. Therefore, the use of these dredgers has been assumed for the purposes of the assessment of potential environmental effects (i.e. studies on the dispersion of sediment plumes during dredging), particularly as the use of BD typically results in lower environmental impact relative to CSD or TSHD. Therefore, the CSD and TSHD represents upper bounding cases for the purposes of the EIA.

In addition to the above, there may be a requirement to use a BD for small, confined areas of dredging, for example, alongside the existing quay wall, to dredge berth pockets or for construction of new quays.

Maintenance dredging in the area of the capital dredge footprint will be kept to an absolute minimum during the capital dredging period and only essential maintenance works will be carried out.

Table 3.1 Details of the existing and proposed depths throughout the navigation channel

Area	Channel section	Existing declared depth (m bCD)	Proposed declared depth (m bCD)	Volume and material to be dredged (Mm^3)	Proposed dredge technique
A	Tees Dock turning area	10.4	14.5	1.15 (mudstone)	Cutter Suction Dredger (CSD) or Backhoe Dredge (BD)
B	Channel upper reach	10.4	14.5	2.06 (mudstone)	CSD or BD
C	Channel lower reach	14.1	14.5	0.85 (silts, clay and sand)	Trailing Suction Hopper Dredger (TSHD)
D	Seaton channel turning area	14.1	14.5	0.21 (boulder clay and sand)	TSHD
E	Channel sea reach	14.1	14.5	Included in the volumes above and below (boulder clay and sand)	TSHD
F	Seaton channel turning area (enlargement)	-	14.5	0.04 (mudstone)	TSHD
G	Berthing pocket	-	16.0	0.50 (mudstone)	CSD or BD



Legend

- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Limit of deviation for Works No. 2 (no longer proposed as part of NGCT scheme)
- Proposed quay face
- Proposed dredge footprint

Client:	Project:
PD Teesport	Northern Gateway Container Terminal

Title: Proposed dredge footprint

Figure: 3.1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	21/10/2019	TC	SR	A3	1:20,000

Co-ordinate system: British National Grid

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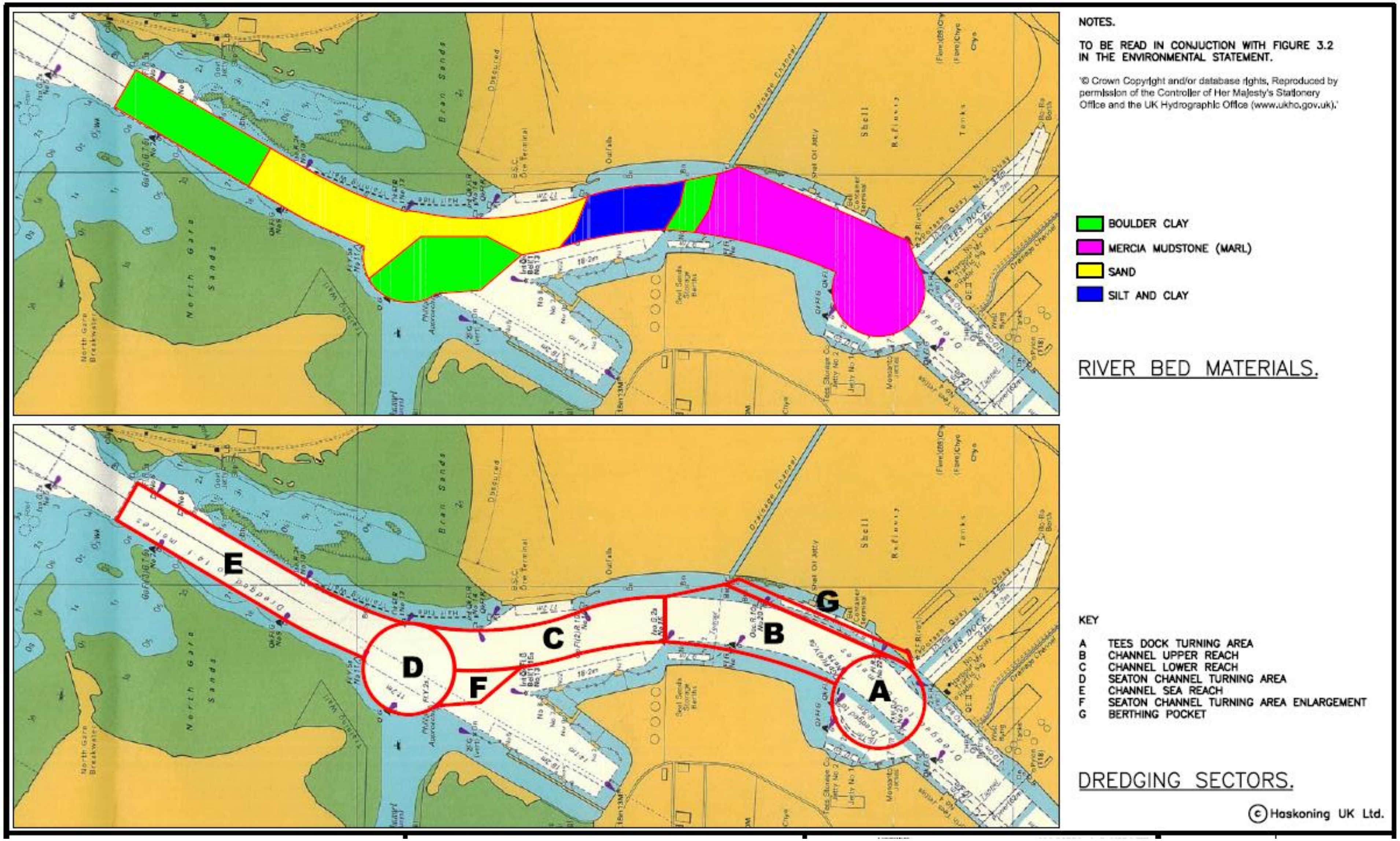

Figure 3.2 Dredge areas for the proposed NGCT

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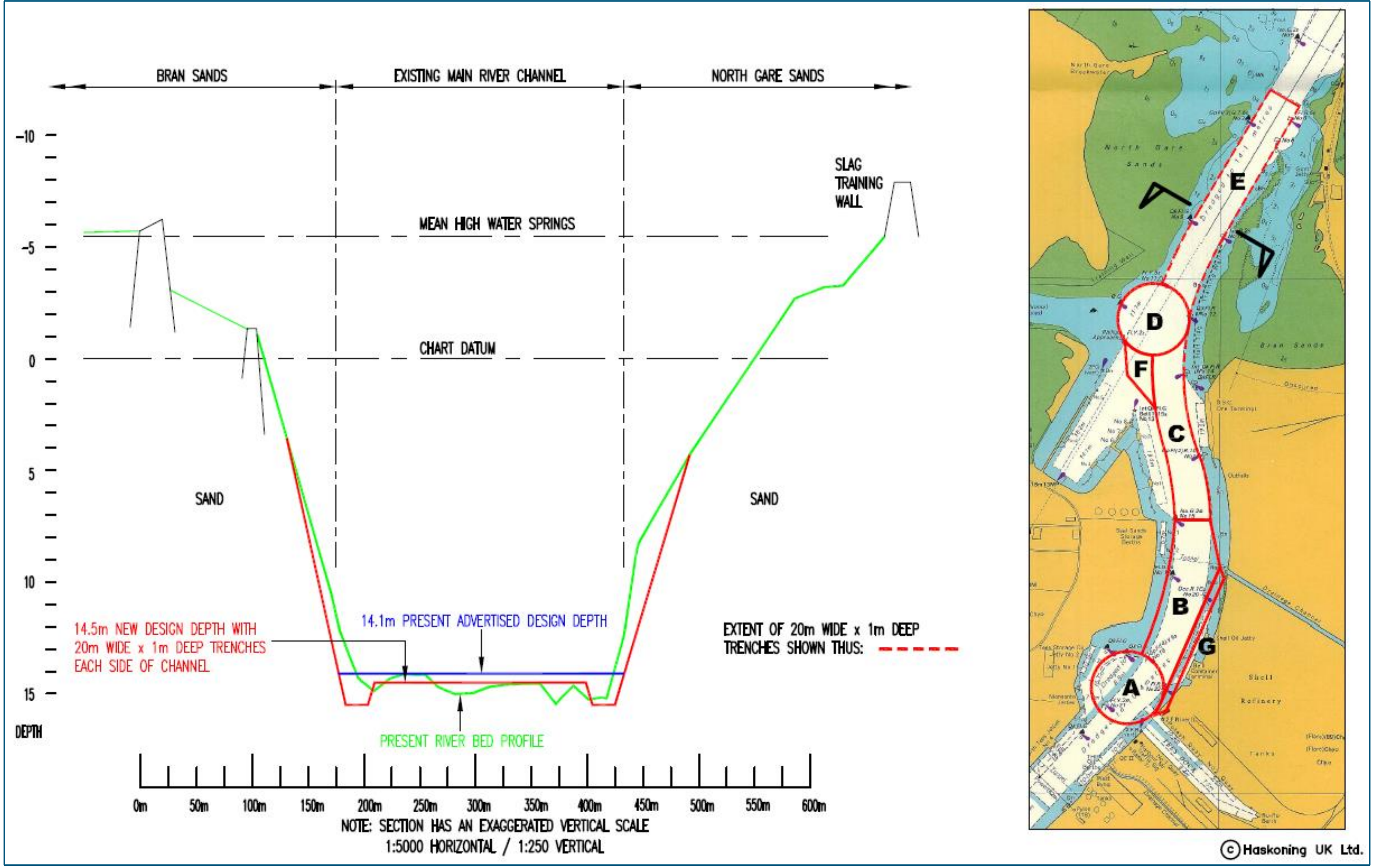

Figure 3.3 Typical section through channel sea reach in Area E of the NGCT dredge footprint

3.1.2 Terminal construction

Construction of the main quay wall

The actual structural form of the main quay wall has not yet been determined, as different options will be explored to provide a value engineered and efficient structure. It is likely that this decision will be made as the design of the scheme progresses, using construction expertise from the Maritime Civil Engineering industry. There are options for both an open and closed structure; that is a deck on piles open to the river below, or a closed structure where a retaining wall is introduced along the quay alignment and fill placed behind.

From experience it is understood that the structural form which presents the greatest environmental impact is the closed solution. On this basis, the assessment evaluates the closed solution, noting that an open solution would have a lesser impact and, therefore, the closed solution represents an upper bounding case for the purposes of the EIA.

For the purpose of the assessment it is assumed that the quay wall will be constructed as an anchored combi-piled retaining wall (Figure 3.4 and 3.5) (i.e. a closed solution). Construction of the quay is anticipated to be undertaken using either a jack-up rig or a floating barge.

The anchored retaining combi-wall comprises large diameter tubular steel piles (approximately 2m diameter), spaced at approximately 3.5m to 4.0m centres. These are proposed to be connected by steel sheet piles to form a continuous, vertical faced, retaining wall.

The tubular piles will be pitched and driven into the river bed. However, it is likely that the presence of hard layers of rock (e.g. mudstone) will prevent the piles being driven to the required depth. It is, therefore, envisaged that an auger will be used to drill down inside each pile. This will allow a concrete socket to be formed that will extend the pile to the required depth. The steel sheet piles will then be driven between the tubular piles to toe into the river bed.

The tubular piles will be anchored to resist horizontal loads acting on the back of the retaining wall when reclamation fill is placed behind it.

As a result of the various different operations required to install the combi-piled wall and the potential variability in ground conditions, the impact driving of both tubular and sheet piles will be intermittent.

A reinforced concrete “relieving” slab will be supported on piles vibrated through the reclamation fill and driven to found in the underlying ground. Above the relieving slab, further reclamation will be placed up to the underside of the pavement surfacing.

Regardless of the chosen option the level of the proposed quay will be set at +6.15m Ordnance Datum (OD). The main terminal area will generally have a downward slope of gradient 1 in 100 from the rear of the terminal towards the quay face, with intermediate valleys formed at 120m centres within traffic aisles.

The terminal will be level parallel to the quay face. It is proposed that the terminal would be paved with Concrete Block Paving (CBP) surfacing on a Cement Bound Material (CBM) base.

The proposed terminal area will be approximately 55ha. This area can be subdivided into existing land (approximately 46.5ha) and the area which is currently seaward of mean high water (approximately 8.5ha).

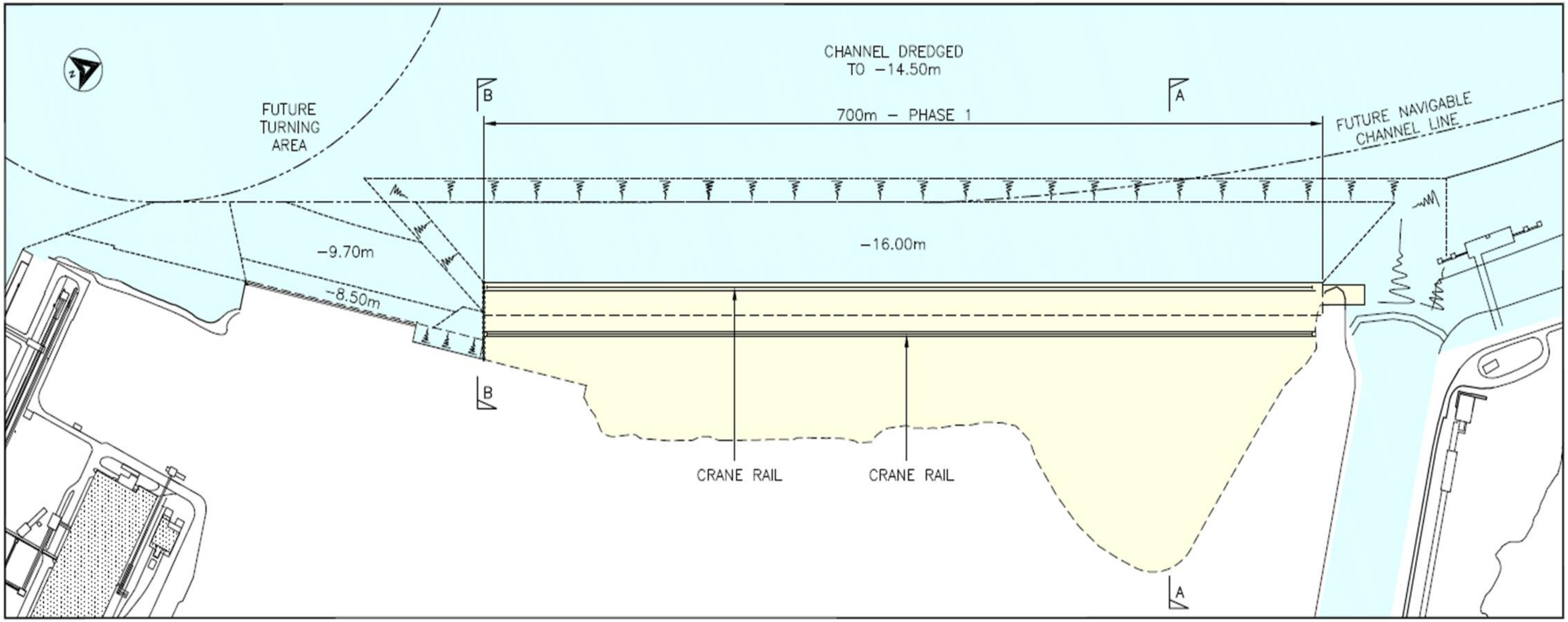

Figure 3.4 ***Anchored combi pile wall***

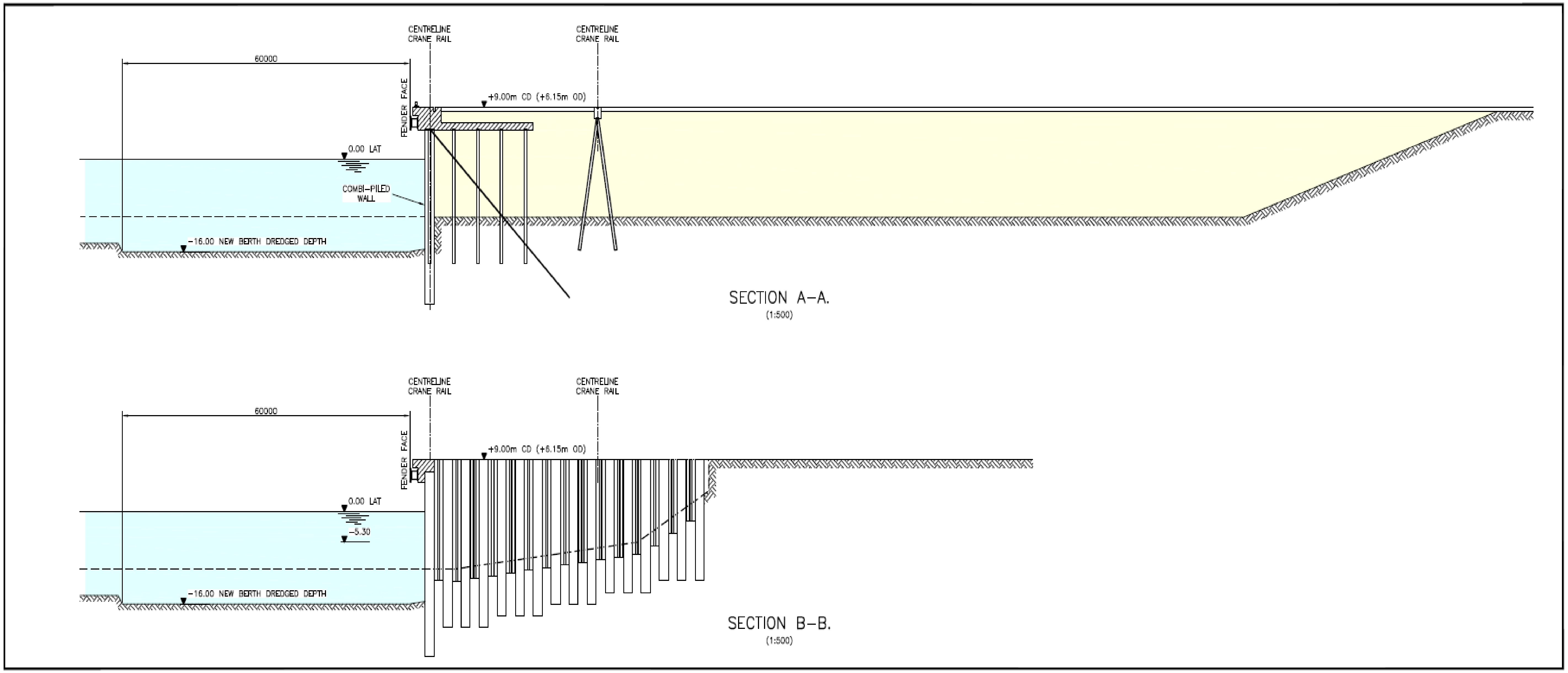

Figure 3.5 Anchored combi pile wall

Reclamation and overflow discharge
The reclamation, if required, will be carried out using dredged granular materials (sands) and dredged mudstone. If necessary it is anticipated that the granular material will be used for reclamation between the quay and the river embankment below water level (approximately 920,000m^3). If necessary mudstone will be used for reclamation above water level. For either solution, dredged granular material and mudstone will also be used to raise ground surface levels within the landside area of the site (equating to approximately 970,000m^3).

It is anticipated that granular material will be dredged from the lower reaches of the river using a TSHD. This material will then be then pumped either into the settling basins or if applicable directly into the "lagoon" formed between the new quay wall and the river embankment.

It is anticipated that mudstone will be dredged using a CSD and/or BD from the upper reach of the river channel. This material will either be pumped into the settling basins onshore using either a floating pipeline (where dredging is being carried out on the same side of the river as the reclamation) or a sunken pipeline (where dredging is being carried out on the opposite side of the river to the reclamation) or (if a BD is used) transported using hopper barges to site and unloaded locally using a long reach excavator on land.

Settling basins will allow suspended sediment to settle out from the mudstone reclamation slurry. Overflow water from the reclamation will then pass through silt traps to limit the amount of suspended sediment discharged to the river.

In summary, the quay wall construction methodology for a closed structure has taken into account comments received from regulators and stakeholders during 2006 and has been optimised as follows:

- Reclamation will take place within a confined area, formed by construction of the new quay wall, to minimise the risk of any detrimental effect to water quality in the river.
- Existing contaminated silts on the river foreshore (confirmed during 2006 survey work) will be capped and enclosed behind the new quay wall to minimise the possibility of release of contaminants into the water course.
- Reclamation will be carried out making beneficial use of dredged material.
- Discharge water from the mudstone material settlement will be controlled to minimise the discharge of suspended sediment into the river.
- Where practical, piles will be installed without impact driving to minimise noise generated during construction.

Phasing
It is proposed that the container terminal will be constructed in phases to allow the continued operation of existing facilities within the proposed scheme footprint. The phasing is likely to be determined by the relative investment costs of the phases, the continued usage of existing facilities and customer demands at the time of construction.

The construction programme for the container terminal has not yet been defined, however, the NGCT would be constructed prior to the expiry of the HRO (i.e. before 7th May 2028).

3.1.3 Disposal of dredged material

As described in Section 3.3, a number of alternative options have been considered for the disposal of dredged material. The preferred option is to use up to approximately 920,000m^3 of dredged material (mainly granular material and mudstone) for reclamation purposes (if required) and to locally raise land levels within the terminal site (up to approximately 970,000m^3). The remainder of the dredged material (soft alluvial

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material and mudstone) will be disposed of at the existing offshore disposal site in Tees Bay (specifically Tees Bay C).

It is anticipated that all granular material arising from the dredging would be used within the reclamation (if required). Additional granular material may arise from routine maintenance dredging. A total of approximately 1.9 million m^3 of material would be required for the reclamation and terminal area. The material not used in the reclamation (i.e. up to approximately 2.9 million m^3, largely comprised of mudstone) would be disposed of at the offshore disposal sites. In addition to the material to be used for reclamation (if required) and within the terminal area, other practicable beneficial uses of dredged material have been sought (Section 3.3).

The 2006 ES considered the environmental impacts associated with the disposal of approximately 2.3 million m^3 of dredged material in Bran Sands lagoon (which would reduce the volume of material required for offshore disposal). However, as mentioned in Section 1 of this report, the disposal of dredged material in Bran Sands lagoon is no longer an option for the NGCT scheme, as habitat enhancement works in Bran Sands lagoon are required and consented as part of the York Potash Harbour Facilities. The proposed disposal of dredged sediment in Bran Sands lagoon is therefore excluded from the proposed scheme design.

Should the open quay wall structure be progressed, the offshore disposal volume would be up to 3,830,000m^3 as there would be less reclamation required. The offshore disposal volume associated with the open structure therefore represents an upper bounding case for the purposes of the EIA presented in Section 26 of this report.

3.1.4 Removal of the Riverside Ro-Ro

In order to construct the full NGCT, it would be necessary to remove the existing Riverside Ro-Ro facility which is currently located within the proposed NGCT footprint.

PDT has confirmed that there is no requirement to relocate the Riverside Ro-Ro elsewhere within the Tees estuary.

3.1.5 Intermodal rail terminal

The intermodal rail terminal (see Figure 3.6) would have six rail sidings to accommodate six 750m long container trains plus one locomotive run around loop.

The strip of paving parallel to the rail sidings would be 30m wide to facilitate the efficient turning of Port Tractor Trailers (PTTs). This width of paving will also accommodate the use of reach-stackers to unload/load trains and PTTs should this be required to supplement RMG crane operations.

It is envisaged that an expansion of the existing Exchange rail sidings at the western end of the site would serve the terminal prior to the completion of both phases of terminal development (and therefore before the total predicted capacity of 1.5 million TEUs is achieved), at which time the new intermodal rail terminal would be needed to provide the desired percentage throughput of containers (i.e. 20% by rail). It is envisaged that two additional 450m long rail sidings would be provided adjacent to the existing sidings. It is proposed that the sidings would be served by two rubber tyred gantry cranes (RTGs) similar to those used within the container terminal stack area. The RTGs would lift containers between rail wagons and PTTs which would shuttle between the sidings and either the new container terminal or the existing TCT 2 container terminal. Heavy duty paving roadways would be provided alongside the new sidings for a roadway to allow containers to be stacked under the span of the RTGs so that trains may operate out of sequence with trailer and tractor units. A new road would be provided to provide more direct access between the new rail sidings and TCT 2.

3.1.6 Road access

The existing road access to the terminal is shown in Figure 3.7. It is proposed that the existing roads will be upgraded to a dual carriageway in both directions, with new and enlarged roundabouts provided where indicated on Figure 3.8. Works are also proposed to Freight Road, Dabholm Road and Teesport Road; this road would link in with the main road network.

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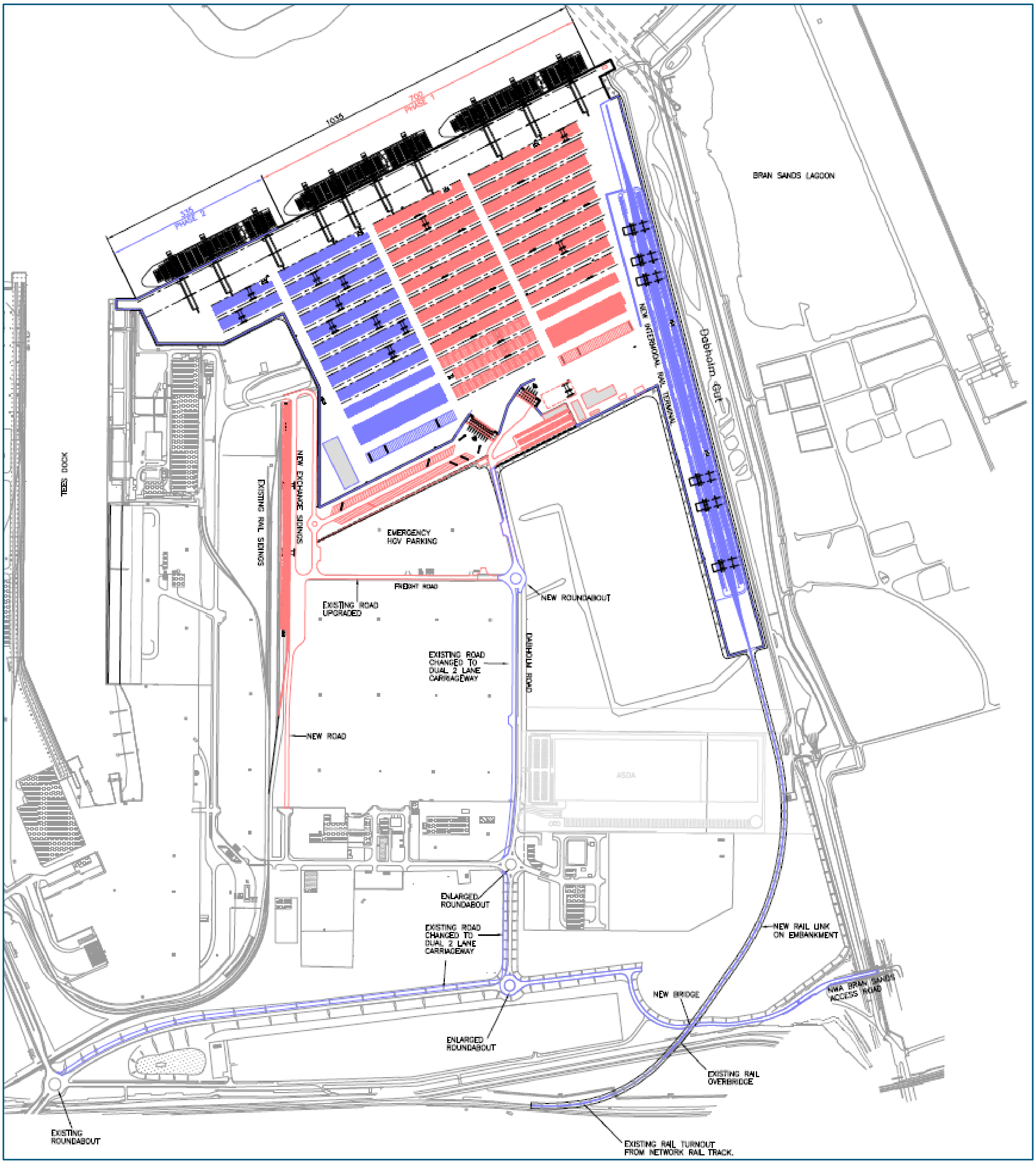

Figure 3.6 Overview of the landside elements of the proposed scheme

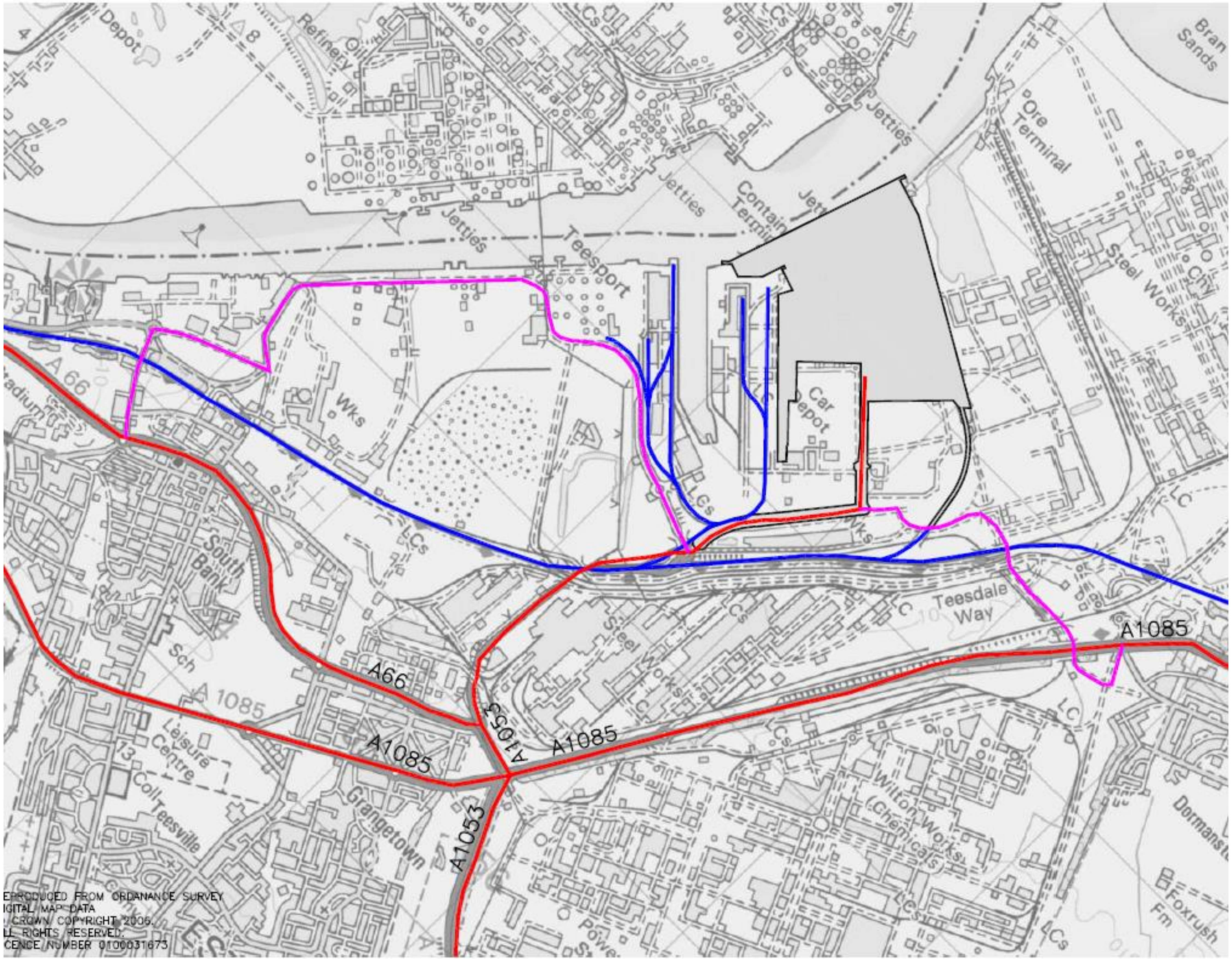

Figure 3.7 *Existing site access routes (blue = rail access; red = main road access; purple = emergency road access*

ZONE	PARAMETER	VALUE
QUAY & CRANE BACK REACH	MAXIMUM SURFACE LEVEL	6.5m OD
	CRANE MAXIMUM HEIGHT WITH JIB IN VERTICAL POSITION	100m
	CRANE MAXIMUM HEIGHT WITH JIB IN HORIZONTAL POSITION	70m
	CRANE MAXIMUM OUTREACH FROM QUAY EDGE	65m
	MAXIMUM NUMBER OF CRANES	10
	MAXIMUM LENGTH	1120m
	MAXIMUM WIDTH	80m
CONTAINER TERMINAL	MAXIMUM CONTAINER STACK HEIGHT LADEN CONTAINERS STACKED 5 HIGH	14.5m
	MAXIMUM CONTAINER STACK HEIGHT EMPTY CONTAINERS STACKED 8 HIGH	23.5m
	RUBBER TYRED GANTRY CRANE MAXIMUM HEIGHT	25m
	LIGHTING MASTS MAXIMUM HEIGHT	30m
	MAXIMUM No. OF LIGHTING MASTS	20
	MAXIMUM PAVED SURFACE LEVEL	9.0m OD
	MAXIMUM PAVED SURFACE AREA (HECTARES)	31
INTERMODAL RAIL TERMINAL	RAIL MOUNTED GANTRY CRANES MAXIMUM HEIGHT	25m
	MAXIMUM CONTAINER STACK HEIGHT (CONTAINERS STACKED 3 HIGH)	9m
	MAXIMUM NUMBER OF RAIL MOUNTED GANTRY CRANES	6
	MAXIMUM No. OF LIGHTING MASTS	6
	MAXIMUM LENGTH	1150m
	MAXIMUM WIDTH	75m
	MAXIMUM PAVED SURFACE LEVEL	9.0m OD
	NOMINAL RAIL LEVEL	8.0m OD
EXCHANGE R AIL TERMINAL	RUBBER TYRED GANTRY CRANES MAXIMUM HEIGHT	25m
	MAXIMUM CONTAINER STACK HEIGHT (CONTAINERS STACKED 5 HIGH)	14.5m
	MAXIMUM LENGTH	500m
	MAXIMUM WIDTH	30m
	NOMINAL RAIL LEVEL (AS EXISTING RAILS)	6.15m OD
	MAXIMUM PAVED LEVEL	6.5m OD
ROADS	NEW ROAD LEVELS GENERALLY TO MATCH EXISTING ROAD LEVELS. TYPICAL ROAD LEVEL	6m OD
	DCT ROAD MAXIMUM WIDTH	7.3m
	POTASH ROAD MAXIMUM WIDTH	7.3m
	TCT 2 ROAD MAXIMUM WIDTH	7.3m
	BRAN SANDS ACCESS ROAD RECONSTRUCTION MAXIMUM WIDTH	7.3m
	FREIGHT ROAD MAXIMUM WIDTH	7.3m
	DABHOLM ROAD NEW CARRIAGEWAY MAXIMUM WIDTH	7.3m
RAIL SPUR	MAXIMUM SURFACE LEVEL	+9.0m OD
	MINIMUM SURFACE LEVEL	+8.0m OD
	MAXIMUM WIDTH	25m
	MAXIMUM LENGTH	1200m
ENTRANCE PLAZA	MAXIMUM PAVING LEVEL	9.0m OD
	MINIMUM PARKING SPACES FOR H.G.V.	100
EMPLOYEE VISITOR CAR PARK	MAXIMUM PAVING LEVEL	9.0m OD
	MINIMUM PARKING SPACES	200

BUILDING FUNCTION	MAX. FLOOR SPACE (m²)	MAX. HEIGHT TO EAVES (m)	CONSTRUCTION (TYP.)	FACITILIES (TYP.)
ADMIN. OFFICE BUILDING	1500	8	STEEL FRAME WITH BRICK/METAL CLADDING AND PITCHED ROOF.	RECEPTION, OFFICE SPACE TRAINING/MEETING ROOMS, PLANT ROOM, NETWORK ROOM, WC ON BOTH FLOORS.
OPERATIONS BUILDING	1500	8	STEEL FRAME WITH BRICK/METAL CLADDING AND PITCHED ROOF.	SHIFT MANAGERS ROOM, MESS ROOMS, KITCHENS, LOCKER ROOMS, COAT ROOMS, DRYING ROOM, CLEANING ROOMS, WC.
GATEHOUSE	1150(IN) 800(OUT)	8	STEEL FRAME WITH METAL CLAD PITCHED ROOF.	LANE BOOTHS, HIGH LEVEL INSPECTION WALKWAY, VEHICLE BARRIER.
WORKSHOP	2500	14	STEEL FRAME WITH BRICK/METAL CLADDING AND PITCHED ROOF.	HIGH WORKSHOP BAYS, VEHICLE PITS, STORES, SUPERVISORS ROOM, LOCKER ROOMS, MESS ROOM, IT ROOM, DRYING ROOM, KITCHEN, ARCHIVE ROOM, ELECTRONICS WORKSHOP, ELECTRICAL INSPECTION ROOM, MECHANICAL INSPECTION, WC & SHOWERS.
CUSTOMS CONTROL	4000	6	STEEL FRAME WITH METAL CLADDING, PITCHED ROOF, HGV DOCKS AND ROLLER SHUTTER DOORS.	WAREHOUSE AREA, CUSTOM CAGES, OFFICES, CHANGING ROOMS, MESS ROOM, WC.
HGV DRIVERS FACILITIES	200	3.5	BRICK STRUCTURE WITH PITCHED ROOF	SEATING AREA, WC.
MAIN SUB. STN.	100	3.5	BRICK STRUCTURE WITH PITCHED ROOF	ELECTRICAL SWITCH GEAR

Client: PD Teesport

Project: Northern Gateway Container Terminal

Title: Key scheme parameters assessed in EIA process

Figure: 3.8

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	30/10/2019	TC	SR	A3	NTS

Co-ordinate system: British National Grid

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It is proposed that new estate roads will be required at the western end of the proposed terminal in order to serve the existing rail sidings in this location. The roads will allow access to the rail sidings from the terminal; the location of the new roads is shown in Figure 3.8.

The access road to the Northumbrian Water Bran Sands sewage treatment plant is situated in the north east corner of the Teesport Estate. This access road connects to the roundabout at the junction between Teesport Road and Dabholm Road and passes close to the old Shell rail bridge which will provide rail access to the new intermodal rail terminal. The existing road will need to be lowered by some 3m, to provide sufficient headroom for a bridge to carry the new rail line over the road.

3.1.7 Terminal gate complex

The terminal gate complex includes an external truck marshalling area for 115 HGVs and a gatehouse comprising eight 'in' lanes and four 'out' lanes. It is envisaged that truck overspill parking (in the event of temporary closure of the terminal due to high winds for example) will be feasible outside the terminal on adjacent land but off the terminal access road.

3.1.8 Buildings

The requirements for buildings within the terminal area are set out below in Table 3.2 which broadly defines parameters for the various buildings.

Table 3.2 Outline details of the buildings to be included within the proposed terminal area

Building	Floorspace (m^2)	Maximum roof height (m)	Construction type	Facilities
Administration office building	1,500	15	Steel frame with brick / metal cladding and pitched roof	Reception, office space, training and meeting rooms, plant room, WC on both floors
Operations building	1,500	15	Steel frame with brick / metal cladding and pitched roof	Shift managers room, mess rooms, kitchens, locker rooms, coat rooms, drying rooms, cleaner's rooms, WC
Gatehouse	1,150 (IN) 600 (OUT)	11	Steel frame with brick / metal cladding and pitched roof	Lane booths, high level incremental walkway, vehicle barrier
Workshop	2,500	20	Steel frame with brick / metal cladding, pitched roof and roller shutter doors	High workshop bays, vehicle pits, stores, supervisor's room, locker rooms, mess room, IT room, drying room, kitchen, archive room, electronic workshop, electrical inspection room, mechanical inspection, WC and showers.
Customs control	4,000	15	Steel frame with metal cladding, pitched roof, HGV docks and roller shutter doors	Warehouse area, customs cages, changing rooms, supervision room, mess room, WC
Drivers amenity building	200	3.5	Brick structure with pitched roof	Seating area, WC
Main substation	100	3.5	Brick structure with pitched roof	None

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The International Labour Organisation (ILO) has revised and updated its Code of Practice on safety and health in ports. This code of practice requires a minimum level of illumination of 10 lux for access routes for people, plant and vehicles, and in lorry parks and similar areas and a minimum of 50 lux in operational areas where people and vehicles or plant work together. This code of practice aligns with standard BS 12464-2 (Light and lighting — Lighting of work places Part 2: Outdoor work places).

To reduce the overall environmental impact of the lighting, luminaires will be of flat glass construction with zero upward light output and minimum tilt angles to minimise the obtrusive light outwards and upwards to the port boundaries and into the surrounding environment. This design also reduces sky glow, light spill, glare, light intrusion and general light pollution.

3.1.9 Drainage

The proposed terminal levels will provide a general fall of nominally 1 in 100 from the rear of the terminal towards the quayside, with the pavement surface being level parallel to the quay.

It is envisaged that the drainage system would comprise channel drains with heavy duty gratings running parallel to the quay with outfall carrier pipes running perpendicular to the quay discharging generally through vented oil separators under/through the quay.

There would be five lines of channel drains. The first channel drain would be situated behind the rear crane rail and would collect surface water from the quay and from the hatch laydown area under the crane back-reach. The second channel drain would be located in the roadway on the riverside of the first block stack of containers. The remaining lines of channel drains would be located at approximately 120m intervals in the roadways between the container block stacks.

3.1.10 Foul water and sewage pumping station

Service disruption
Foul water drainage and a sewage pumping station will support sanitary facilities in the following buildings:

- Administration building;
- Operations building;
- Workshop;
- Customs control building;
- Driver’s amenity building;
- Site area toilets.

The foul system will also collect non-potable water from site interceptors and full retention separators associated with the following services:

- RTG service area;
- Mechanical transport fuelling facility;
- Cassis washing area;
- Workshop.

Foul water
There are currently no mains domestic sewage services in the location of the proposed NGCT. Sewage from occupied buildings at TCT 1 is currently collected in a septic tank and removed by bowser as and when required.

The nearest sewage main is routed along Kinkerdale Road before turning south-east down Dabholm Road and connecting to Teesport Road, a distance of approximately 900m from the boundary of the proposed NGCT.

To enable the collection of domestic waste from sanitary facilities in occupied buildings and from toilets located within the container yard, it is proposed that a domestic waste service will be provided. This will consist of site collection pipework, a packaged sewage pumping station and pipework to connect to Northumbria Water's domestic waste mains at Teesport Road. The pumping station should include macerator pumps to support waste flow and minimise the potential for blockages. Connection to the domestic mains would be subject to approval by Northumbrian Water.

Non-potable water

It is proposed that water from site interceptors will be routed into the foul domestic waste main. This water includes washings and waste water associated with the operations at the RTG service area and workshop. For the chassis washing area and the mechanical transport fuelling facility, it is proposed that a fully bunded complete retention separator will be required. This will again discharge non-potable water from the separator into the foul water mains.

3.1.11 Habitat enhancement

PDT has held discussions with the Tees Rivers Trust (TRT) regarding the possible beneficial use of maintenance dredged material as part of habitat enhancement works being proposed by the TRT within the Tees estuary. The TRT has identified that there are opportunities to enhance currently degraded areas of intertidal on the east bank of the Tees, downstream of Newport Bridge, located approximately 10km upstream of the proposed NGCT footprint. The TRT is investigating the feasibility of habitat enhancement in a number of areas; the area being discussed between PDT and the TRT has a footprint of approximately 0.5ha, covering approximately 265m of intertidal (see Figure 3.9).

As illustrated on Plate 1 below, the works proposed by the TRT comprise the installation of a 'green-wall' in front of the existing retaining wall. The foreshore would be reprofiled and geotextile bags would be placed at the boundary of the existing intertidal. Maintenance dredged material, supplied by PDT, would then be pumped onto the intertidal. Should the timing of the proposed NGCT scheme and the proposed TRT align, PDT has agreed to supply up to 6,000m^3 of maintenance dredged material to the TRT to allow the above habitat enhancement works to be undertaken. In addition to constituting a beneficial use of dredged material, the proposals represent habitat improvement to offset the predicted impact of the NGCT; this is discussed further in Section 9.

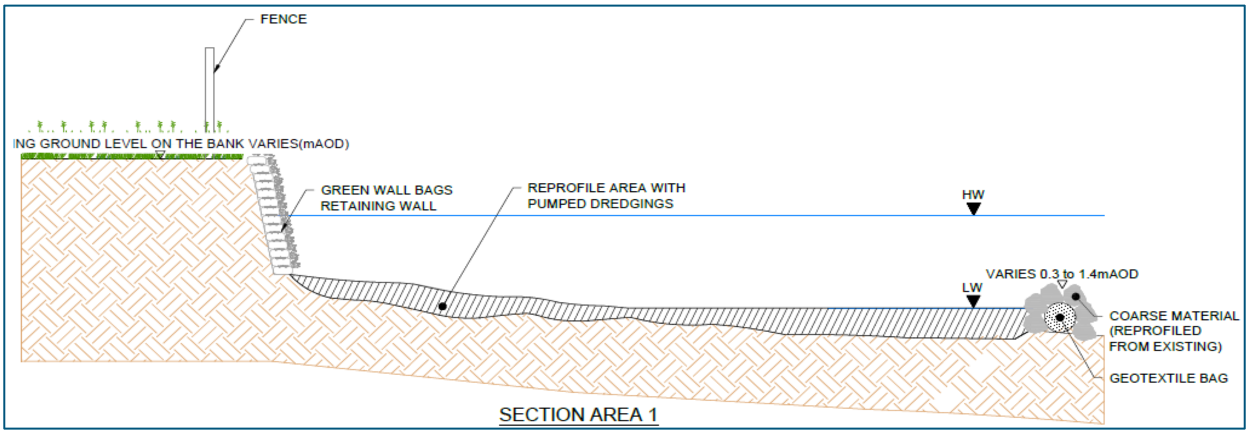
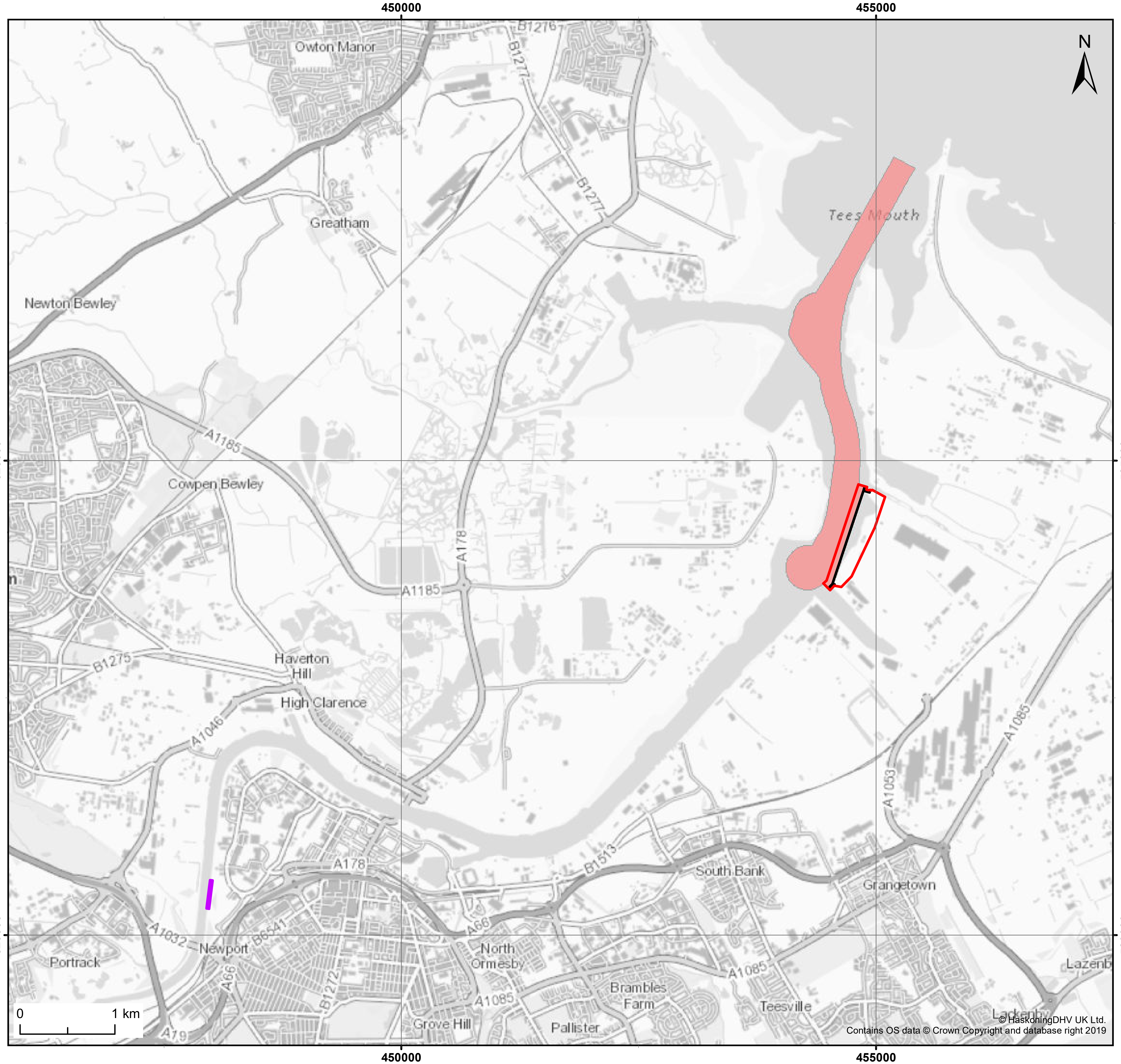


Plate 1 Indicative cross section of proposed habitat enhancement works to be undertaken by the TRT (working in partnership with PDT) downstream of Newport Bridge



Legend

- Intervention Works Area 1
- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Proposed quay face
- Proposed dredge footprint

Client:	Project:
PD Teesport	Northern Gateway Container Terminal

Title: Proposed location of intervention works in the context of the proposed NGCT

Figure: 3.9

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	07/11/2019	TC	SR	A3	1:40,000

Co-ordinate system: British National Grid

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3.1.12 Construction programme

PDT's intention is to construct the proposed scheme prior to the expiry date of the HRO (which as noted in Section 1 is 7th May 2028). Indicative durations for the various scheme elements are detailed below.

Dredging

Due to the differences in the material to be dredged, it is likely that dredging in the lower reaches and dredging in the upper reaches will take place using different types of dredger. Consequently, there is the possibility that both dredgers could be operating simultaneously.

The removal of granular material from the lower reaches of the river will be carried out either following construction of the new quay wall, if dredged material is to be placed directly behind the quay, or earlier if the dredged material is to be placed into settling basins and stockpiled on land prior to placement behind the quay wall.

The TSHD production rate will depend upon the size of the dredger and is likely to be in the range 100,000 m^3 to 225,000 m^3 per week. On this basis, the time required to dredge 1,100,000 m^3 of granular material and clays will be between approximately 4 and 11 weeks.

Dredging the mudstone in the upper reach of the channel using a CSD is likely to be at a production rate of approximately 110,000 m^3 per week. Hence the time required to dredge 3,700,000m^3 is predicted to take approximately 33 weeks. It is anticipated that the timing of the CSD dredging operation will be managed so that mudstone can be pumped ashore for reclamation on top of the sand. As noted above, a BD could also be used for this activity, but a CSD represents an upper bounding case for the purposes of the EIA.

Dredging activity would be undertaken 24 hours a day.

Piling

The phasing of the scheme has not yet been determined; however it is likely to be undertaken in two or three phases. In order to reflect the worst case with respect to the piling, for the purpose of the EIA, a two phase approach has been assumed, with Phase 1 representing construction of an initial 700m, and Phase 2 representing the remaining 300m of quay.

It is estimated therefore that the construction period for Phase 1 of the proposed development (i.e. construction of the initial 700m of quay) would last for an overall duration of approximately 80 weeks. Piling for Phase 1, which is expected to be the most significant source of noise during the construction period, is estimated to take approximately 44 weeks of the total 80-week programme.

Phase 2 of the proposed development (i.e. construction of the remaining 300m of quay) would last for an overall duration of approximately 40 weeks. Piling for Phase 2 is estimated to take approximately 24 weeks of this period. Overall, therefore, the construction period for the full development is expected to be 120 weeks in total, with this total period being split into two phases of 80 and 40 weeks.

The majority of the construction operations for each of the two phases of construction will occur for 10 hours each day from Monday to Saturday; the working period has nominally been assumed to be 08:00 to 18:00.

Assuming a closed structural form, the piling of the combi-wall will be the first step which requires percussive piling. Piling for the combi-wall will involve panels of approximately five tubular piles with sheet piles between the tubular piles. Impact driving will only occur when piles are being seated into the rock. The remainder of the time will be used to set up the piling frame, position piles and drill rock sockets into the bedrock. As a result, piling will be undertaken intermittently, in between these activities. For the open structure, there is likely to be more piles (which may be percussive), but the same mitigation measures would be implemented as proposed for a closed structure to reduce the environmental impact.

3.2 Operational phase

3.2.1 Terminal capacity

The total container throughput of the terminal will be approximately 1.5 million TEU per annum (as determined through modelling of terminal throughput) with the following anticipated mix:

- 10% of containers transhipped by sea or feeder vessels;
- 70% of containers carried by road; and,
- 20% of containers carried by rail.

The terminal will operate 365 days per year, 24 hours per day.

The predicted modal split depends, amongst other factors, on the particular requirements of the customers. For the purposes of this assessment, the potential impacts of transporting 100% of containers by road have been assessed, in addition to the above split. This ensures that a worst-case situation with respect to environmental impact is assessed (i.e. effects on road traffic and consequently noise and air quality effects) in the event that the aspirations for modal split are not achieved.

3.2.2 Internal plant

The operation of the proposed container terminal will require the following internal plant:

- 10 ship to shore quayside electric rail mount container cranes;
- 24 RTG cranes;
- 72 PTT units;
- 6 RMG cranes;
- 6 reach stacker empty container handlers; and
- railhead reach stackers.

3.2.3 Terminal operation (RTG-Port Tractor Trailer Operation)

This mode of operation is currently the most widely employed in the world's major deep-water container terminals and its widespread use is principally due to the combination of achieving good accessibility with high density stacking coupled with 'scalability' of investment against revenues.

Laden containers are stacked in blocks parallel to the quay using RTGs, with Port Tractor Trailers (PTTs) shuttling containers between the quayside, the container stack areas and the railhead. External highway trucks deliver and collect containers directly from the laden and empty container stack areas via a terminal gate complex. Empty containers are stacked in blocks using Empty Container Handlers. Reefer containers are also stacked by RTG with access gantries being provided to permit safe access by reefer service operatives for the plugging/unplugging of electrical supplies and various monitoring activities. Hazardous cargoes may also be stacked using RTGs. Similarly, out-of-gauge consignments may also be "stacked" using RTGs, however, in this instance the "stacks" are only one high. The layout for this mode of operation is shown on Figure 3.6.

The RTG stacks are based on stacking one over five high (stacking 9'6" high containers up to five high and lifting a further 9'6" high container over this stack). Each stack has a truck bypass roadway outside of the RTG legs.

The layout shown on Figure 3.6 provides approximately 5,900 Twenty-foot Ground Slots (TGS) for general (dry) laden containers, 1,200 TGS for Empties, 210 TGS for Hazardous, 310 Forty-foot Ground Slots for Reefers and a lay-down area for Out-of-Gauge consignments.

It is envisaged that Reefers would be stacked up to three high and that Empties are stacked up to six high.

3.2.4 Access and egress

Figure 3.8 shows the road and rail access and egress arrangement to and from the proposed terminal to the local road network and rail network.

In the event that the proposed terminal could not be accessed via the main gateway during an emergency situation, there is a provision for a secondary access to the terminal for the emergency services. Secondary access to Teesport is available via Corus land along a private road running parallel to the river (see Figure 3.8). Although not in general use, this access has been used on a number of occasions. This route also offers emergency access/egress and is known to the emergency services. Access is controlled by Corus security and the Harbour police.

The PDT Emergency Plan identifies a number of other emergency routes which have been agreed with the emergency services. There is an existing agreed route from Teesport to the Wilton site which is controlled by Sembcorp Security and the Harbour police.

In the event of an emergency, it is possible that the terminal would be closed. Provision has therefore been made for overflow parking of HGVs and is shown in Figure 3.8. The area illustrated is estimated to be able to accommodate approximately 650 HGVs. It is also estimated that approximately 115 HGVs could be accommodated in the terminal gate complex area itself, with the potential for approximately a further 100 HGVs parked on the inside lane of the new dual carriageway from the entrance roundabout to Freight Road. This gives a total capacity of over 800 HGVs, which is equivalent to approximately 6 hours' worth of arrivals.

3.2.5 Maintenance dredging

There is an existing requirement for maintenance dredging of the approach channel and various berthing pockets in the lower Tees estuary. The existing maintenance dredging regime is well-established, and the locations, volumes and frequency of dredging are well recorded. These various aspects of the existing maintenance dredging are discussed in detail in the Tees Maintenance Dredging Baseline Document (Royal Haskoning, 2008) and the annual updates to that report (with the most recent being in 2019).

As a result of the proposed scheme, it is predicted that there will not be a requirement to adjust the maintenance dredging strategy (e.g. the annual volume dredged is not predicted to change significantly beyond the existing variability already managed by the port); this has been established through the hydraulic and sedimentary studies that have been undertaken as part of the 2006 EIA (see Section 6). It is proposed that maintenance dredged material would be disposed of at the existing disposal sites in Tees Bay, as currently occurs.

3.3 Consideration of alternatives

3.3.1 Introduction

This section sets out the consideration of alternatives in the following context:

- Alternative locations for the proposed scheme that are within the control of PDT;
- Alternative methods for the construction of the proposed scheme at the preferred location.

With respect to the second bullet above, a range of alternatives for various aspects of the proposed scheme have been considered from a technical, environmental and economic perspective, including alternatives for:

- Method for quay construction
- Approach channel and berthing pocket dredge depth
- Disposal locations for dredged material
- Terminal handling equipment
- Terminal design and phasing

For certain aspects of the proposed scheme, a preferred option has been identified and in such instances, the reason for this selection of the preferred option is described. As well as the above, the 2006 ES presented a range of options which were considered for relocation of the Riverside Ro-Ro. As PDT has confirmed that the Ro-Ro does not need to be relocated, further consideration regarding possible relocation options for the Ro-Ro is not required.

3.3.2 Alternative locations within the control of PDT

PDT can only deliver the NGCT within the boundaries of the HRO. However, for completeness, consideration of any alternative locations for the proposed scheme that are within the control of PDT has been undertaken. In particular it is important to examine whether alternatives for the scheme exist that would potentially have a lesser environmental impact.

It is considered that operational land which is owned by PDT can be classified as potential alternative locations within the control of the developer. Such areas of land are shown on Figure 3.10 and are described as Teesport Estate, Hartlepool, Seal Sands, Teesport Commerce Park and Haverton Hill.

Teesport Estate
This is the preferred and proposed location for the scheme and is the location assessed in this EIA Report. Alternative approaches to various aspects of the construction of the proposed scheme at this location are discussed in Section 3.3.3.

Hartlepool
Hartlepool is not a realistic location for the proposed scheme since construction here would require a complete reconfiguration of the port. A significant issue preventing a development of the scale proposed at this location is that the harbour is too small to handle large container vessels. This alternative has, therefore, not been studied further, but it can be concluded, even if this alternative were technically feasible, that it would have a greater overall environmental impact compared with the proposed scheme location (given the proximity of sensitive receptors, including residential properties, to the port).

Seal Sands
There is insufficient space for a development of the proposed scale at this location. Dredging a channel to the required depth would be likely to have more significant effects on the nearby designated mudflats. The

overall level of disturbance of this area would also increase. This location is not, therefore, a realistic alternative option for both technical and environmental reasons.

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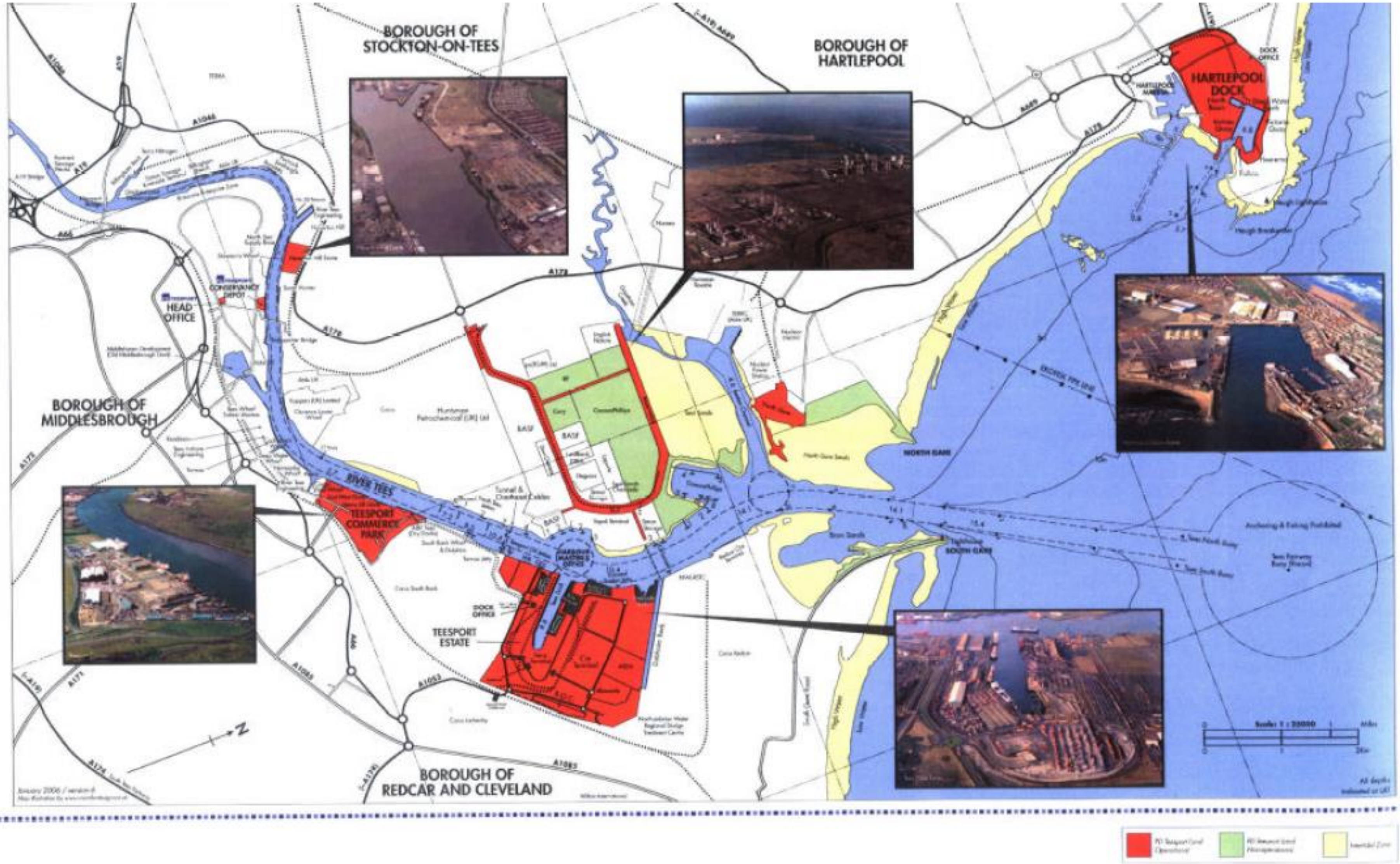

Figure 3.10 Areas within the control of PDT

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Teesport Commerce Park
Teesport Commerce Park is located on the south bank of the Tees estuary, upstream of the proposed scheme location. This area of land is currently occupied by a number of companies offering mainly offshore-related services and ship repair facilities. In view of the existing operations at this site, this location is not considered a technically feasible alternative.

In the event that the land were available for development, the environmental impacts associated with developing at this location are likely to be greater than the proposed location. This is due to the greater dredging requirement associated with deepening the channel at the required depth up to this location. This location is not, therefore, a realistic alternative option for both technical and environmental reasons.

Haverton Hill
This area is located well upstream of the proposed scheme location on the north bank of the Tees estuary. It is not a realistic alternative in that the area of land available is not sufficient to accommodate a development of the scale that is proposed. The river is also very narrow and manoeuvring of large container vessels would be difficult if not impossible. In any event, the environmental impacts of siting a facility at this location would be greater than for the proposed development given the increased volume of the dredge that would be needed to create the navigation channel. This location is not, therefore, a realistic alternative option for both technical and environmental reasons.

Other locations
In addition to the above locations that are within the control of PDT, there are numerous other positions throughout the Tees estuary with river frontages that could, in theory, accommodate the proposed development. However, in practice existing quays are utilised for other purposes and are under the ownership of private operators; therefore, availability of land is limited.

Conclusion
It is concluded that the environmental implications associated with constructing the proposed development at another location in the Tees estuary would be at least as significant as those environmental impacts arising from the proposed scheme, and probably greater as it is likely that the dredging requirement would be greater. In addition, road and rail infrastructure is well developed at the proposed scheme location and larger scale works would be likely to be required to provide suitable infrastructure at another location.

3.3.3 Alternative methods for construction of the proposed scheme

Approach channel and berthing pocket dredge
The proposed dredged depth of 14.5m below CD in the navigation channel has been chosen to maximise the tidal window to which the quay and channels are accessible for vessels of particular drafts. The proposed depth of the berthing pocket (at 16.0m below CD) is required to enable berthing of vessels at the quayside throughout the tidal cycle. There are no real alternatives to the proposed design depths as these are inherent to the proposed scheme design.

Dredging plant
There is likely to be a requirement to utilise a number of different types of dredger depending on the nature of the material being dredged and the placement option for the material. Therefore, for different parts of the dredging it will be necessary to use a TSHD, CSD or BD. The environmental implications of using these dredgers have been assessed and no other alternatives exist that could undertake the work.

Disposal of dredged material
A number of scenarios for the disposal of dredged material have been considered, each of which involves the placement of dredged material at a number of possible disposal (placement) locations.

The placement locations that have been considered are as follows:

- Teesport Estate;
- Former Leathers chemical works site at North Gare; and,
- Disposal at sea at either, or both, of the existing active disposal sites in Tees Bay.
- Re-use of dredged material for habitat enhancement purposes.

Further details of each of these locations are provided in the following sub-sections, with a summary of the disposal scenarios that are assessed in this EIA Report.

Teesport Estate
Historically, land on the Teesport Estate has been reclaimed and the disposal of material as part of the proposed scheme would comprise infilling behind the proposed quay wall (involving approximately 920,000m^3) for the closed quay wall structure only, and locally raising ground levels within the proposed terminal area (involving approximately 970,000m^3) (required for both the closed and open quay wall structures).

The disposal of material in this way would represent an option for the beneficial use of the granular material arising from the dredging of the lower channel and Seaton Channel turning circle and would allow the terminal to be constructed to the required level. This option for the beneficial use of dredged material (i.e. to locally raise ground levels) therefore forms part of the scheme and is included in all disposal scenarios.

The total volume of material needed for reclamation and land raising would be approximately 1.8 million m^3 and, therefore, given that the capital dredging is expected to generate approximately 1 million m^3 of sand, additional material (approximately 800,000m^3) will be required for reclamation (should this be the preferred option selected). A possible source is sandy material arising from routine maintenance dredging undertaken by PDT, thus avoiding the need to import fill from elsewhere. Other disposal locations would be required for the balance of the capital dredged material (up to approximately 3.8 million m^3 given that the total dredge volume would be approximately 4.8 million m^3).

A further advantage of the disposal of dredged material within the Teesport Estate is its close proximity to part of the proposed dredge area and, therefore, the dredged material can be piped directly to the site. Additionally, the land within the existing Teesport Estate is already industrialised and, consequently, the use of material at this location would be expected to have a lower overall environmental impact compared with disposal at the other possible locations (see below).

No other areas within the Teesport Estate have been considered for the disposal of dredged material, largely due to the absence of areas of suitable size. Disposal of the dredged material on a constrained area of land would create a significant mound of material which would subsequently pose problems should the land be needed for other purposes.

Former Leathers chemical works site
This site has an area of approximately 10ha and is situated at North Gare. Historically, it is understood that the previous owners carried out land remediation works to bury existing contaminated material at this site. As a result of previous discussions with (at the time) English Nature, it was considered that the disposal of dredged material at this site could represent the beneficial use of dredged material, in that the material would cap and contain any existing contaminated material.

A number of consultees (notably the Environment Agency and Teesmouth Bird Club) raised concerns over the potential use of this location due to its importance for nature conservation in 2005/06. Consequently, it is considered that this option would not be beneficial and, therefore, the use of this site for the disposal of dredged material has been excluded from the scheme and is not considered further in the EIA.

Disposal at sea

There are two disposal sites within Tees Bay that could potentially receive material from the proposed channel dredging (Tees Bay C and Tees Bay A). Both of these sites have historically received capital and maintenance dredged material. It is proposed that dredged material (arising largely from the dredging of mudstone) will be disposed of at sea.

This EIA Report assesses the potential impacts associated with the disposal of dredged material at the Tees Bay C offshore disposal site in Tees Bay.

Re-use of dredged material for habitat enhancement purposes

During production of the recent Hartlepool approach channel EIA Report (Royal HaskoningDHV, 2019), Hartlepool Borough Council (HBC) recommended that the creation of safe, shorebird roost island(s) (possibly doubling as little tern nesting islands) could be created using the dredged material from Hartlepool channel. In terms of Hartlepool borough and the wider Teesmouth and Cleveland Coast, HBC also advised that the lack of safe shorebird roost islands is a conservation issue of great concern to the Council, particularly as existing 'slag' islands have eroded and recreational disturbance is adversely affecting wader roosts.

Further consultation with HBC was undertaken during September 2018 to discuss possible locations for the creation of bird islands. HBC identified four locations at the mouth of the Tees estuary which could be suitable locations for the re-use of dredged sediment; three were located adjacent to the South Gare Breakwater, with one adjacent to the North Gare Breakwater. Consultation with Natural England in October 2018 confirmed that the creation of bird islands as an environmental enhancement measure to the proposed scheme by beneficially re-using dredged material would be welcomed.

It is considered that such beneficial re-use of dredged material from the NGCT could also represent a possible option for the NGCT scheme.

PDT will continue to investigate the option of creating bird islands using dredged material (i.e. not necessarily material from the NGCT), possibly linking with the aims and desires of the Tees Estuary Partnership. Such creation of bird islands at the mouth of the Tees (or any beneficial use of dredged material in the marine environment) would require a separate marine licence application to deposit dredged material, or potentially a variation to the marine licence for the proposed scheme (if granted) should it be possible to implement the bird islands in parallel with the proposed scheme. PDT will continue to liaise with the Tees Estuary Partnership and will aim to develop or input into strategic beneficial use schemes to benefit the overall Tees estuary and the wider Teesmouth and Cleveland coast. However, for the reason set out above, it has been assumed that beneficial use to create bird islands would not be undertaken as part of the proposed scheme.

As described in Section 3.1.11, PDT proposes to work in partnership with the TRT to enhance an area of intertidal habitat downstream of Newport Bridge through the placement of dredged material (this area is included within the marine licence application area). It is proposed that maintenance dredged material is used for this purpose because its properties are more suitable for the intended use compared with material arising from the capital dredging. While this does not, strictly, represent alternative use of dredged material arising directly from the proposed NGCT, the habitat enhancement measures are proposed in light of the predicted impact of NGCT on intertidal habitat and would represent an alternative use for dredged material arising from maintenance dredging activity in the Tees.

Summary of potential disposal scenarios and assumed option
In light of the above, there are a number of possible scenarios for the disposal of capital dredged material. However, the scenario which has been assessed in this EIA Report comprises:

- Reclamation – 920,000m^3
- Disposal within the terminal area to locally raise land levels – 970,000m^3
- Sea disposal – 2,910,000m^3

The impact assessment predicted in Section 26 has been undertaken on a worst-case basis from an offshore disposal perspective, whereby 3,830,000m^3 of material would be disposed of at sea (i.e. the dredged material would be disposed of through a combination of sea disposal and land raising, without the need for reclamation using 920,000m^3 of dredged material).

Terminal layout and operations
Various terminal layouts have been considered with the common aim of achieving a throughput of 1.5 million TEU per annum. The terminal operations (container stacking areas) considered from a technical operational point of view are summarised as follows:

- Rubber Tyred Gantry crane and Port Tractor Trailer operation (RTG-PTT);
- Straddle Carrier operation (SC);
- Rail Mounted Gantry crane and PTT or Automatically Guided Vehicle operation (RMG-PTT/AGV); and,
- Hybrid of RTG and RMG operations.

The operational performance of the various terminal layouts has been assessed using the terminal simulation software Posport CTS. The results of the simulations show that the RTG-PTT operation most closely achieves the required throughput capacity and levels of service. Therefore, the RTG-PTT operation is the most attractive as it can achieve the required throughput capacity of 1.5 million TEU per annum and achieve the required service levels whilst at the same time being a “scalable” investment. This is, therefore, the preferred option for the layout of the proposed terminal and this option is assessed.

In terms of the environmental implications associated with each of the above potential options for operational layout, it is concluded that there are unlikely to be significant differences between the options. The type of layout adopted for the terminal would not result in a difference in the level of environmental impact experienced outside of the boundaries of the port. The only environmental impact which would vary is the level of noise generated during the operational phase. However, differences between the various modes of operation are not considered to be of material significance in selecting a preferred option given that the difference in noise experienced at sensitive receptors associated with the various options would be negligible.

Phasing of the development
Phasing of the development (specifically phasing of the construction of the quay wall) has not yet been defined and will be subject to the capital cost of the first phase of the development, taken together with the customer demand and the utilisation of the existing facilities. Options with respect to phasing include differing lengths for an initial phase of the development with the completion of the remaining length during a subsequent phase (or number of phases).

For the purpose of the assessment a longer length of quay to be constructed during Phase 1 (700m) has been assumed as this reflects an upper bounding envelope for the environmental assessment. If this were progressed , the final 300m of quay face would be developed to complete the proposed 1,000m of quay face.

The phasing of the development as described above is considered in this EIA Report. However, the sensitivity of the environmental impacts to other phasing arrangements has been assessed and it is concluded that any difference in environmental impact would be negligible. This conclusion is based on the fact that, in order to make phasing the development economically feasible and viable from an operational point of view, it would be necessary to construct a first phase of at least 500m in length, followed by a second phase of 500m. A decrease of 200m in the first phase is considered to be negligible in terms of difference in potential environmental impact.

Construction of the quay wall

The following options for construction of the quay wall have been subject to consideration to determine the most appropriate solution:

- A gravity wall structure.
- A piled suspended deck structure.
- An anchored retaining wall (the solution which has been assessed in this EIA representing an upper bounding envelope for the assessment of potential impacts).

Whilst a concrete block gravity wall remains a feasible solution, the anchored combi-piled retaining wall has been selected as the assessed solution based on the ground conditions at the site and the buildability of the anchored combi-piled wall from a technical perspective. A piled suspended deck structure could also be an appropriate option from a technical perspective and remains considered as an option.

4 LEGISLATIVE FRAMEWORK

4.1 Introduction

As noted in Section 1, the NGCT scheme is authorised by RCBC under planning permission R/2006/0433/00 (Appendix 2) and by The Teesport HRO 2008 (SI 2008 No. 1160) (Appendix 1). The marine elements of the NGCT have not yet been implemented; however, the landside elements of the scheme have commenced (and therefore the planning permission granted by RCBC has been implemented).

To allow PDT to implement the marine elements of the NGCT scheme, a marine licence from the MMO is required. Further detail regarding the legislative framework is provided below.

4.2 Marine and Coastal Access Act 2009

Part 4 of the MCAA 2009 provides a framework for the marine licensing system for those 'licensable marine activities' undertaken within the UK marine area. The MMO is the regulatory authority for marine licensing in English inshore and offshore waters.

Part 2 Section 7 of the Teesport HRO states:

> *"(1) The Company may, for the purposes of constructing and maintaining the works and of affording access to the works by vessels from time to time deepen, dredge, scour, cleanse, alter and improve so much of the bed, shores and channels of the river as adjoin or are near to the works and the approaches thereto and may use, appropriate or dispose of the materials (other than wreck within the meaning of Part IX of the Merchant Shipping Act 1995(a)), from time to time dredged by them.*
>
> *(2) No such materials shall be laid down or deposited—*
> *(a) in contravention of the provisions of any enactment as respects the disposal of waste; or*
> *(b) in any place below the level of high water otherwise than in such position and under such conditions and restrictions as may be approved or prescribed by the Secretary of State*."

It is therefore concluded that a marine licence from the MMO is not required for the proposed dredging works. A marine licence is, however, required for the following elements of the NGCT scheme:

- Offshore disposal of dredged material.
- Use of dredged material to undertake the proposed reclamation works (i.e. a deposit below MHWS).
- Construction of the container terminal facility.
- Removal / demolition of the Riverside Ro-Ro.
- Placement / pumping of maintenance dredged material onto the intertidal area downstream of Newport Bridge as part of a wider habitat enhancement initiative proposed by the TRT.

The proposed dredge footprint is located within an area which is subject to maintenance dredging by PDT (under licence L/2015/00427/1). No changes to the maintenance dredge disposal licence held by PDT are envisaged following construction of the proposed scheme. This would, however, be monitored by PDT and a variation request the maintenance dredge disposal licence submitted to the MMO, if required.

4.3 Environmental Impact Assessment Directive

The requirement for EIA is established by the European Directive 2011/92/EU (codifying previous EIA Directives), as amended by 2014/52/EU on the assessment of the effects of certain public and private projects on the environment (the EIA Directive). The EIA Directive is implemented via various regulations; in this instance, The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) are applicable to the proposed scheme.

Prior to submission of the application to extend the 2008 HRO for a further 10 years in 2018, the MMO confirmed that the proposed scheme comprised a Schedule A2 project under the EIA Directive, specifically:

- Construction of harbours and port installations including fishing harbours (unless included in Schedule A1); and
- Any change to or extension of development of a description listed in paragraphs 1 to 87 of this Schedule where that development is already authorised, executed or in the process of being executed.

The MMO confirmed during October 2018 that as the project has already been screened and determined to be an EIA project, there is no requirement to request an additional EIA screening opinion. PDT has, therefore, undertaken an EIA for the scheme and has submitted this EIA Report in support of the marine licence application.

4.4 Habitats Directive

The Conservation of Species and Habitats Regulations 2017 (the Habitats Regulations) implement EC Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (the Habitats Directive) in England and Wales. The Habitats Regulations also transport elements of the EU Wild Birds Directive in England and Wales.

In accordance with Section 63 of the Habitats Regulations, Appropriate Assessment is required for any plan or project, not connected with the management of a European site, which is likely to have a significant effect on the site, either alone or in-combination with other plans or projects. European sites comprise Special Protection Areas (SPA) and Special Areas of Conservation (SAC). Appropriate Assessment is also required as a matter of government policy for potential SPAs (pSPA), candidate SACs (cSAC) and listed Ramsar sites for the purpose of considering development proposals affecting them (ODPM, 2005).

The proposed scheme footprint is located with the footprint of the proposed Teesmouth and Cleveland Coast SPA (pSPA) and Ramsar site. There is potential for the proposed scheme to affect these designated sites; this is considered further in this EIA Report and is examined in detail via an HRA (see Section 29).

4.5 Wildlife and Countryside Act 1981 (as amended)

Under the terms of Section 28(4)b of the Wildlife and Countryside Act 1981, as amended by Schedule 9 to the Countryside and Rights of Way Act 2000, any operations within or adjacent to a Site of Special Scientific Interest (SSSI) require consent from Natural England.

Natural England has undertaken a review of SSSIs around the Teesmouth and Cleveland coast, which has resulted in the notification of the Teesmouth and Cleveland Coast SSSI. This site includes the majority of the area protected by the previous SSSIs in the area, linking and combining them with substantial extensions.

The Seal Sands SSSI remains designated in part approximately 2.5km to the west of the Tees estuary. Part of the existing Seal Sands SSSI is not considered to be of special interest and is therefore proposed for de-notification. On 20 March 2019, the Board of Natural England approved the confirmation of the notification of the Teesmouth and Cleveland Coast SSSI with modifications to the boundary and, accordingly, to the area figure presented on the citation. Natural England confirmed the notification of Teesmouth and Cleveland Coast SSSI on 18 April 2019 and, on the same date, confirmed the de-notification of parts of the Seal Sands SSSI.

Consent under Section 28 of the Wildlife and Countryside Act 1981 (as amended by the Countryside and Rights of Way Act, 2000) would be intrinsic to Natural England's overall response to the marine licence application and therefore a separate application for this has not been submitted.

4.6 Water Framework Directive

The WFD (2000/60/EC) establishes a legal framework to protect and restore clean water across Europe to ensure long-term, sustainable use. It applies to waters out to one nautical mile from the baseline from which territorial waters are drawn.

One of the aims of the WFD is to ensure that all European waterbodies are of Good Ecological Status or Potential (for 'heavily modified' and 'artificial' waterbodies) by 2021 by the setting of Environmental Quality Objectives (EQOs), for water chemistry, ecological and hydromorphological quality parameters. The WFD is transposed into English and Welsh law through The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

A WFD compliance assessment has been undertaken, the findings of which are presented in Section 28.

4.7 Waste Framework Directive

The Waste Framework Directive (2008/98/EC) consolidates earlier legislation regulating waste. The Directive sets out the general rules applying to all categories of waste, a key objective of which is to provide measures to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste and by reducing overall impacts of resource use and improving the efficiency of such use.

Article 3(1) of the Directive defines waste as:

"….any substance or object….which the holder discards or intends or is required to discard".

More generally, the Directive provides a general duty to ensure that waste is dealt with in an environmentally-friendly way. The key to this is the 'waste hierarchy', which emphasises prevention (in the first instance) and then re-use, recycling and recovery of waste (see Figure 4.1). EU Member States must have regard to the waste hierarchy when dealing with waste. Disposal to landfill or at sea is the least favourable option.

Options for the disposal of waste (i.e. the material to be dredged from the approach channel) have been investigated in accordance with the waste hierarchy.

Possible alternative options for dredged material have been presented in Section 3.3.

Figure 4.1 The waste hierarchy

4.8 National, regional and local planning policy

All proposed development must take account of existing planning policy and guidance, and there are a number of national, regional and local plans and policies relevant to the proposed scheme.

4.8.1 National Policy Statement for Ports

Section 1.2 of the National Policy Statement for Ports (NPS) (Department for Transport, 2012) states that in addition to being part of the planning system established under the Planning Act 2008, the NPS is a relevant consideration for the MMO when deciding other port development proposals (i.e. projects that are not considered Nationally Significant Infrastructure Projects).

In summary, the UK Government seeks to:

- Encourage sustainable port development to cater for long term forecast growth in volumes of imports and exports by sea with a competitive and efficient port industry capable of meeting the needs of importers and exporters cost effectively and in a timely manner, thus contributing to long term economic growth and prosperity.
- Allow judgements about when and where new developments might be proposed to be made on the basis of commercial factors by the port industry or port developers operating within a free market environment.
- Ensure all proposed developments satisfy the relevant legal, environmental and social constraints and objectives, including those in the relevant European Directives and corresponding national regulations.

In order to help meet the requirements of the government policies on sustainable development, new port infrastructure should also:

- Contribute to local employment, regeneration and development.
- Ensure competition and security of supply.
- Preserve, protect and where possible improve marine and terrestrial biodiversity.
- Minimise emissions of greenhouse gases from port related development.
- Be well designed, functionally and environmentally.
- Be adapted to the impacts of climate change.
- Minimise use of greenfield land.
- Provide high standards of protection for the natural environment.
- Ensure that access to and condition of heritage assets are maintained and improved where necessary.
- Enhance access to ports and the jobs, services and social networks they create, including for the most disadvantaged.

It is considered that the proposed scheme will be compliant with a number of points raised above and is therefore complaint with the NPS.

4.8.2 Marine plans

The north-east marine plan areas include the north-east inshore and the north-east offshore marine plan areas. The north east inshore marine plan area covers an area of approximately 687 kilometres of coastline stretching from the Scottish border to Flamborough Head in Yorkshire, taking in over 6,000km^2 of sea. A review of the North East Inshore and North East Offshore Marine Plan (Draft for Consultation) (issued in January 2020) has been undertaken. The proposed scheme is considered to be compliant with the following objectives of the North East Marine Plan:

- 1: Infrastructure is in place to support and promote safe, profitable and efficient marine businesses.
- 2: The marine environment and its resources are used to maximise sustainable activity, prosperity and opportunities for all, now and in the future.
- 3: Marine businesses are taking long term strategic decisions and managing risks effectively. They are competitive and operating efficiently.
- 4: Marine businesses are acting in a way which respects environmental limits and is socially responsible. This is rewarded in the market place.
- 11. Biodiversity is protected, conserved and where appropriate, recovered, and loss has been halted.

The proposed scheme is also considered to be compliant with the applicable policies of the marine plan, namely

- Policy NE-DD-3 – proposals for the disposal of dredged material must demonstrate that they have been assessed against the waste hierarchy. The waste hierarchy assessment in presented in Section 3.3).
- Policy NE-PS-1 – only proposals demonstrating compatibility with current activity and future opportunity for sustainable expansion of port and harbour activities will be supported. The requirement for the project is detailed in Section 2.
- Policy NE-BIO-3 – proposals that deliver environmental net gain for coastal habitats where important in their own right and / or for ecosystem functioning and provision of ecosystem services will be supported. Section 5.1.5 and Appendix 10 of this report detail the net gain assessments.
- Policy NE-CE-1 – proposals which may have adverse cumulative effects with other existing, authorised or reasonably foreseeable proposals must demonstrate that they will, in order of

preference avoid, minimise, mitigate significant adverse cumulative and in-combination effects. Section 27 of this report presents the CIA.

5 APPROACH TO EIA

The purpose of EIA is to provide an independent assessment of a project's potential environmental impacts to enable authorities, and the public, to understand the potential impacts of the project before making decisions on whether consent for the development should be granted. This section sets out the approach for the assessment of impacts which has been adopted within this EIA Report. In summary, this section presents:

- A summary of the EIA process.
- A summary of the consultation undertaken in relation to the proposed scheme and how issues raised have been addressed through the EIA process.
- The results of the scoping exercise undertaken to define the issues to be addressed by the EIA process and the approach to be taken to the assessment of these issues;
- The approach adopted to define the baseline environment (specific details are provided for each environmental topic considered in the relevant chapter).
- The generic approach taken to assess potential impacts, including the evaluation of significance (where a different approach has been adopted for a specific topic, this is set out in the relevant chapter).
- The generic approach taken to the derivation of mitigation measures and the assessment of residual impacts.
- The approach taken to the assessment of cumulative impacts with other plans and projects.
- The approach taken to WFD compliance assessment.
- The approach taken to the HRA.

5.1 The EIA process

EIA is an iterative tool for systematically examining and assessing the impacts and effects of the construction, operation and decommissioning phases of the proposed scheme on the environment. The formal reporting mechanism for an EIA is the EIA Report. In accordance with Schedule 3 of the 2007 Regulations (as amended), the EIA Report should include such information as is reasonably required to assess the likely significant environmental effects of the proposed scheme and which the applicant can reasonably be required to compile, including:

- A description of the project and of the regulated activity, in particular:
  - A description of the location of the project.
  - A description of the physical characteristics of the whole project and regulated activity.
  - A description of the main characteristics of the operational phase of the project and the regulated activity.
  - An estimate of expected residues and emissions resulting from operation of the proposed project and the regulated activity.
- A description of the reasonable alternatives studied by the applicant which are relevant to the proposed project, the regulated activity and their specific characteristics, and an indication of the main reasons for selecting the chosen option.
- A description of the relevant aspects of the current state of the environment (baseline scenario), and an outline of the likely evolution thereof without implementation of the project.
- A description of the factors specified in Regulation 21A(2)(a) to (e) likely to be significantly affected by the project and the regulated activity: population, human health, biodiversity, land, soil, water, air, climate, material assets, cultural heritage and landscape.

- A description of the likely significant effects of the project and the regulated activity on the environment, which should cover the direct effects and any indirect, secondary, cumulative, short, medium and long term, permanent and temporary, positive and negative effects of the project.
- A description of the forecasting methods or evidence used to identify and assess the significant effects on the environment including any difficulties encountered.
- A description of the measures envisaged to avoid, prevent, reduce or if possible offset any identified significant adverse effects on the environment and where appropriate any proposed monitoring arrangements.
- A description of the expected significant adverse effects of the project and the regulated activity on the environment deriving from the vulnerability of the project and the regulated activity to risks of major accident or disaster which are relevant to the project.
- A non-technical summary of the information provided under this part of the EIA Regulations.
- A reference list detailing the sources used for the description and assessments included in the report.

The following stages were included in this EIA:

- Scoping – to determine the issues that the EIA should address (via the HRO extension process and through targeted consultation with the MMO, Environment Agency and Natural England to agree the scope of assessment).
- Consultation with stakeholders.
- Desk-based data collection to establish the baseline environment.
- New data collection and surveys (where necessary) to supplement desk-based information and to fill any data gaps.
- Impact identification and the evaluation of significance.
- The identification of mitigation measures (where required) to reduce the significance of, or avoid, any identified adverse impacts.
- The evaluation of impacts, post-mitigation, to determine the significance of residual impacts.
- The assessment of cumulative impacts with other past, present and reasonably foreseeable future developments and plans.
- Identification of appropriate monitoring requirements.

5.1.1 Screening

As noted in Section 4, it was not considered necessary to request an additional EIA Screening Opinion for the scheme as the scheme has previously been confirmed as EIA development. PDT has therefore undertaken an EIA for the scheme and has submitted this EIA Report in support of the marine licence application.

5.1.2 Scoping

Consultation was undertaken with the MMO in December 2017 to agree the scope of environmental assessment required in support of the HRO extension application. This was undertaken via the submission of a Scoping Report and a request for a Scoping Opinion.

Within its Scoping Opinion, the MMO advised that it has received comments from consultees which it considered were more applicable to the marine licensing process for the NGCT, rather than the HRO extension process (which was the purpose of the consultation undertaken at the time). The MMO provided these comments in December 2017 as part of its overall scoping response on the HRO extension process project (included as Appendix 4).

During a meeting with the MMO in October 2018, it was proposed that the comments received during December 2017 would be used to inform the scope of works required in support of the marine licence application, rather than undertaking a further formal scoping process. It was agreed that the comments received in December 2017 would be supplemented with information sourced from targeted discussions with the Environment Agency and Natural England, to further define the scope of works necessary to support the marine licence application.

A meeting was held with both Natural England and the Environment Agency in November 2018, and minutes from the meeting are presented in Appendix 5. The minutes from the meetings have been used to inform the scope of assessment presented in this report. Further detail from the meetings (in terms of the assessment required) has been included in the relevant sections of this report.

5.1.3 Description of the baseline environment

A wide range of information has been gathered and activities undertaken to define the baseline environment for the proposed scheme, including but not limited to the following:

- desk-based review of existing published data;
- data provided by consultees; and,
- field survey and site investigation information.

The term 'baseline environment' is used to describe the nature, scale, condition, and other relevant information to provide a detailed description of a given environmental receptor that falls within the scope of the EIA Report. Within this EIA Report, the description of the baseline environment consists of the following aspects:

- the spatial location and extent of the environmental features or receptors;
- a description of the environmental features or receptors and their character;
- the context of the environmental features or receptors in terms of rarity, function, and population at the local, regional and national level;
- the sensitivity of the environmental features or receptors in relation to physical, chemical or biological changes; and,
- the value of the environmental features or receptors (e.g. designated status).

Receptor 'sensitivity' and 'value' are considered further below.

Receptor sensitivity
All receptors will exhibit a greater or lesser degree of sensitivity to the changes brought about by the proposed scheme and defining receptor 'sensitivity' as part of the definition of the baseline environment helps to ensure that the subsequent assessment is transparent and robust. The sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected, and is defined by the following factors:

- Adaptability – the degree to which a receptor can avoid, adapt to or recover from an effect.
- Tolerance – the ability of a receptor to accommodate temporary or permanent change.
- Recoverability – the temporal scale over and extent to which a receptor will recover following an effect.

In order to define the sensitivity of a receptor, the guidelines presented in Table 5.1 have been adopted in this EIA Report and the conclusions reached regarding the sensitivity of receptors has been presented in the baseline sections of each relevant environmental topic.

Table 5.1 Generic guidelines used in the determination of receptor sensitivity and value

Sensitivity	Description
Very high	Receptor has very limited or no capacity to accommodate physical or chemical changes or influences. Receptor possesses fundamental characteristics which contribute significantly to the distinctiveness, rarity and character of the resource, is of very high importance and rarity that is international in scale (e.g. designated sites such as SACs, SPAs, Ramsar Sites and Habitats Directive Annex II species), and has very limited potential for substitution / replacement).
High	Receptor has a limited capacity to accommodate physical or chemical changes or influences. Receptor possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the resource, is of high importance and rarity that is national in scale (e.g. designated sites such as SSSIs, NNRs, UK Biodiversity Action Plan (BAP) habitats and species, Scheduled Monuments, Grade I and II* Listed Buildings), and has limited potential for substitution / replacement.
Medium	Receptor has a limited capacity to accommodate physical or chemical changes or influences. Receptor possesses key characteristics which contribute to the distinctiveness and character of the resource, is of medium importance and rarity that is regional in scale (e.g. designated sites such as County Wildlife Sites (CWS), Grade II Listed Buildings, Local BAP), and has limited potential for substitution / replacement.
Low	Receptor has a moderate capacity to accommodate physical or chemical changes or influences. Receptor possess characteristics which are locally distinctive only, are of low to medium importance and rarity that is local in scale (e.g. designated sites such as Local Nature Reserves), and potentially can be substituted / replaced.
Very low	Receptor is generally tolerant of and can accommodate physical or chemical changes or influences. Receptor characteristics do not make a significant contribution to local character or distinctiveness, and are of very low importance and rarity, are not designated, and are easily substituted / replaced.

Value is defined as the measure of a receptor's importance; this forms part of the definition of sensitivity. In some instances, the inherent value of a receptor is recognised by means of designation, and the 'value' element of the composite criterion recognises and gives weight in the assessment to that designation. However, irrespective of the recognised value, all receptors will exhibit a greater or lesser degree of sensitivity to the potential changes brought about by the proposed scheme. It should be noted that the assessment of sensitivity is informed by a number of factors, including the findings of studies / monitoring / surveys as well as judgement applied by professional experts based on the receptors within the relevant study area.

5.1.4 Impact identification and assessment

The EIA has been undertaken within a framework that allows for a transparent approach to the assessment and the resulting conclusions presented within this EIA Report. This section sets out the assigned definitions that are used in the assessment process for a number of topics considered in the EIA Report. In addition, a description of the approach taken to the specific impact assessment for each environmental topic is provided (in each relevant chapter) so that it is clear to the reader how impacts have been defined, particularly where such an approach differs to that described within this section.

EIA provides an assessment of the impacts on sensitive receptors as a result of the effects of a development upon the environment. The terms 'effects' and 'impacts' have, in the past, been used interchangeably, but they are in fact different and one drives the other. Effects are physical changes in the environment that are set in motion as a consequence of a particular development or activity. Effects do not impact all receptors, as some receptors are not always sensitive to them.

Effects are measurable physical changes in the prevailing environment (e.g. volume, time and area) arising from construction and operation activities. Effects can be classified as primary (e.g. the physical presence of a built element of the development) or secondary (e.g. increase in erosion due to a change in the rate of discharge of surface water).

Impacts consider the possible changes in potentially sensitive receptors as a result of an effect. Impacts can be classified as direct or indirect, permanent or time-limited and beneficial or adverse.

The relationship between effects and impacts is not always straightforward. For example, a secondary effect may result in both a direct and indirect impact on a single receptor. Given this the EIA framework used herein is based on the 'source-pathway-receptor' conceptual model process used to provide a systematic and auditable approach to understanding the potential for effects to arise, the spatial extents of the effect-receptor interactions, impact pathways, and potential impact significance. The conceptual *'source-pathway-receptor'* model is effective in the identification of potential effects and the means by which these can manifest themselves on the receiving environment and its sensitive receptors.

The term 'source' describes the origin of potential effects (e.g. construction activities) and the term 'pathway' describes the means (e.g. through air, water, or ground) by which the effect reaches the receiving sensitive 'receptor' (e.g. terrestrial habitats, archaeology and human receptors). If the source, pathway or receptor is absent, no linkage exists and thus there will be no potential for an impact to manifest.

For each effect, the assessment identifies receptors within the study area that are sensitive to that effect and implements a systematic approach to understand the impact pathways and the level of impacts on given receptors. The process considers the following:

- the magnitude of the effect;
- the sensitivity of a receptor to the effect;
- the probability that an effect-receptor interaction will occur;
- the determination and (where possible) qualification of the level of impact on a receptor, considering the probability that the effect-receptor interaction will occur, the spatial and temporal extents of the interaction and the significance of the resulting impact; and,
- the level of certainty at all stages.

The magnitude of effect

The magnitude of an effect is typically defined by four factors:

- Extent – the area over which an effect occurs.
- Duration – the time for which the effect occurs.
- Frequency – how often the effect occurs.
- Severity – the degree of change relative to existing environmental conditions.

In order to help define effect magnitude, the criteria presented in Table 5.2 have been adopted for the purposes of this EIA. While this table provides guidelines of a generic nature, it should be noted that more specific guidelines in relation to impact magnitude have been adopted for the topics assessed, where considered necessary.

Table 5.2 Generic guidelines used in the determination of magnitude of effect

Magnitude	Description
Very high	Loss of resource; severe damage to key characteristics, features or elements (Adverse). Permanent / irreplaceable change, which is certain to occur. Large scale improvement of resource or attribute quality; extensive restoration or enhancement (Beneficial).
High	Loss of resource; partial loss of or damage to key characteristics, features or elements (Adverse). Permanent / irreplaceable change, which is likely to occur. Improvement to, or addition of, key characteristics, features or elements of the resource; improvement of attribute quality (Beneficial).
Medium	Minor loss of, or alteration to, one (maybe more) key characteristics, features or elements; measurable change in attributes, quality or vulnerability (Adverse). Long-term though reversible change, which is likely to occur. Minor improvement to, or addition of, one (maybe more) key characteristics, features or elements of the resource; minor improvement to attribute quality (Beneficial).
Low	Very minor loss of, or alteration to, one (maybe more) key characteristics, features or elements; noticeable change in attributes, quality or vulnerability (Adverse). Short- to medium-term though reversible change, which could possibly occur. Very minor improvement to, or addition of, one (maybe more) key characteristic, feature or element; very minor improvement to attribute quality (Beneficial).
Very low	Temporary or intermittent very minor loss of, or alteration to, one (maybe more) characteristic, feature or element; possible change in attributes, quality or vulnerability (Adverse). Short-term, intermittent and reversible change, which is unlikely to occur. Possible very minor improvement to, or addition of, one (maybe more) characteristic, feature or element; possible improvement to attribute quality (Beneficial).

The determination and qualification of impact significance

The significance of an impact is determined by combining the predicted magnitude of the effect with the sensitivity of the receptor; for example, as defined in Table 5.3. Impact statements carry a degree of subjectivity, as they are based on expert judgement regarding the effect-receptor interaction that occurs and on available data. As such, impact statements should be qualified appropriately.

The probability of an effect occurring (i.e. an effect-receptor interaction) should also be considered in the assessment process; capturing the probability that the effect will occur and also the probability that the receptor will be present. For example, the magnitude of the effect and the sensitivity of the receptor may have been established, and it may be highly probable that the effect will occur; however, the probability that the receptor will be present at the same time should also be considered.

In the context of the EIA Regulations, ‘significant impacts’ are taken to be those of moderate or major significance (as defined above); albeit that appropriate mitigation, where available, should be sought for all impacts.

It should be reiterated that, although this section sets out the overall approach adopted for this EIA (using, for example, magnitude and sensitivity to determine the level of impact), individual sections may take their own approach where industry standard methodologies are appropriate or another approach has been agreed with the relevant regulator. Where a different approach is taken, this is explained in the relevant methodology section.

Table 5.3 Impact assessment matrix

Receptor sensitivity (inclusive of value)	Magnitude of effect				
	Very high	High	Medium	Low	Very low
Very high	Major	Major	Moderate	Moderate	Minor
High	Major	Moderate	Moderate	Minor	Negligible
Medium	Moderate	Moderate	Minor	Minor	Negligible
Low	Minor	Minor	Minor	Negligible	Negligible
Very low	Minor	Negligible	Negligible	Negligible	Negligible

Mitigation

Mitigation measures have been proposed, where available and practical, in those cases where adverse impacts have been identified. It is important to note that the mitigation measures applied should be proportionate to the scale of the impact predicted.

'*Mitigation through design'* is an important factor in ensuring that the environmental impacts of a proposed scheme are minimised. Through the development of the proposed scheme, and the iteration of the engineering and environmental impact studies, mitigation has been built into the design of the proposed scheme. Where significant impacts potentially remain, further issue-specific mitigation measures are defined.

Whilst mitigation for minor or negligible impacts may not be specifically defined as a matter of course, industry standard or 'embedded' mitigation often applies in these cases (and is set out herein). It is also recognised that minor and negligible impacts could become significant when considered cumulatively with other pressures on a receptor and, in this event, mitigation may be required.

With regard to the HRA (presented in Section 29), the recent ruling (April 2018) by the Court of Justice of the European Union (CJEU) referred to as *People Over Wind and Sweetman v Coillte Teoranta (C-323/17)* is relevant to the treatment of mitigation in HRA. The CJEU ruling determined that "…*it is not appropriate, at the screening stage, to take account of the measures intended to avoid or reduce the harmful effects of the plan or project on that site*". In the context of HRA, the phrase …"*measures intended to avoid or reduce the harmful effects...*" is interpreted as meaning any mitigation measures that are not clearly an intrinsic part of the design of a plan or project. The effect of this ruling is that mitigation measures, which are not clearly intrinsic to the proposed scheme design, have not been considered when determining likely significant effect (LSE) at the HRA screening stage.

Monitoring

Appropriate mitigation measures have been identified and recommended in this EIA Report where the EIA process has identified an adverse impact and mitigation is available (see above). In some cases, in order to ensure that the mitigation measures are successful or where there is significant uncertainty with respect to important receptors, monitoring requirements have been identified and are presented within the relevant topic chapters of this EIA Report.

Residual impacts

Where further mitigation measures are identified, the significance of the residual environmental impact (i.e. the post-mitigation impact) is assessed.

Assumptions and limitations

The EIA Regulations and relevant guidance require an EIA Report to provide an indication of any difficulties (technical deficiencies or lack of know-how) encountered during the assessment process. Any such assumptions or limitations are identified within the relevant topic chapter, where relevant.

The EIA Regulations also require that an EIA Report is prepared by competent experts. This EIA Report has been compiled by Royal HaskoningDHV, a company which is a corporate member of the Institute of Environmental Management & Assessment (IEMA) (number 0001189) and also a Corporate Registered Assessor for EIA under IEMA's voluntary EIA Quality Mark scheme. Through this scheme, EIA activity is independently reviewed, on an annual basis, to ensure it delivers excellence in areas including EIA management, team capabilities, regulatory compliance, content, presentation and improving practice.

5.1.5 Net gain / enhancement

In 2018, the Government sought views on proposals to improve the planning system in England to protect the environment. Consultation proposals for a mandatory requirement (to incorporate net gain into proposals) did not include nationally significant infrastructure project or marine projects (such as the marine elements of the NGCT). After a period of consultation on a mandatory requirement for all new developments within the Town and Country Planning Act to deliver net gain for nature, the Government announced in March 2019 its favourable view on mandating biodiversity net gain for developments in England. This means that coastal and intertidal habitats will have to be considered to account for the whole regime of the Act, including the intertidal area down to the mean low water mark. Government advised in July 2019 that nationally significant infrastructure and net gain for marine development (meaning development under the Marine and Coastal Access Act, 2009) will remain out of scope of mandatory requirement in the Environment Bill.

The Chancellor also announced in 2019 that the Defra biodiversity metric 2.0 would be the mechanism used to calculate the amount of habitat creation or improvement needed to enable net gain in biodiversity. This metric has been developed for terrestrial habitats and was expanded to include coastal habitat. Natural England published a paper in April 2019 which presents a metric for intertidal habitat. Within this paper, Natural England (2019) states that net gain will be attained when the 'post-intervention' biodiversity units (i.e. the effect of implementation of habitat creation or improvement measures) are at least 10% higher than the original ('pre-intervention') biodiversity units, plus the predicted impact of the NGCT (i.e. loss of biodiversity units due to development).

Although the proposed scheme already has planning permission under the Town and Country Planning Act (which has been implemented), and as noted, above there is no mandatory requirement (at present) to incorporate net gain into works under the Marine and Coastal Access Act 2009, PDT has applied the principles of the biodiversity metric methodology published by Natural England (2019) as good practice, illustrating PDT's commitment to the natural environment. Further details on the application of the biodiversity metric is provided in Section 9.

5.1.6 Cumulative Impact Assessment

Impact inter-relationships

Council Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment (the EIA Directive) states that an EIA should identify, describe and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on the following receptors:

- Population and human health.

- Biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC.
- Land, soil, water, air and climate.
- Material assets, cultural heritage and the landscape.
- The interaction between the factors referred to above.

This EIA Report has given due consideration to the potential for different residual impacts to have a combined impact on key sensitive receptors. The objective is to identify where the accumulation of impacts on a single receptor, and the relationship between those impacts, potentially gives rise to a need for additional mitigation. Inter-relationships have been assessed within the relevant sections of the topic chapters of the EIA Report.

Cumulative impacts

In line with IEMA's Guidelines for EIA (2004), cumulative impacts are defined as: *"…the impacts on the environment which result from incremental impacts of the action when added to other past, present and reasonably foreseeable future actions …"*

There is no legislation that outlines how cumulative impact assessments (CIAs) should be undertaken. However, the EIA and Habitats Directives and their associated regulations require the consideration of direct impacts and any indirect, secondary and cumulative effects of a project. Government guidance states that: "cumulative effects could refer to the combined effects of different development activities within the vicinity" (Department for Communities and Local Government, 2006, Paragraph 121).

The EIA Regulations do not define 'cumulative' but guidance on cumulative effects assessment is provided in a number of good practice documents (e.g. the European Commission, 1999). This guidance is not prescriptive, but rather suggests various approaches which may be used, depending on their suitability to the project (for example the use of matrices, expert opinion, consultation, spatial analysis and carrying capacity analysis).

A tiered approach has been adopted for the CIA, based upon the following definitions:

- Site-specific (or within-development) cumulative impacts - different effects associated with the proposed scheme have the potential to interact and, together, influence common receptors (e.g. noise and visual effects on ecology). Where applicable, these inter-relationships are considered in the CIA (in Section 27) and the HRA (Section 29).
- Wider cumulative impacts which are the combined impacts (additive or interactive) that may occur between the proposed scheme and any other relevant development(s).

With respect to 'past' projects, a useful ground rule in CIA is that the environmental impacts of schemes that have been completed should be included within the environmental baseline; as such, these impacts will be taken into account in the EIA process and, generally, can be excluded from the scope of CIA. However, the environmental impacts of recently completed projects may not be fully manifested and, therefore, the potential impacts of such projects should be taken into account in the CIA.

Project-wide and wider cumulative assessment has been documented within Section 27.

6 HYDRODYNAMIC AND SEDIMENTARY REGIME

6.1 Introduction

The predicted effects of the proposed scheme on the hydrodynamic and sedimentary regime have been assessed through undertaking numerical modelling and expert interpretation of the modelling outputs (based on the closed quay construction as the worst case), as reported in the 2006 ES and the 2007 Supplement. As reported in the 2006 ES, the predicted changes to the physical regime of the Tees estuary are described as changes or effects (and, where possible, quantified). The significance of the potential impact on various environmental parameters (e.g. marine ecology, ornithology, water quality, etc.) is then assessed in subsequent sections of this EIA Report, informed by the predicted changes to the hydrodynamic and sedimentary regime.

In addition to the above, a review of the findings of other environmental assessments for consented schemes (specifically the York Potash Harbour Facilities ES, QEII Berth Development ES and Tees Dock No.1 Quay ES) has also been undertaken to inform the evidence base.

The hydrodynamic and sedimentary regime chapter from the 2006 ES is contained in Appendix 6 for reference. The information from the 2007 ES supplement of relevance to this chapter has been incorporated into the consideration of potential effects, presented below.

6.2 Updates to environmental baseline since 2006

The 2006 ES was informed by a large number of data collection exercises, modelling studies and geomorphological interpretations to provide a very comprehensive and robust assessment in relation to the hydrodynamic and sedimentary regime of the Tees estuary and Tees Bay. The 2006 ES defined the baseline environment thoroughly, covering the following topics:

- Tides and water level
- Fluvial flow
- Density effects
- Wind and waves
- Sediment (covering each of fluvial, industrial and marine sources)
- Estuary morphology

Since production of the 2006 ES, there have been further studies undertaken for proposed schemes in the Tees estuary, particularly in relation to:

- **Maintenance Dredging** – the Maintenance Dredging Baseline Document (Royal Haskoning, 2008) provided information about the maintenance dredging material regularly removed from the Tees estuary (and the potential implications of maintenance dredging and disposal for European and Ramsar sites). This report is updated annually through the Tees Maintenance Dredging Annual Review, the latest version of which relates to maintenance dredging in 2018.
- **QEII Berth Development** – the 2009 ES for this development (the marine licence for which has now expired) was largely based on the baseline description of the physical environment that was presented in the 2006 ES for NGCT. The baseline description was updated where required with further information about maintenance dredging regimes and materials arising from the Maintenance Dredging Baseline Document (Royal Haskoning, 2008). The dredge technique that was assessed within the QEII Berth ES (predominantly a backhoe with localised cutter suction dredging) differs to those to be used for NGCT (trailing suction hopper dredger and cutter suction)

and, therefore, the construction effects on the sediment regime were assessed through SEDPLUME-RW(3D) numerical modelling. Post construction effects were specifically assessed through: (i) TELEMAC modelling of effects on tides; (ii) assessment of the wave reflection properties of the proposed structures for effects on the wave regime; and (iii) geomorphological interpretation of effects on both the sediment transport regime and morphological changes.

- **Tees Dock No.1 Quay** – following consultation with the MMO, Natural England, Environment Agency and CEFAS in 2011, it was agreed that, given the low environmental risk associated with the (then proposed but now constructed) Tees Dock No. 1 Quay scheme, existing modelling results from the NGCT and QEII schemes could be used to provide suitable evidence upon which to base predictions of possible effects from the proposed dredging operations (required for the Tees Dock No.1 Quay scheme). This position was substantiated by means of a Technical Note in 2011 which demonstrated the applicability of the findings of existing models produced for the NGCT and QEII schemes to the Tees Dock No.1 Quay scheme. Through consultation it was agreed that this approach was sufficient and that no additional hydrodynamic and sediment transport modelling effort would be necessary for the Tees Dock No.1 Quay scheme. The ES was subsequently produced in 2012.
- **York Potash Harbour Facilities** – the ES (Royal HaskoningDHV, 2014) for this project was based on numerical modelling tools first established and calibrated in support of the 2006 ES for NGCT. The suite of modelling activities undertaken specifically for the York Potash Harbour Facilities EIA included tidal flow modelling, wave modelling, sediment transport, bed change modelling and modelling of sediment plume released from construction activities.

It is recognised that the York Potash Harbour Facilities work was undertaken during 2014 (i.e. approximately five years ago). It is understood that there have been no significant developments which have progressed in the interim period within the Tees estuary, and therefore it is considered that the findings of the 2014 EIA studies remain valid.

A review of the above information sources (and particularly the 2014 York Potash work) has identified that there have been no changes to baseline understanding regarding the hydrodynamic and sedimentary regime in the estuary since the production of the 2006 ES.

Specifically, it is concluded that there is no requirement to amend the following baseline information presented in the 2006 ES:

- Tides and water levels.
- Understanding regarding fluvial flows and density effects within the estuary.
- Wave climate (including calculated wave return periods at waverider buoy locations).
- Sediment regime (including background levels of suspended sediment and sources of suspended sediment).

The only additional information which enhances the existing understanding of the environmental baseline since 2006 is that presented in the Tees Maintenance Dredging Annual Reviews. As a consequence of sediment deposition with limited natural re-suspension, an average of approximately 1 million m^3 of material is dredged annually as maintenance activities (average from 2001 to 2018). This comprises around 180,000m^3 of mud, mostly found in the upstream reaches beyond the Transporter Bridge. Of the remainder, 80% typically is clean, fine sand (approximately 650,000m^3) and 20% typically is silty sand (approximately 170,000m^3).

With regard to bathymetry of the Tees estuary, similarly, no significant changes have occurred since the 2006 ES was written. The only significant project undertaken has been the dredging and re-strengthening

of No.1 Quay in Tees Dock; all works associated with this project were contained within Tees Dock, and therefore it is considered that this removes the potential for any significant impacts to have arisen to the bathymetry of the estuary.
Other than the above information on maintenance dredging regimes, there are equally no significant new data sources which would alter understanding of the environmental baseline that was presented in the 2006 ES.

Within its scoping opinion during the HRO extension process, Natural England commented that the potential impact of recent infrastructure and developments (e.g. the Teesside Offshore Wind Farm) on the Tees should be carefully considered, as such infrastructure may have altered the characteristics of the estuary. A review of the ES produced for the Teesside Offshore Wind Farm (located approximately 1.5km offshore from Coatham Sands) has identified that that development is predicted to have no significant effect on water levels, and the effect of tidal flows is largely contained within the footprint of the development site.

Consequently, no effects on the tidal regime are envisaged as a result of the Teesside Offshore Wind Farm scheme. Wave modelling predicted that the Teesside Offshore Wind farm will have a moderate effect on the wave climate in both the development footprint and the coastal area surrounding the site (of the windfarm). The principal consequence of this is that there could be alterations in littoral drift along the Coatham Sands shoreline. The non-technical summary for the Wind Farm project does not report any changes to the bathymetry of the Tees estuary as a result of the offshore wind farm.

The only other significant construction project undertaken in the Tees estuary since 2006 and 2007 is the Tees Dock No.1 Quay refurbishment; as noted above, all works for this project were contained in Tees Dock and, therefore, this project did not result in a change to the bathymetry of the estuary or have any significant effect on hydrodynamics.

6.2.1 Future evolution of the baseline in the absence of the proposed scheme

In the absence of the proposed scheme, there is no reason to believe that the hydrodynamic and sedimentary regime within the Tees estuary is likely to materially change from the present-day conditions. PDT will continue to undertake maintenance dredging of the river to maintain the advertised dredge depths, with disposal of the material offshore (on the assumption that no beneficial use opportunities arise).

6.3 Summary of predicted construction phase effects

To assess the effects of the proposed scheme, a 3D sediment transport model was used to simulate dispersion, deposition and resuspension of released sediment in the Tees estuary. A 3D flow model was also set up to simulate currents in the Tees estuary and Tees Bay and provided current and tidal flow information to drive the sediment transport model. To model sand transport, HR Wallingford used SANDFLOW, an in-house model which predicts movement of non-cohesive sediment.

The 2006 ES adopted a very comprehensive and robust assessment in relation to the assessment of construction phase effects on the hydrodynamic and sedimentary regime. Given that there are no significant changes to the understanding of the environmental baseline presented in the 2006 ES, and the proposed scheme remains as presented in the 2006 ES and the 2007 Supplement, it is considered that the previous assessment of construction phase effects on the hydrodynamic and sedimentary regime remains valid. These effects are summarised below.

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6.3.1 Increase in suspended sediment concentrations and deposition resulting from capital dredging

The capital dredging will involve dredging (generally) sand in the lower channel and Mercia mudstone (marl) in the channel in the vicinity of the NGCT. The total volume of dredged material is predicted to be approximately 4.8 million m^3. The dredging (and placement of dredged material at the reclamation site, if required) will generate a plume of sediment in the water column. The simulated dredge locations and the 'sensitive' receptor points included in the model are shown in Figure 6.1.

The modelling predicts that the largest rise in peak suspended sediment concentrations (SSC) above background concentrations (up to 1000mg/l) occurs within the immediate vicinity of the dredger (with concentrations being significantly greater in the vicinity of the TSHD than the CSD). Immediately outside of this zone, it is predicted that the concentrations of suspended solids will be significantly less (approximately 25mg/l above background). The model outputs are shown in Figure 6.2 to 6.4.

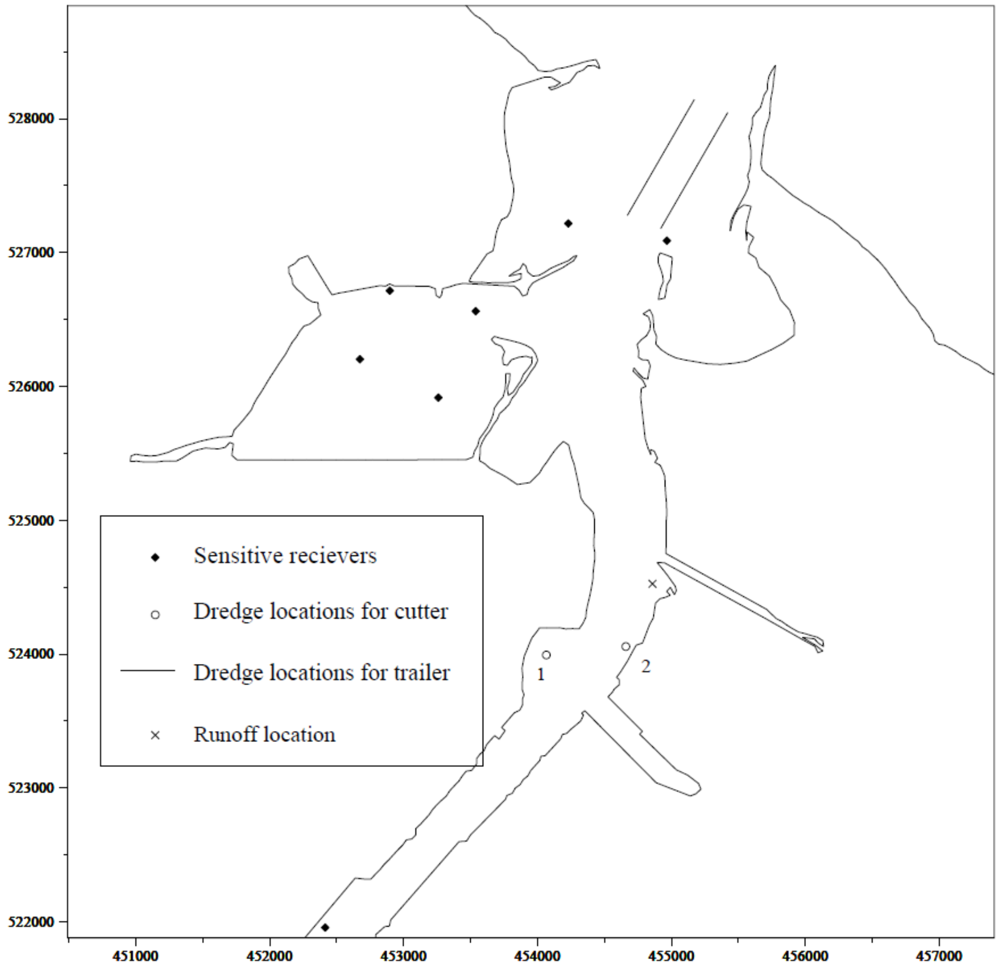

Figure 6.1 Simulated dredge locations for CSD and TSHD and sensitive receptor points

Peak deposition of sediment on the seabed is predicted to follow a similar pattern, with deposition predicted to be greatest in the immediate vicinity of the dredger (see Figure 6.2 to 6.4). Much of the material is therefore predicted to deposit within the area of the proposed dredge footprint and would be re-dredged or would deposit within an already dredged area.

For dredging in the Seaton Channel area, deposition is predicted to occur on Seal Sands, however, depths are predicted to be fractions of a millimetre (up to 0.05mm over three tides) (Figure 6.5). The dredging is predicted to take approximately 30 days in this area, and over this period it is calculated that up to 1mm of material would settle on Seal Sands. Some resuspension is also anticipated. A similar scenario is predicted for deposition in Seaton Channel. The dredging is predicted to have little influence on suspended solid concentrations and deposition at Bran Sands and North Gare Sands (Figure 6.7).

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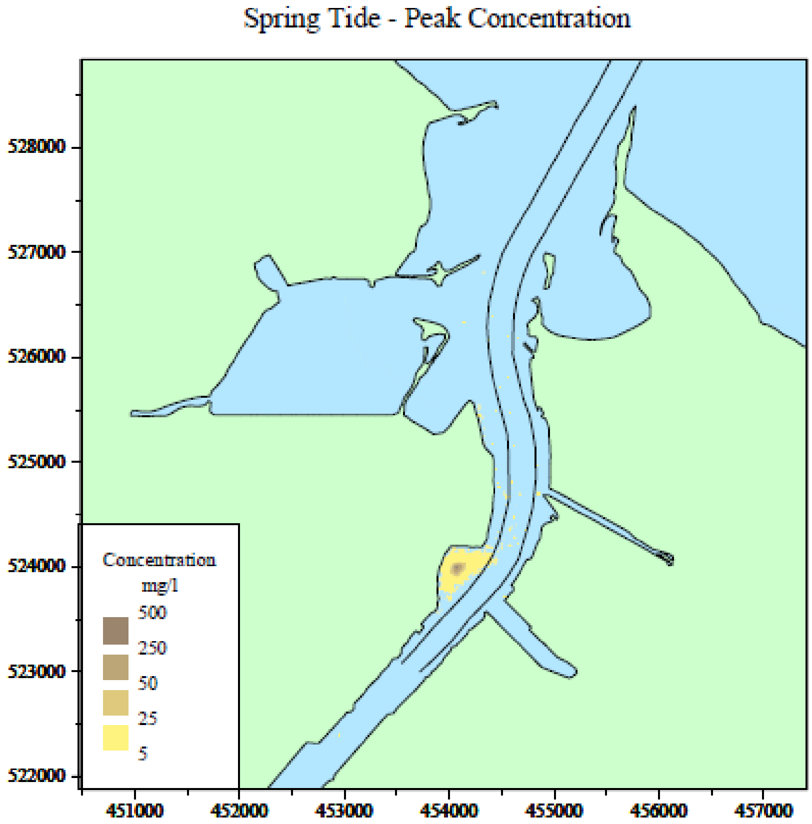

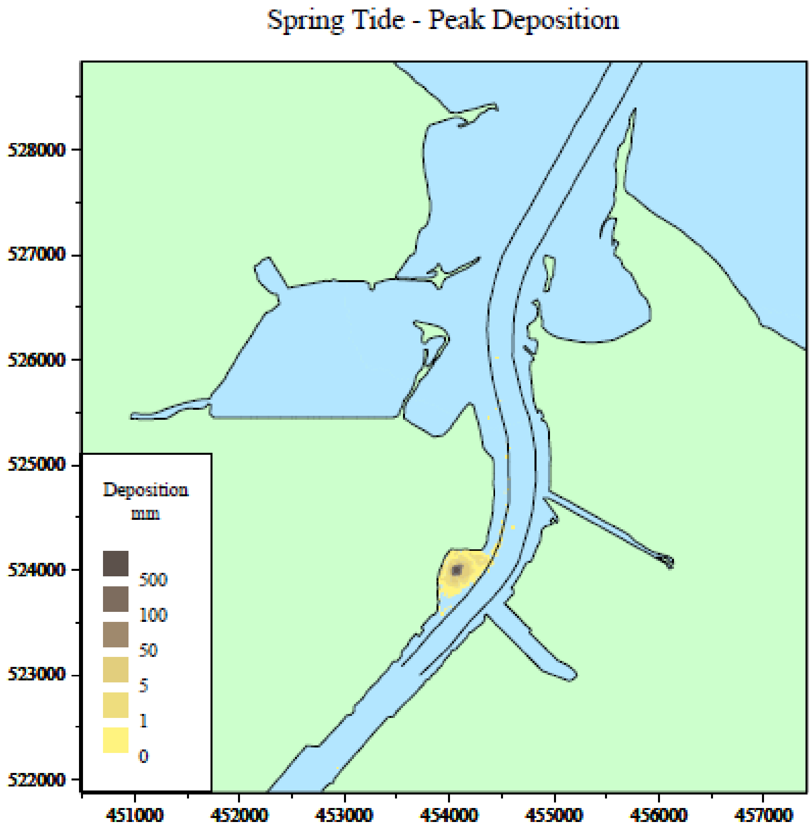

Figure 6.2 Peak concentration and peak deposition for cutter suction dredger at location 1, spring tide, low flow

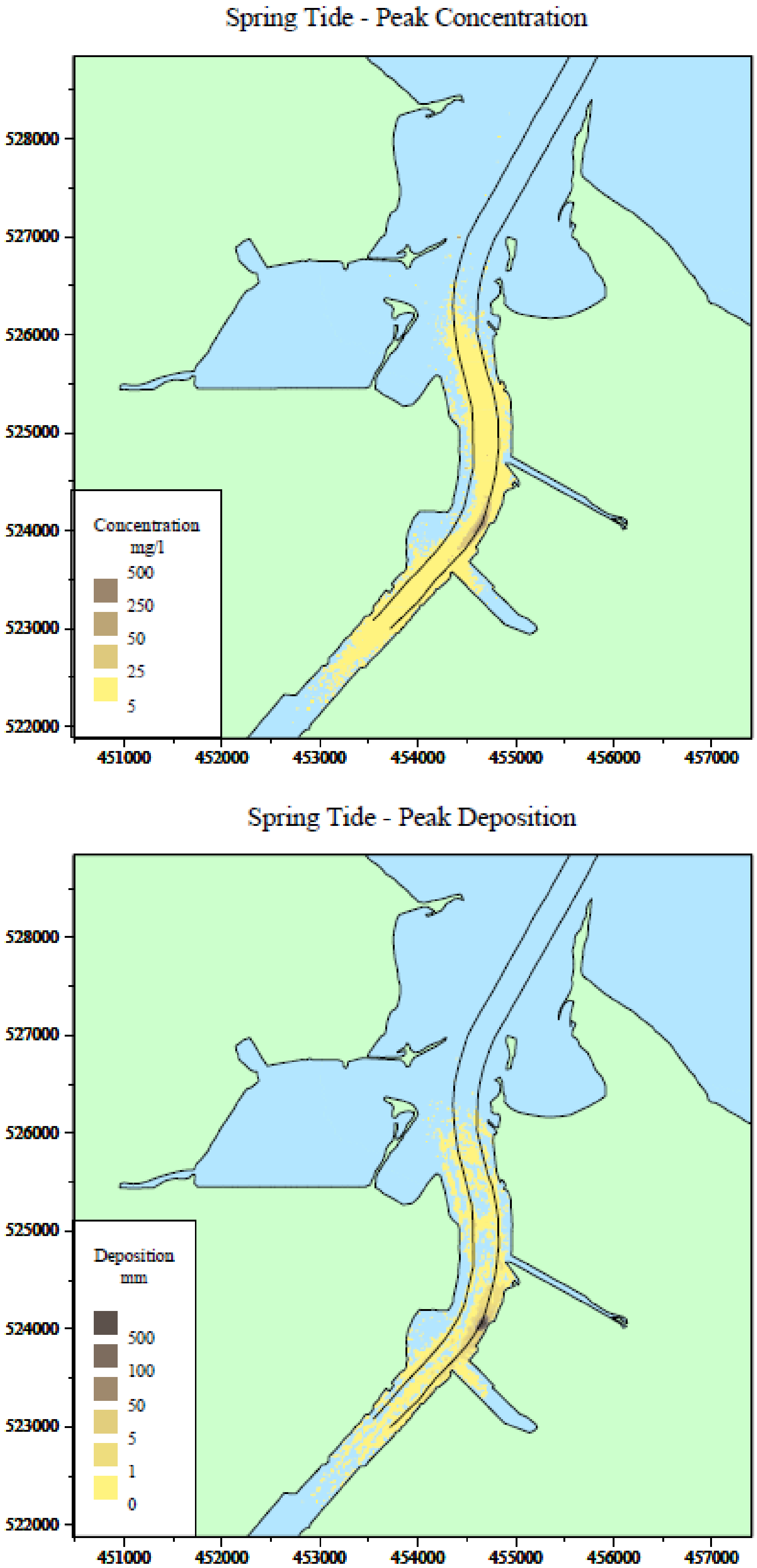

Figure 6.3 ***Peak concentration and peak deposition for cutter suction dredger at location 2 spring tide, low flow***

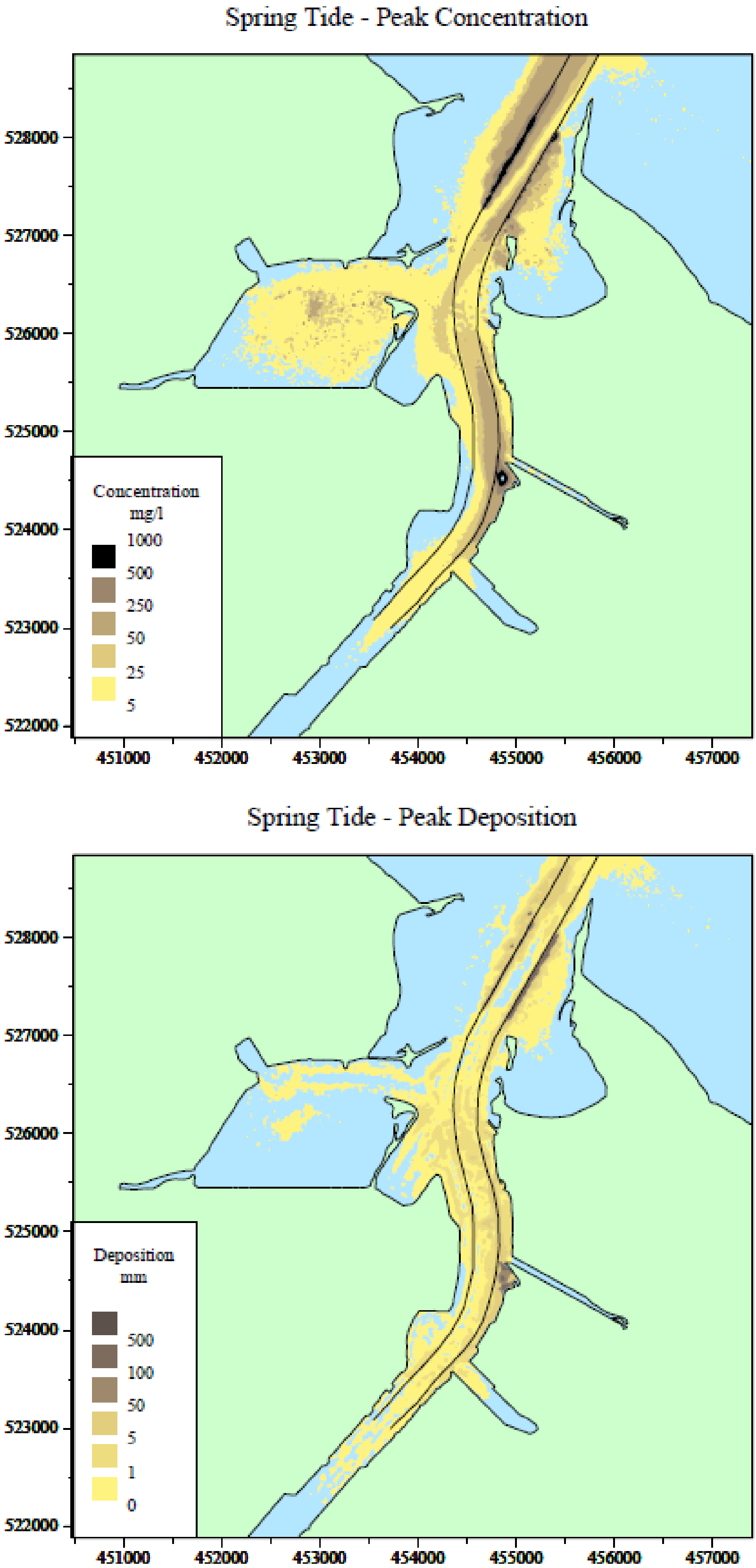

Figure 6.4 Peak concentration and peak deposition for TSHD dredging sand in the approach channel, spring tide, low flow conditions

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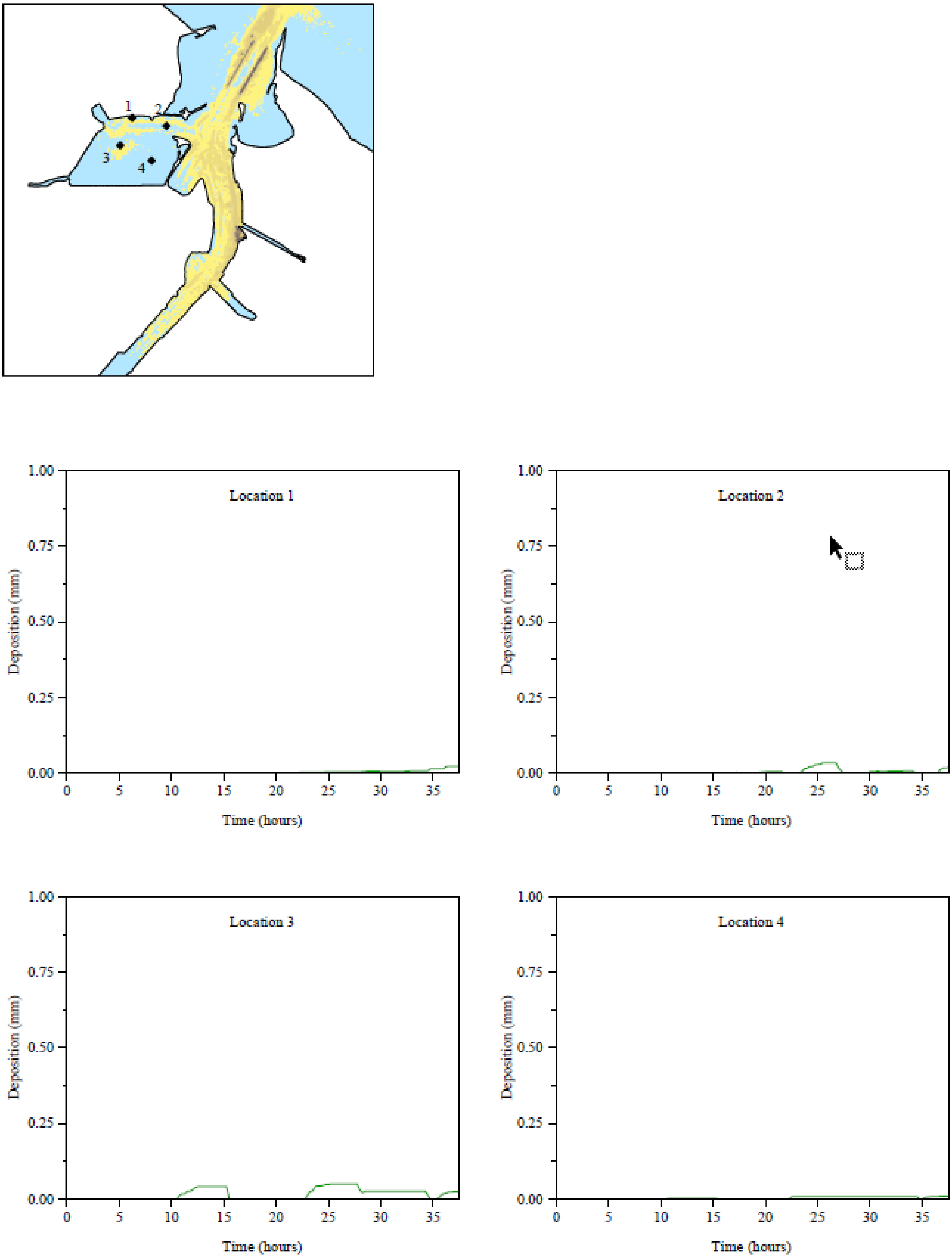

Figure 6.5 Time histories of deposition in Seaton Channel (Locations 1 and 2) and Seal Sands (Locations 3 and 4) for TSHD dredging sand in the approach channel, spring tide, low flow conditions

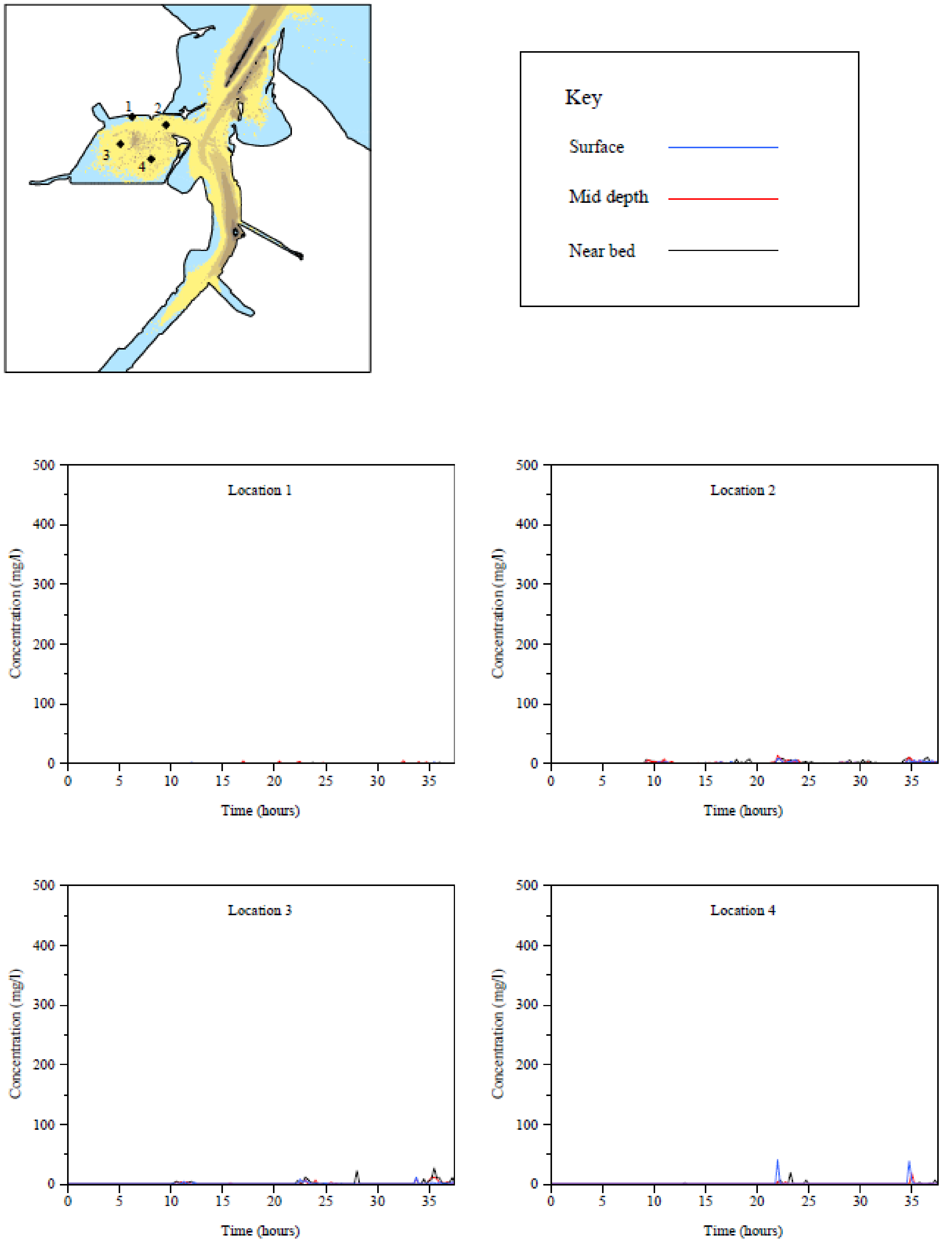

Figure 6.6 ***Time histories of concentration in Seaton Channel (Locations 1 and 2) and Seal Sands (Locations 3 and 4) for TSHD dredging sand in the approach channel and runoff from the reclamation site, spring tide, low flow conditions***

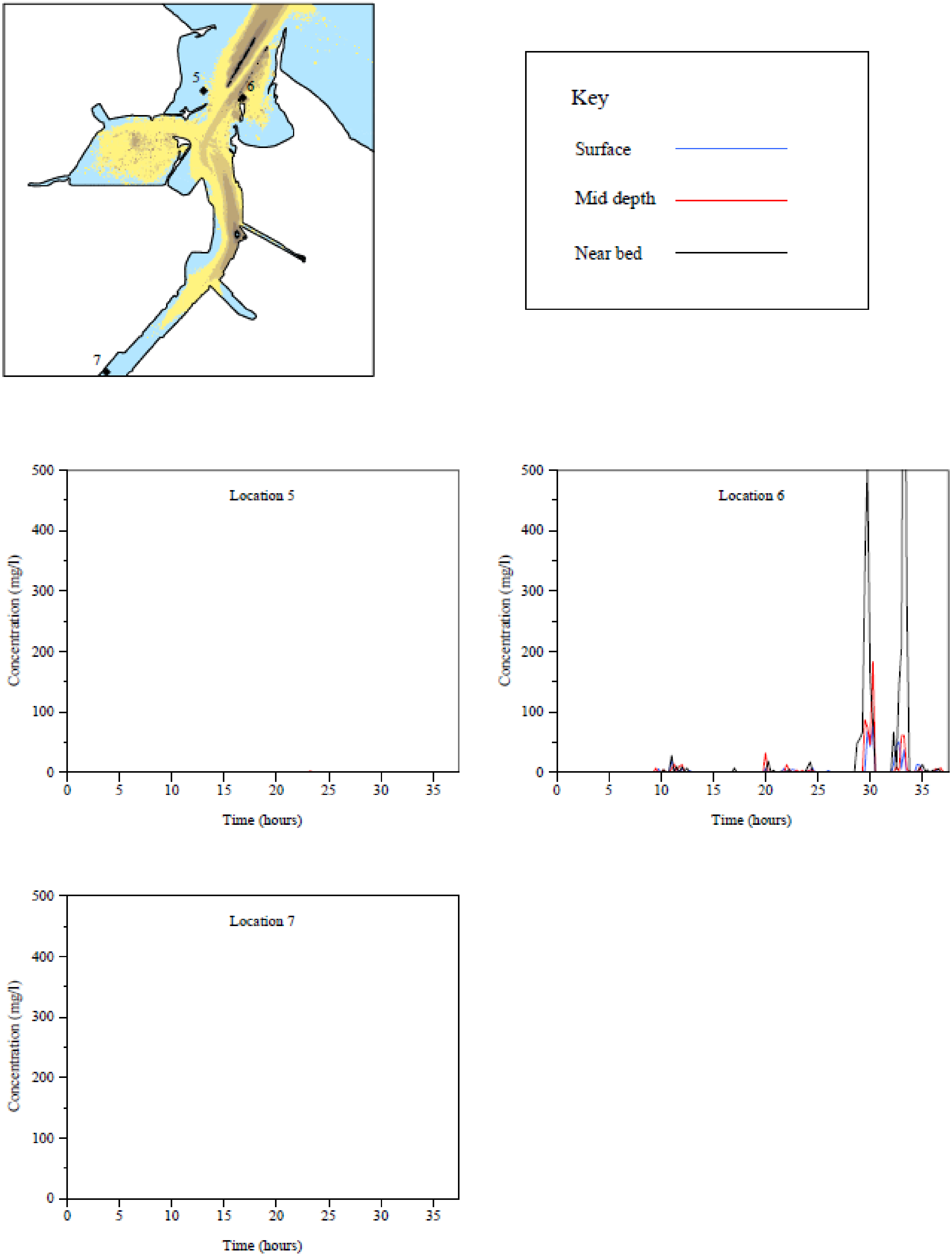

Figure 6.7 ***Time histories of concentration at Bran and North Gare Sands for TSHD dredging sand in approach channel, spring tide low flow conditions***

During the capital dredging works, other port facilities would remain operational. Maintenance dredging is, therefore, expected to continue throughout the capital dredge period. The capital dredge is also expected to influence maintenance dredging requirements during and immediately after the period of construction. This is because fine material will be released into suspension, some of which will then settle in the various maintained areas.

However, dredging of the lower reaches of the river to remove sands driven into the mouth of the river, represents the main maintenance dredging operation undertaken by PDT on the Tees. The capital dredging also requires the dredging of sands from the lower reaches of the river, which are to be used in the reclamation behind the new quay wall. When capital dredging of the lower reaches is being undertaken, therefore, this will negate a large proportion of the requirement for maintenance dredging.

As a consequence, PDT would use this opportunity to undertake maintenance dredging elsewhere, for example, at Hartlepool and the Tees upstream of Tees Dock. Monitoring of accretion at the berths will also be undertaken, particularly the ConocoPhillips berths and the Corus Redcar Ore Terminal berth. These are areas which are close to where the dredging for sands will be taking place. If required, PDT would keep these berths at their required depths. This requirement, however, is unlikely to be significant. Nevertheless, the in-combination effects of the capital and maintenance dredging have been considered through a model run. The outputs of the model run are presented below and are further discussed in Section 27 and 29 of this report.

The capital dredging scenario used in the model was a large (6,000m^3 capacity) TSHD removing material from the sides of the approach channel and pumping ashore at the reclamation site. As illustrated above, this case has been demonstrated to have the most potential effect on the intertidal areas during the capital dredge. In addition, a potential 'worst' case for supply of material to Seal Sands from maintenance dredging was identified. This is deemed to be the situation when short-term maintenance dredging is required in the Seaton Channel turning circle (as the Seaton Channel is the main route of sediment transport to Seal Sands). For the purposes of demonstrating the nature of the in-combination effect, it was assumed that this maintenance dredging would be carried out by a small TSHD (approximating to PDT's TSHD *Heortnesse*).

Due to the similarity of the mid to far-field effects of a plume created by the CSD dredging in the upper reaches of the estuary to that of a small TSHD, the result presented is a simulation of continuous CSD dredging. The model was used to simulate the dredging scenario during a spring tide with low river flow. The simulation was run for three tidal cycles with the dredgers releasing fine material (less than 60 microns) into the bottom metre of the water column.

The dredger and sediment parameters used for the simulation were:

Sediment parameters:

- Critical shear stress for deposition = 0.1 N/m^2
- Critical shear stress for erosion = 0.2 N/m^2
- Erosion constant = 0.001 m^{-1}s
- Settling velocity (minimum) = 1 mm/s
- Diffusion coefficient = 1.0 m^2/s
- Dry density of settled material = 500 kg/m^3

Cutter suction dredger (comparable to maintenance dredging)

- Filling time = 27 mins
- Overflow time = 224 mins
- Release rate = 44 kg/s

Large Trailing Suction Hopper Dredger (6,000m^3 capacity, capital dredging) -

- Dredge cycle time = 190 mins
- Total dredge time = 60 mins
- Overflow time = 60 mins
- Release rate = 173 kg/s
- Transect length = 1km
- Speed of dredger when working = 0.75 m/s (1.5 knots)

The modelling outputs are presented in Figure 6.8 to 6.10 below. As shown below, the addition of maintenance dredging activity in the Seaton Channel turning circle during the capital dredging is not predicted to change either the peak concentration or deposition away from the immediate area of the maintenance dredging. The overall footprint of the concentration and deposition on Seal Sands is very similar to that for the capital dredge alone. However, the area of peak concentration greater than 50 mg/l is increased by the inclusion of the maintenance dredging.

At the sensitive receivers (shown on Figure 6.1), whilst the presence of the sediment released by the maintenance dredging is discernible in the time series of concentration, the results are not significantly different (i.e. no extended period of concentration above 50 mg/l). A number of peaks in concentration are shown at Position 4 but these disappear very shortly after they occur. The time series of deposition shows an increase compared to the capital dredging alone, but the resultant increases in deposition remain less than 0.1mm over the simulated period.

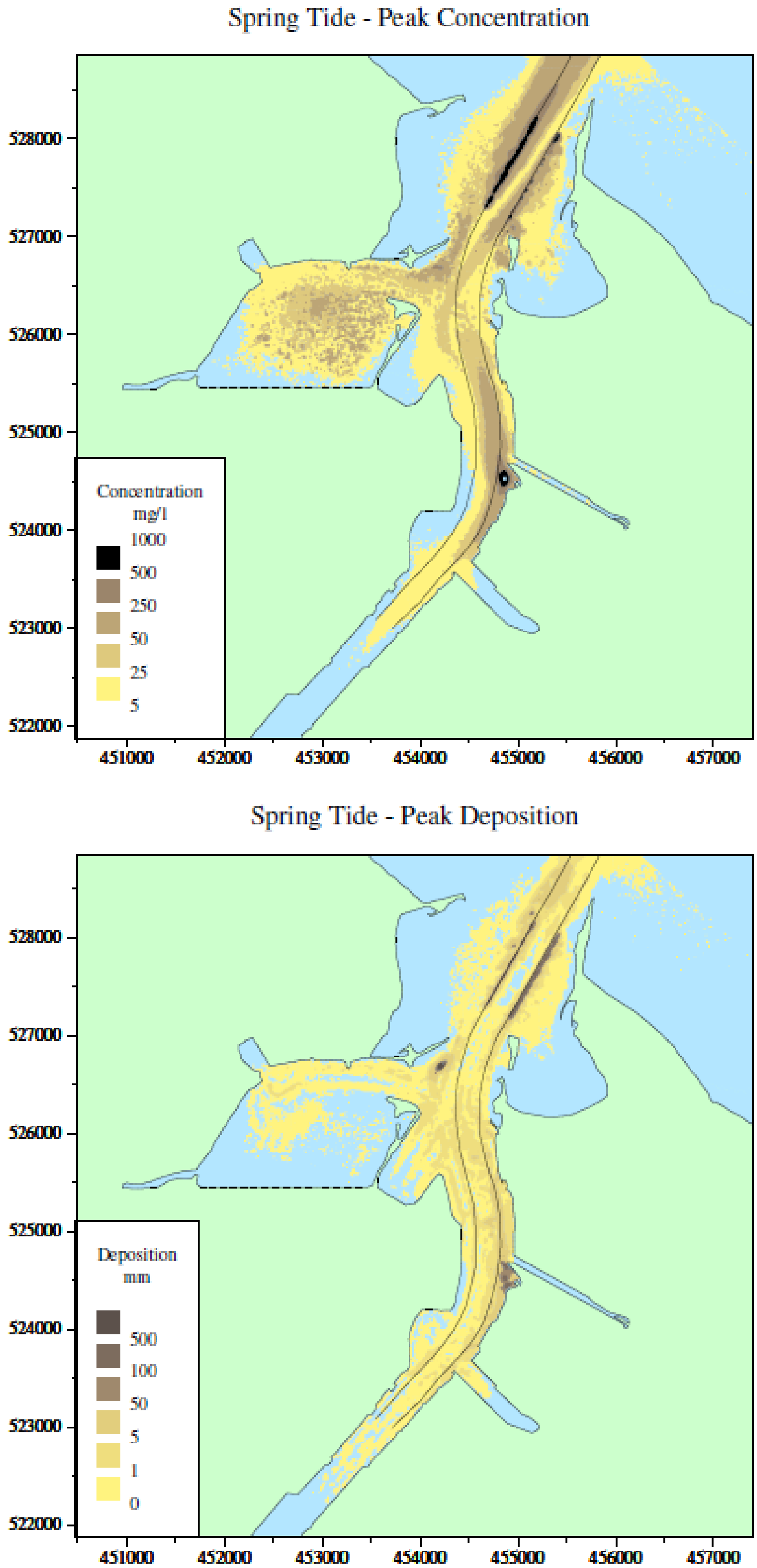

Figure 6.8 Peak concentration and peak deposition for combined capital and maintenance dredging scenario, spring tide, low flow conditions

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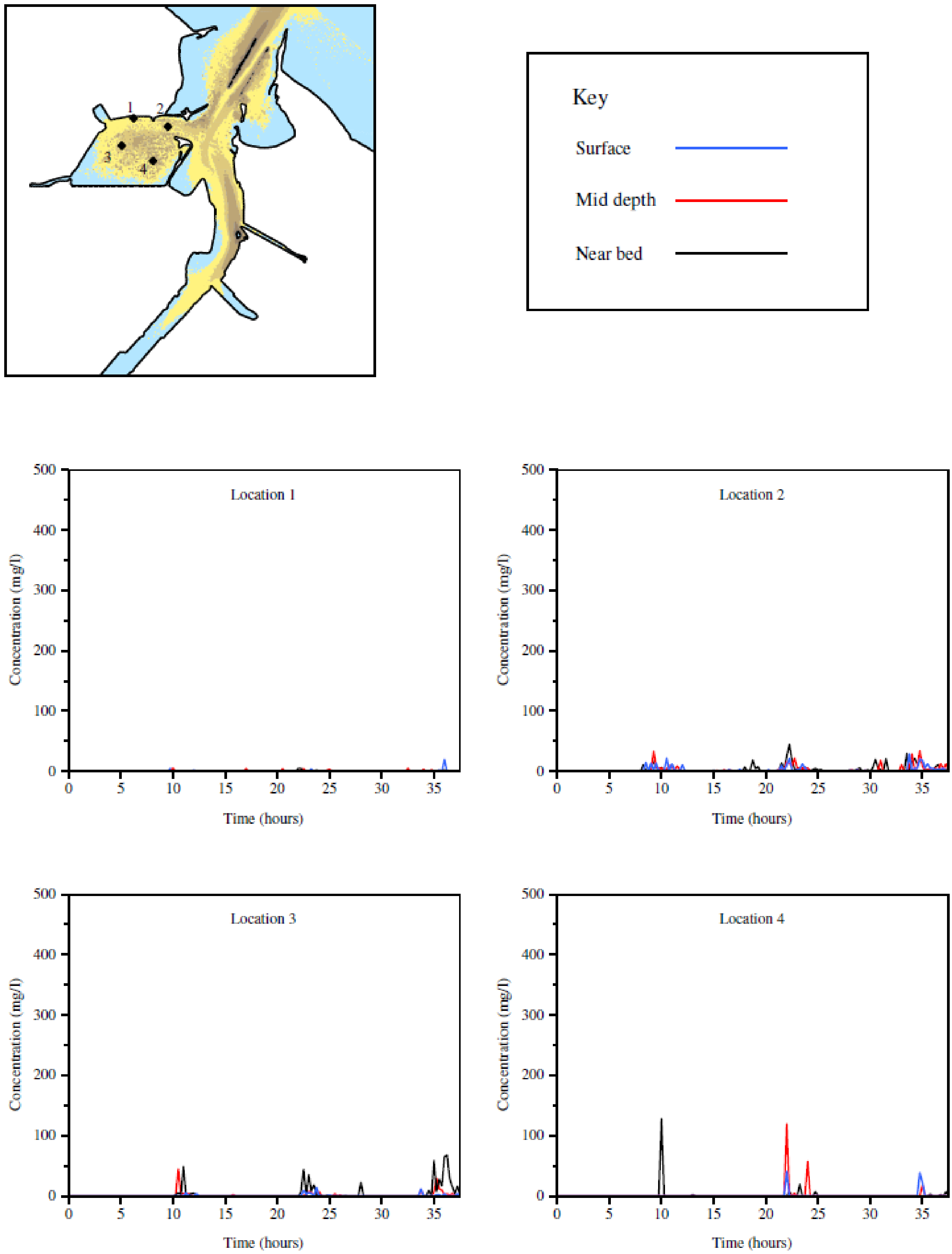


Figure 6.9 Time histories of concentration in Seaton Channel and Seal Sands from combined capital and maintenance dredging scenario, spring tide, low flow conditions

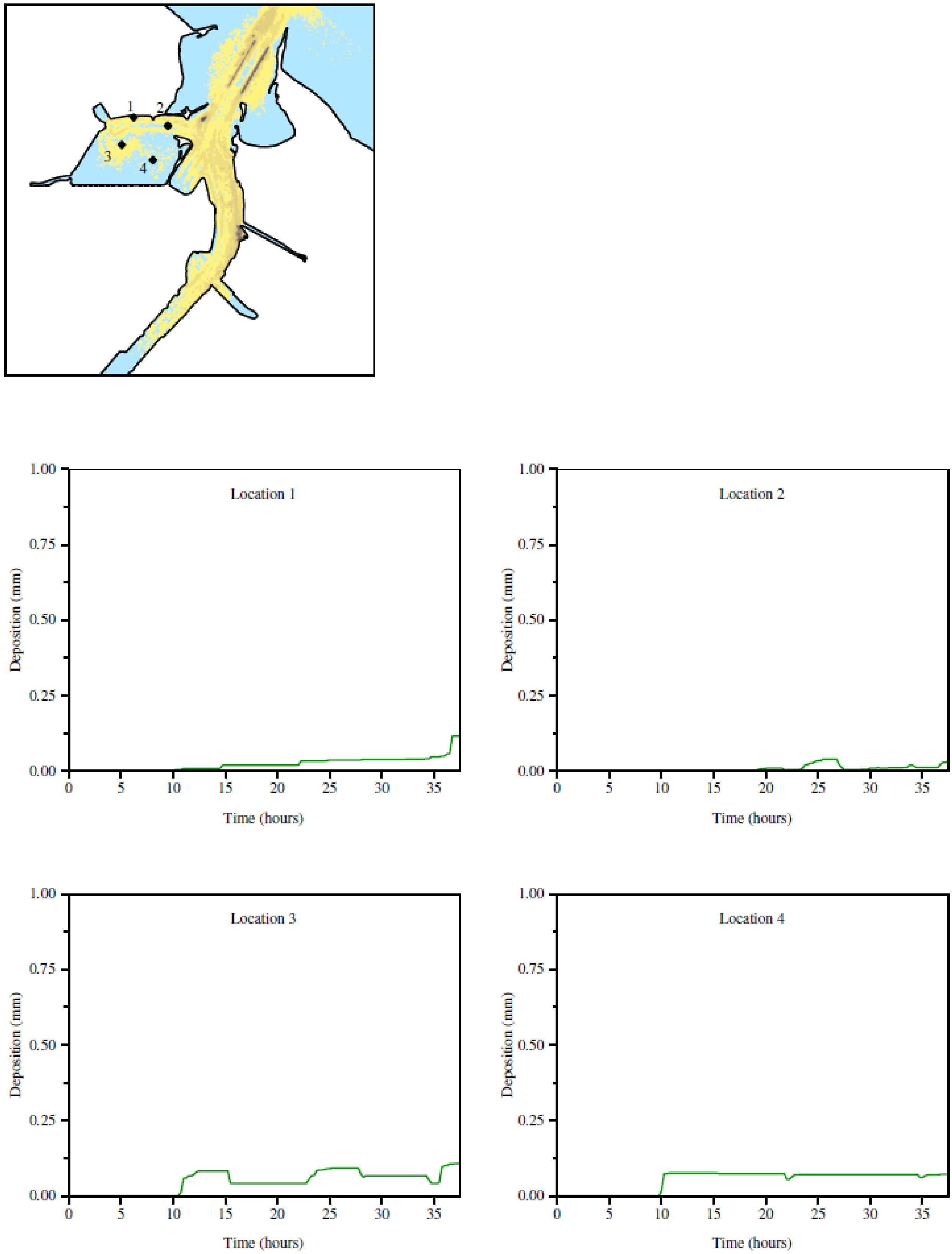


Figure 6.10 Time histories of deposition in Seaton Channel and Seal Sands from combined capital and maintenance dredging scenario, spring tide, low flow conditions

6.4 Summary of predicted operational phase effects

The 2006 ES adopted a very comprehensive and robust assessment in relation to the assessment of operation phase effects (then referred to as 'post-construction effects') on the hydrodynamic and sedimentary regime. This incorporated results from bespoke assessments and numerical modelling of the following principal issues:

- Effects of the development on tidal flows and water levels - informed by hydrodynamic modelling undertaken by HR Wallingford Ltd. using the TELEMAC-3D flow model to simulate the tidal currents within the River Tees estuary and across the wider Tees Bay. The model was verified against field measurements of flow measured by Acoustic Doppler Current Profiler (ADCP). Simulations were performed under a neap-spring tidal cycle. Sensitivity tests were also performed to assess the implications of changes to the proposed channel design.
- Effects of the development on waves - informed by wave modelling by HR Wallingford Ltd. using the SWAN wave model to simulate the changes in the wave regime. Simulations were undertaken under a range of wave input conditions.
- Effects of the development on non-cohesive sediments - informed by sand transport modelling by HR Wallingford Ltd. using the SANDFLOW sediment transport model to simulate the advection and dispersion of suspended sand due to the effects of both tidal currents and wave stirring. Simulations were undertaken under a range of flow conditions.
- Effects of the development on cohesive sediments - informed by mud transport modelling by HR Wallingford Ltd. using the SUBIEF3D mud transport model to simulate the deposition and erosion of silts and clays over the bed due to the effects of both tidal currents. Simulations were undertaken under a range of flow conditions.
- Effects of the development on morphology - informed by geomorphological interpretation of the results from the modelling of changes in tides, waves, non-cohesive sediment transport and cohesive sediment transport. Consideration was given to effects on subtidal and intertidal areas, with specific focus on certain key locations, such as the Tees Dock turning circle, the proposed container terminal, Dabholm Gut, the deepened approach channel, the enlarged Seaton Channel turning circle, Seaton Channel, Seal Sands, North Gare and Bran Sands.

Given that there are no significant changes to the environmental baseline presented in the 2006 ES, and the proposed scheme remains as presented in the 2006 ES, it is considered that the assessment of operational phase effects on the hydrodynamic and sedimentary regime remains valid. The potential operational phase effects are presented below.

6.4.1 Effects of completed scheme on tidal current speeds

Minor changes in current speeds are predicted in the estuary in the vicinity of the proposed NGCT and at the mouth of the estuary. In the vicinity of the proposed scheme, a decrease in current speed of up to 0.10m/s is predicted with localised decreases of up to 0.20m/s. Increases in current speeds of a similar order of magnitude are predicted for closer to the shores of the estuary. The area adjacent to the proposed reclamation is predicted to experience the greatest effects on flows. Further downstream at the mouth of the estuary, very little effect is predicted and decreases in current speeds are in the order of 0.05m/s. Changes to current direction are also predicted in the location of the proposed scheme, as the overall cross section of the estuary would be altered. The overall predicted effects are described as being of low magnitude.

One of the main effects of the proposed scheme is to result in enhanced current flows near the bed of the estuary, which is predicted to result in a 10% increase in the supply of fine material from Tees Bay into the estuary.

6.4.2 Effect of completed scheme on tidal range

The proposed scheme is predicted to have a very small effect on water levels. Tidal range is predicted to increase by less than 4mm and the tide is predicted to arrive up to two minutes earlier.

6.4.3 Effect of completed scheme on wave activity

Wind waves that are generated within the estuary are predicted to be affected by the reflective properties of the proposed scheme but would be unaffected by the increase in channel depth.

Swell waves generated offshore do not penetrate far into the estuary and therefore are not predicted to be affected by the proposed terminal development. Swell waves however are predicted to be impacted by the increase in depth of the proposed channel.

Changes to swell waves during predominant wind conditions (i.e. south westerly at 20m/s) show a small increase in wave height of less than 10cm due to the proposed scheme. With stronger south westerly winds, wave height increases of 10cm are predicted. This pattern is not predicted to be altered by the presence of proposed dredged trenches at the edges of the channel.

In more extreme events, the modelling predicts that waves approaching from a northerly direction with a swell height of 6m (return period of 1 in 1 year) will be reflected on the side of the dredged channel and reach the area around the ConocoPhillips Oil Terminal. This is predicted to increase the significant wave height on the western side of the ConocoPhillips Dock by up to 30cm. The reflection within the channel also leads to a decrease in wave height for swell waves North Gare Sands and Bran Sands.

Much of the predicted changes in wave height at the mouth of the river however, arise from the backlog of maintenance dredging that exists at this location. A sensitivity test was therefore performed to illustrate the difference in impact from the current consented depth to the proposed depth. The results showed that about half of the increase in wave height in the channel and reduction of wave heights over North Gare Sands and Bran Sands was due to the re-establishment of the channel edges and the declared depth. The implications are therefore, that the predicted increases in wave heights are greater because the baseline case included in the model was shallower that the existing declared depth. The effect therefore of the proposed scheme on wave heights is in reality half of that described above.

6.4.4 Potential effects on intertidal areas due to a change in tidal prism

Changes to the cross-sectional area of an estuary due to capital dredging and reclamation can influence tidal propagation. As a consequence, the level of high and low water can be affected, which can change the extent of intertidal exposed at low water. The studies undertaken to inform this EIA have concluded that for the zone of the estuary that supports the most significant intertidal habitat (i.e. downstream of the proposed NGCT), the effect on tidal propagation would be insignificant. No impact on these areas due to a change in tidal propagation is therefore predicted.

The North Tees mudflat (located upstream of the proposed NGCT) is the only area of importance that has the potential to be impacted by the predicted increase in tidal range (4mm for spring tides). The predicted changes, however, will not affect the intertidal area at high water as the water level will change against the river walls. For low water, it is concluded that the predicted increase of 2mm on spring tides has the potential to convert up to 40m^2 of intertidal to very shallow subtidal. However, it should be noted that this area would not be lost, rather, the frequency at which it would be submerged will change. This change in low water level would result in a notional shift of the low water line 10cm towards the river edge, and a narrow strip of presently drying intertidal area remaining wet. The water depth in this area would be up to 2mm.

6.4.5 Potential effects on intertidal areas due to change in sedimentary regime

The main potential for effect on intertidal areas is predicted at Seal Sands. During the dredging, about 3% of the material dredged in the outer channel is predicted to deposit on Seal Sands. This is a minor effect and the maximum accumulation is predicted to be approximately 1mm.

The 10% increase in import of fine material from Tees Bay is predicted to result in an increased supply of fine material to Seal Sands. At present, it is estimated that Seal Sands experiences accretion of approximately 3.5mm/year. The proposed scheme is predicted to increase this rate of accretion by approximately 0.3mm/year.

The intertidal areas at the mouth of the estuary (Bran Sands and North Gare Sands) are outside any predicted changes in tidal hydrodynamics. Swell wave conditions are predicted to be unchanged or decrease. No change to the tidal range or phasing is predicted.

Since no change in sandy infill is predicted for the channel, it is expected that the overall volume of intertidal will be unchanged. However, the changes to the pattern of extreme wave conditions may result in local redistribution of bed material and either an increase in net accumulation or reduction in net erosion.

7 MARINE SEDIMENT AND WATER QUALITY

7.1 Introduction

This section of the EIA Report considers the following potential environmental impacts:

- Reductions in water quality associated with the dispersion and redistribution of sediments during capital dredging, reclamation and piling.
- Reductions in water quality and effects on sediment quality at receptor sites due to maintenance dredging.
- Reductions in water quality due to changes to the hydrodynamic regime.
- Effects on water quality due to changes to the dispersion characteristics of outfalls.
- Effects on water quality due to surface water runoff and domestic wastewater from the proposed terminal.

7.2 Policy and consultation

7.2.1 Policy

National Policy Statement for Ports

The assessment of potential impacts on marine sediment and water quality has been made with reference to the policy guidance for this topic area contained within the NPS for Ports. Table 7.1 summarises the requirements of the NPS which are of relevance to this section of the EIA Report.

Table 7.1 Summary of NPS requirements with regard to marine sediment and water quality

NPS for Ports requirement	NPS reference	EIA Report reference
Infrastructure development can have adverse effects on the water environment, including groundwater, inland surface water, transitional waters and coastal waters. During the construction, operation and decommissioning phases, it can lead to increased demand for water, involve discharges to water and cause adverse ecological effects resulting from physical modifications to the water environment.	Section 5.6, Paragraph 5.6.1	Section 7.5 and 7.6, and WFD compliance assessment (Section 28)
There may be increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats and could, in particular, result in surface waters, groundwaters or protected areas failing to meet environmental objectives established under the Water Framework Directive.	Section 5.6, Paragraph 5.6.2	Section 7.5 and 7.6, and WFD compliance assessment (Section 28)
Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of, the proposed project on water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent.	Section 5.6, Paragraph 5.6.3	Section 7.5 and 7.6, and WFD compliance assessment (Section 28)

7.2.2 Consultation

Summary of comments received during the HRO scoping phase

Table 7.2 provides a summary of the comments received from the MMO within its Scoping Opinion on the HRO process (specifically comments which the MMO considered should be addressed within a marine licence application). Table 7.2 also includes a reference to the relevant section of this EIA Report where the comment has been addressed.

Sediment sampling and analysis consultation

Targeted consultation was undertaken with the MMO to confirm the sediment sampling and laboratory analysis requirements. This was undertaken through the submission of a sediment sampling plan request through the MMO's Marine Case Management System (MCMS) (Appendix 7). The MMO provided its sampling and laboratory analysis requirements in July 2019 (SAM/2018/00069) (Appendix 8).

Table 7.2 Summary of comments in the MMO's Scoping Opinion with regard to marine sediment and water quality

Scoping comment	Response / section of the EIA Report where comment has been addressed
Disposal at sea will be subject to a marine licence and new samples and analysis of the dredged material may be required to assess the suitability for disposal at sea.	Section 7.1.2 and Section 7.3.
Sampling for a disposal licence should be designed through consultation with the MMO (and Cefas) via the pre-application licencing process.	Section 7.1.2
Cefas provided advice regarding the level of environmental assessment required with regard to sediment quality within the SEIR. Cefas stated that: "the HRO does empower the holders to dredge, which has the potential to disturb and re-distribute contaminated sediment. This should be considered in the SEIR (as an update to the ES supplement Sections 3.1 to 3.1.4)	An update to the assessment presented in the SEIR has been provided following an additional sediment quality survey.

Summary of comments received during consultation with the Environment Agency and Natural England

A meeting was held with the Environment Agency and Natural England in November 2018. The Environment Agency stated that should sediment be found to be contaminated, alternatives to offshore disposal would be required. A summary of the sediment quality data is presented in Section 7.3, and alternative uses to the disposal of material offshore are discussed in Section 4.7.

7.3 Methodology

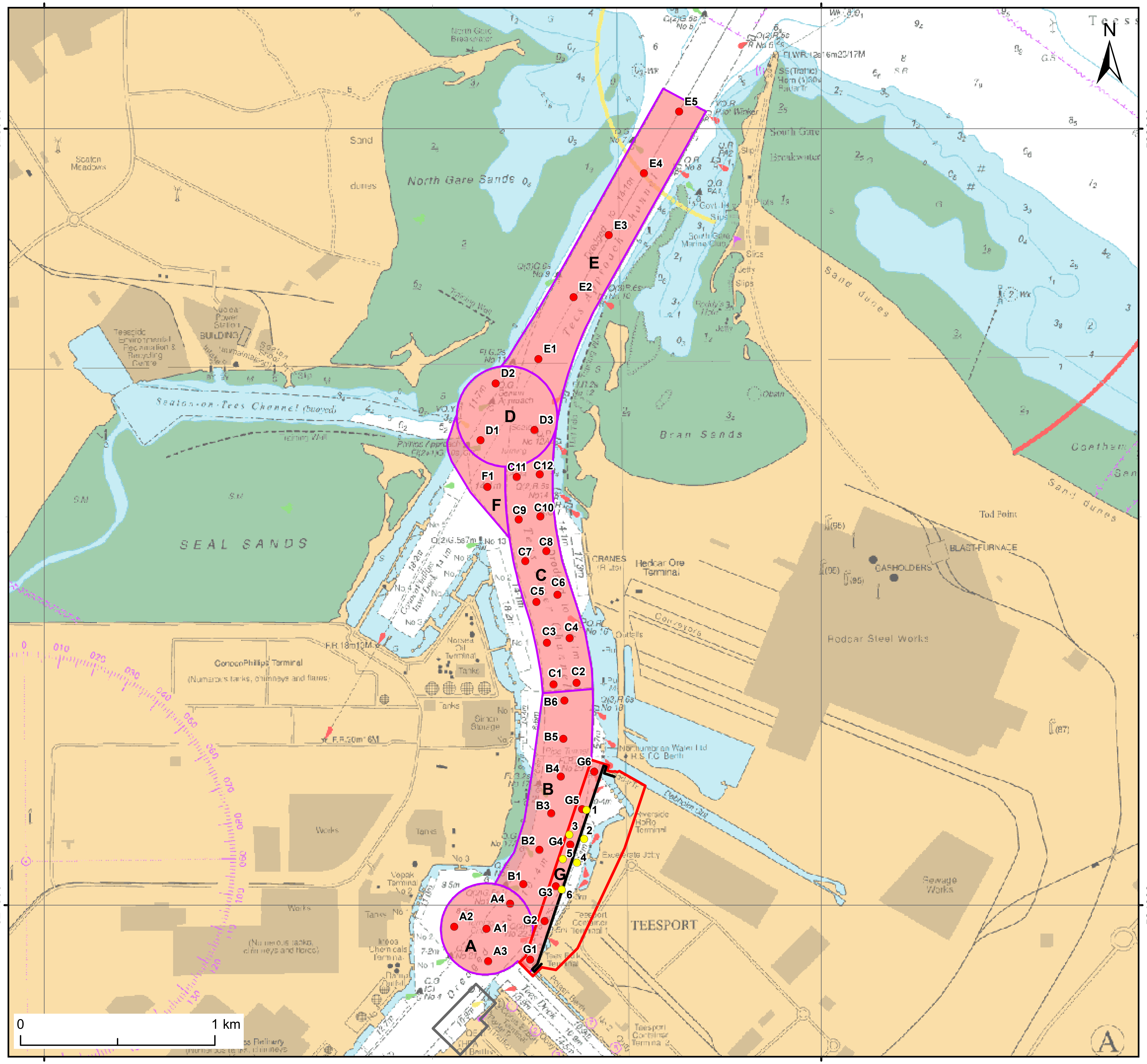
7.3.1 Study area

For marine sediment and water quality, the study area comprises the likely maximum extent over which potentially significant environmental impacts of the proposed scheme may occur. This was informed by hydrodynamic and sediment dispersion modelling and is based on the maximum extent over which effects are predicted to occur (e.g. sediment plumes generated during capital dredging and effects on tidal currents during operation).

7.3.2 Methodology used to describe the existing environment

The description of the existing environment with regard to sediment quality has been informed through a combination of desk-based review and a targeted sediment quality sampling survey. As noted above, the scope of the survey was agreed with the MMO.

The site-specific survey was undertaken in July and August 2019 and comprised the recovery of 37 surface samples within and adjacent to the proposed dredge envelope (see Figure 7.1). The MMO confirmed that sampling at depth was not required due to ground conditions evidenced through borehole logs, recovered by PDT and submitted in support of the sampling plan request to the MMO.



Legend

- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Limit of deviation for Works No. 2 (no longer proposed as part of NGCT scheme)
- Proposed quay face
- 2019 sediment sampling locations for NGCT
- 2018 sediment sampling locations for Tees Gasport
- Proposed dredge footprint
- Dredge sectors

Client:	Project:
PD Teesport	Northern Gateway Container Terminal

Title: Sediment sampling locations

Figure: 7.1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	07/11/2019	TC	SR	A3	1:20,000

Co-ordinate system: British National Grid

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The MMO confirmed that the sampling results could be used to inform both the marine licence application for the proposed scheme, as well as the mid-licence sampling condition on PDT's existing maintenance dredge disposal licence (L/2015/00427/1). As the maintenance dredge footprint extends beyond the NGCT dredge footprint, the results from the 37 samples were supplemented with the findings of 10 surface samples collected in December 2018 within the Tees upstream of the NGCT dredge footprint (as well as six surface samples recovered from Tees GasPort in October 2018), to provide sufficient evidence of sediment quality across the full maintenance dredge footprint in the Tees.

The samples were analysed by SOCOTEC for the following parameters:

- Metals (arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc).
- Organotins.
- Total hydrocarbon content (THC).
- Polycyclic aromatic hydrocarbons (PAH).
- Polychlorinated biphenyls (PCBs).
- Organochlorines (OCs).
- Particle Size Analysis (PSA).

Cefas carried out the analysis for Polybrominated diphenyl ethers (PDBEs).

The understanding of the existing environment with regard to water quality has been informed through desk-based review. The assessment of potential water quality impacts has been informed using information from the 2006 ES, the 2007 Supplement, the Environment Agency's Catchment Data Explorer and the Northumbria River Basin Management Plan (RBMP) (Environment Agency, 2015). Although water quality information from the Catchment Data Explorer and the RBMP is routinely used to inform the WFD compliance assessment (Section 28), the data that was used to classify the chemical quality element of the water bodies within and adjacent to the proposed scheme footprint is of relevance to this section of the EIA Report.

7.3.3 Methodology for assessment of potential impacts

The methodology used to assess the significance of the potential environmental impacts on marine sediment and water quality is as described in Section 5.

The assessment of potential impacts associated with disturbance of sediment during the construction phase has been undertaken in accordance with recognised guidelines and Action Levels, namely:

- Cefas Guideline Action Levels for the disposal of dredged material (Cefas, 2000); and,
- Canadian Sediment Quality Guidelines (CSQG) for the Protection of Aquatic Life (Canadian Council of Ministers of the Environment (CCME), 2002).

The Action Levels are used as part of a 'weight of evidence' approach to assessing the suitability of dredged material for disposal at sea but are not themselves statutory standards. Selected Action Levels are set out in Table 7.3.

Cefas guidance indicates that, in general, concentrations of contaminants within sediment which are below Action Level 1 are not considered to be of concern and are, therefore, likely to be approved for disposal at sea. Material with concentrations of contaminants above Action Level 2 is generally considered to be unsuitable for disposal at sea. Dredged material with contaminant concentrations between Action Level 1 and 2 requires further consideration before a decision can be made. Comparison of results from sediment quality analysis with Cefas Action Levels therefore provides a good indication regarding the risk of the material to the environment.

The CSQG involved the derivation of interim marine sediment quality guidelines (ISQGs), or Threshold Effect Levels (TEL) and Probable Effect Levels (PEL). Selected Canadian guidelines are presented in Table 7.4 and comprise two assessment levels. The lower level is referred to as the TEL and represents the concentration below which adverse biological effects are expected to occur only rarely (in some sensitive species for example). The higher level, the PEL, defines a concentration above which adverse effects may be expected in a wider range of organisms.

These levels were derived from an extensive database containing direct measurements of toxicity of contaminated sediments to a range of aquatic organisms exposed in laboratory tests and under field conditions (CCME, 2002). As a result, these guidelines provide an indication of likely toxicity of sediments to aquatic organisms. However, these guidelines should be used with caution as they were designed specifically for Canada and are based on the protection of pristine environments. In the absence of suitable alternatives, however, it has become commonplace for these guidelines to be used by regulatory and statutory bodies in the UK, and elsewhere, as part of a 'weight of evidence' approach.

Table 7.3 Selected Cefas Action Levels

Contaminant	Action Level 1 (mg/kg)	Action Level 2 (mg/kg)
Arsenic	20	100
Cadmium	0.4	5
Chromium	40	400
Copper	40	400
Nickel	20	200
Mercury	0.3	3
Lead	50	500
Zinc	130	800
Organotins (TBT, DBT)	0.1	1
PCBs (sum of ICES 7)	0.01	None
PCBs (sum of 25 congeners)	0.02	0.2
PAHs	0.1	None
DDT	0.001	None
Dieldrin	0.005	None

Table 7.4 Selected CSQG values (taken from CCME, 2002)

Contaminant	Units	TEL	PEL
Arsenic	mg/kg	7.24	41.6
Cadmium	mg/kg	0.7	4.2
Chromium	mg/kg	52.3	160
Copper	mg/kg	18.7	108
Mercury	mg/kg	0.13	0.7
Lead	mg/kg	30.2	112

Contaminant	Units	TEL	PEL
Zinc	mg/kg	124	247
Acenaphthene	µg/kg	6.71	88.9
Acenaphthylene	µg/kg	5.87	128
Anthracene	µg/kg	46.9	245
Benz(a)anthracene	µg/kg	74.8	693
Benzo(a)pyrene	µg/kg	88.8	763
Chrysene	µg/kg	108	846
Dibenz(a,h)anthracene	µg/kg	6.22	135
Fluoranthene	µg/kg	113	1,494
Fluorene	µg/kg	21.2	144
Napthalene	µg/kg	34.6	391
Phenanthrene	µg/kg	86.7	544
Pyrene	µg/kg	153	1,398

The potential impacts associated with the proposed offshore disposal of dredged material are considered in Section 26.

7.4 Existing environment

The results of the sediment quality surveys outlined in the previous section, and information pertaining to the water quality within the location of the proposed scheme, are detailed below.

7.4.1 Sediment quality

Results of the 2019 site specific sediment quality survey

A sediment quality survey was undertaken in July 2019 in accordance with the requirements set out in the MMO's sample plan (SAM/2018/00069). A summary of the data is provided in Table 7.5.

Table 7.5 Summary of sediment quality data from the site-specific sediment quality survey

Contaminant	Min conc. (mg/kg) (dry weight)	Max conc. (mg/kg) (dry weight	Action Level 1 exceedance (number of samples)	Action Level 2 exceedance (number of samples)	TEL exceedance (number of samples)	PEL exceedance (number of samples)
Arsenic	6.9	33.3	Yes (29)	No (0)	Yes (35)	No (0)
Cadmium	0.04	0.59	Yes (3)	No (0)	No (0)	No (0)
Chromium	5.4	52.2	Yes (11)	No (0)	No (0)	No (0)
Copper	7.8	74.3	Yes (11)	No (0)	Yes (31)	No (0)
Mercury	0.05	0.6	Yes (21)	No (0)	Yes (32)	No (0)
Nickel	5.2	35.6	Yes (26)	No (0)	No (0)	No (0)
Lead	13.2	135	Yes (29)	No (0)	Yes (33)	Yes (6)
Zinc	35.2	254	Yes (22)	No (0)	Yes (25)	Yes (2)

Contaminant	Min conc. (mg/kg) (dry weight)	Max conc. (mg/kg) (dry weight	Action Level 1 exceedance (number of samples)	Action Level 2 exceedance (number of samples)	TEL exceedance (number of samples)	PEL exceedance (number of samples)
DBT	<0.005	0.020	No (0)	No (0)	No (0)	No (0)
TBT	<0.005	0.014	No (0)	No (0)	No (0)	No (0)
Acenaphthene	0.04	0.88	No (0)	-	Yes (36)	Yes (33)
Acenaphthylene	0.02	3.78	Yes (1)	-	Yes (36)	Yes (19)
Anthracene	0.05	1.20	Yes (1)	-	Yes (36)	Yes (36)
Benzo(a)anthracene	0.07	1.15	Yes (1)	-	Yes (36)	Yes (5)
Benzo(a)pyrene	0.06	1.10	Yes (1)	-	Yes (34)	Yes (4)
Benzo(b)fluoranthene	0.04	0.96	No (0)	-	-	-
Benzo(e)pyrene	0.09	0.85	No (0)	-	-	-
Benzo(ghi)perylene	0.08	0.81	No (0)	-	-	-
Benzo(k)fluoranthene	0.02	0.52	No (0)	-	-	-
C1 Naphthalene	2.14	7.83	Yes (36)	-	-	-
C1 Phenanthrene	0.65	4.55	Yes (33)	-	-	-
C2 Naphthalene	1.42	5.46	Yes (36)	-	-	-
C3 Naphthalene	1.05	3.35	Yes (36)	-	-	-
Chrysene	0.10	1.05	Yes (2)	-	Yes (34)	Yes (3)
Dibenzo(ah)anthracene	0.01	0.16	No (0)	-	Yes (36)	Yes (5)
Fluoranthene	0.10	2.20	Yes (19)	-	Yes (35)	Yes (4)
Fluorene	0.10	3.00	Yes (1)	-	Yes (36)	Yes (33)
Indeno(1,2,3-c,d)pyrene	0.02	0.65	No (0)	-	-	-
Naphthalene	0.70	1.94	Yes (33)	-	Yes (36)	Yes (36)
Perylene	0.006	0.23	No (0)	-	-	-
Phenanthrene	0.54	5.83	Yes (33)	-	Yes (36)	Yes (36)
Pyrene	0.13	2.54	Yes (17)	-	Yes (34)	Yes (4)
PCB – sum of ICES7	0.004	0.006	Yes (1)	-	-	-
PCB – sum of ICES25	0.008	0.014	Yes (1)	No (0)	-	-
Alpha-hexachlorocyclohexane	<0.0001	0.00028	-	-	-	-
Beta-hexachlorocyclohexane	<0.0001	0.00014	-	-	-	-
Gamma-hexachlorocyclohexane	<0.0001	0.00134	-	-	-	-
Dieldrin	<0.0001	0.00059	No (0)	-	-	-
Hexachlorobenzene	0.00018	0.00868	-	-	-	-

Contaminant	Min conc. (mg/kg) (dry weight)	Max conc. (mg/kg) (dry weight	Action Level 1 exceedance (number of samples)	Action Level 2 exceedance (number of samples)	TEL exceedance (number of samples)	PEL exceedance (number of samples)
1,1,-dichloro-2,2-bis(p-chlorophenyl) ethane (PPTDE)	0.00012	0.00204	-	-	-	-
1,1,-dichloro-2,2-bis(p-chlorophenyl) ethylene (PPDDE)	0.00020	0.00106	-	-	-	-
Dichlorodiphenyltrichloroethane (PPDDT)	<0.0001	0.00389	Yes (2)	-	-	-
BDE17	<0.00002	0.000926	-	-	-	-
BDE28	<0.00002	0.000701	-	-	-	-
BDE47	0.000104	0.00417	-	-	-	-
BDE66	<0.00002	0.000707	-	-	-	-
BDE85	<0.00002	0.000278	-	-	-	-
BDE99	0.0000988	0.00493	-	-	-	-
BDE100	0.0000202	0.000598	-	-	-	-
BDE138	<0.00002	<0.00002	-	-	-	-
BDE153	<0.00002	0.000968	-	-	-	-
BDE154	<0.00002	0.000466	-	-	-	-
BDE183	<0.00002	0.000841	-	-	-	-
BDE209	0.00381	0.407	-	-	-	-

Metals

Concentrations of metals in the vast majority of samples were elevated above Action Level 1 (30 of the 36 samples contained at least one metal above Action Level 1). The exceedances above Action Level 1 were marginal only. There were no exceedances of Action Level 2.

With regard to the CSQG values, the vast majority of samples contained arsenic, copper, mercury, lead and zinc in concentrations above the TEL.

Organotins

Concentrations of organotins in all samples were below Action Level 1. In the vast majority of cases, concentrations were less than the laboratory detection limit. There is no TEL or PEL for organotins and therefore screening of the results against the CSQG was not possible.

Polyaromatic hydrocarbons

Concentrations of at least one PAH compound were present above Action Level 1 in samples recovered (and the TEL and PEL where available). There is no Action Level 2 for PAH compounds.

The concentrations ranged from marginal exceedances above Action Level 1 with regard to the majority of PAH compounds, however, concentrations of napthalenes were present in one location (at area G) up to seven times greater than Action Level 1 (however were generally two or three times the Action Level 1 value). Concentrations of C1 Naphthalene, C2 Naphthalene and C3 Naphthalene were present above Action Level 1 in all 36 samples, whilst C1 Phenanthrene, Naphthalene and Phenanthrene were elevated above Action Level 1 in 33 samples. Concentrations of THC were also relatively high, peaking at 975mg/kg. Concentrations of PAH compounds within the Tees estuary have historically been elevated, and based on the results of the 2006 sampling effort, there does not appear to have been a significant change in the concentrations of these contaminants throughout the estuary over time.

Polychlorinated biphenyl
One of the 36 samples analysed contained PCBs (sum of ICES7 and sum of 25 congeners) in concentrations marginally greater than Action Level 1. This sample was recovered from Area G1 (see Figure 7.1). There were no exceedances of Action Level 2. There is no TEL or PEL for PCBs and therefore screening of the results against the CSQG was not possible.

Organochlorines
The concentration of organochlorines present was generally less than the laboratory detection limit of 0.0001mg/kg. Dieldrin was not located in any sample above Action Level 1, whilst DDT was marginally elevated in two of the 36 samples analysed. There is no Action Level 2 for OCPs or CSQG values.

Polybrominated diphenyl ethers
As detailed above, the concentrations of PDBEs ranged from <0.02µg/kg to 4.93µg/kg (excluding BDE209). The concentrations of BDE209 ranged from 3.81µg/kg to 407µg/kg.

Cefas has previously advised (within SAM/2018/00069) that the distribution and concentrations of PBDE congeners in the marine environment are highly variable, and whilst named as a Chemical for Priority Action, there are no formal OSPAR assessment values developed with which to assess status. The significance of the concentrations reported above has therefore been informed by a review of concentrations present within historic samples within the Tees, as well as information provided by Cefas and the MMO within SAM/2018/00069.

Within SAM/2018/00069, Cefas stated that BDE congener 209 is generally expected to be found in much higher concentrations in the marine environment (compared with the results of the other BDE congeners); the data presented above confirms this expectation. This trend was also evident within the findings of the sediment samples recovered in 2006, with BDE209 concentrations ranging from <0.5µg/kg to 340µg/kg. The results of BDE209 are marginally higher than that found in 2006, however, are lower than the concentrations found within the upstream part of the Tees estuary during 2018 (which had a peak of 912µg/kg for BDE209). The upstream samples were recovered as part of the mid-licence sampling requirements on PDT's maintenance dredge disposal licence (reference L/2015/00427). The MMO did not apply any exclusion zones to the maintenance dredge disposal licence following review of the PDBE results. As the results from the NGCT footprint are lower than those found upstream, it is concluded that the concentrations of PBDEs are not a cause for concern.

Results from the 2018 Tees GasPort scheme
A sediment quality survey was undertaken in support of the marine licence application for the Tees GasPort scheme, which is located within the footprint of the proposed NGCT. The survey for the Tees GasPort project comprised recovery of six surface samples from the proposed dredge footprint for that scheme (as agreed in SAM/2018/00005 (see Figure 7.1)).

Samples were recovered in October 2018 and were analysed by the National Laboratory Service (NLS). Given the location of the proposed Tees GasPort scheme (within the footprint of the proposed NGCT), the MMO has confirmed that the results of this analysis can be used in support of the marine licence application for the proposed NGCT (in order to reduce the sampling requirements for the NGCT project). A summary of the data is provided in Table 7.6.

Table 7.6 Summary of sediment quality data from the Tees GasPort scheme

Contaminant	Min conc. (mg/kg) (dry weight)	Max conc. (mg/kg) (dry weight	Action Level 1 exceedance (number of samples)	Action Level 2 exceedance (number of samples)	TEL exceedance (number of samples)	PEL exceedance (number of samples)
Arsenic	23.5	27.9	Yes (6)	No	Yes (6)	No
Cadmium	0.234	0.366	No	No	No	No
Chromium	68.1	83.1	Yes (6)	No	Yes (6)	No
Copper	34.6	48.4	Yes (3)	No	Yes (6)	No
Mercury	0.302	0.524	Yes (6)	No	Yes (6)	No
Nickel	30.1	35.8	Yes (6)	No	-	-
Lead	90.6	113	Yes (6)	No	Yes (6)	Yes (1)
Zinc	147	190	Yes (6)	No	Yes (6)	No (0)
DBT	<0.009	0.0011	No	No	-	-
TBT	0.0114	0.0189	No	No	-	-
Acenaphthene	0.083367	0.383981	Yes (5)	No	Yes (6)	Yes (5)
Acenaphthylene	0.072106	0.08986	No	No	Yes (6)	No
Anthracene	0.094496	0.425018	Yes (5)	No	Yes (6)	Yes (3)
Benzo(a)anthracene	0.176986	1.025433	Yes (6)	No	Yes (6)	Yes (3)
Benzo(a)pyrene	0.130976	0.852781	Yes (6)	No	Yes (6)	Yes (1)
Benzo(b)fluoranthene	0.156179	0.975849	Yes (6)	No	-	-
Benzo(e)pyrene	0.141463	0.833184	Yes (6)	No	-	-
Benzo(ghi)perylene	0.10508	0.829704	Yes (6)	No	-	-
Benzo(k)fluoranthene	0.066859	0.433551	Yes (4)	No	-	-
C1 Naphthalene	0.926859	5.071459	Yes (6)	No	-	-
C1 Phenanthrene	0.700803	3.599416	Yes (6)	No	-	-
C2 Naphthalene	0.880869	4.854572	Yes (6)	No	-	-
C3 Naphthalene	0.662793	3.522597	Yes (6)	No	-	-
Chrysene	0.15134	0.880049	Yes (6)	No	Yes (6)	Yes (1)
Dibenzo(ah)anthracene	0.124132	0.160211	Yes (3)	No	Yes (6)	Yes (2)
Fluoranthene	0.427686	2.053173	Yes (6)	No	Yes (6)	Yes (2)
Fluorene	0.12137	0.564042	Yes (6)	No	Yes (6)	Yes (5)
Indeno(1,2,3-c,d)pyrene	0.078357	0.59554	Yes (5)	No	-	-
Naphthalene	0.3528	1.891173	Yes (6)	No	Yes (6)	Yes (5)
Perylene	0.03248	0.213124	Yes (3)	No	-	-

Contaminant	Min conc. (mg/kg) (dry weight)	Max conc. (mg/kg) (dry weight	Action Level 1 exceedance (number of samples)	Action Level 2 exceedance (number of samples)	TEL exceedance (number of samples)	PEL exceedance (number of samples)
Phenanthrene	0.50817	2.62192	Yes (6)	No	Yes (6)	Yes (5)
Pyrene	0.391734	2.004324	Yes (6)	No	Yes (6)	Yes (3)
PCB - 018 : Dry Wt	0.000255	0.000373	No	No	-	-
PCB - 028 : Dry Wt	0.000532	0.000687	No	No	-	-
PCB - 031 : Dry Wt	0.000395	0.000498	No	No	-	-
PCB - 044 : Dry Wt	0.000262	0.000342	No	No	-	-
PCB - 047 : Dry Wt	0.000172	0.00024	No	No	-	-
PCB - 049 : Dry Wt	0.000205	0.000257	No	No	-	-
PCB - 052 : Dry Wt	0.000401	0.000514	No	No	-	-
PCB - 066 : Dry Wt	0.0003	0.000462	No	No	-	-
PCB - 101 : Dry Wt	0.000537	0.00072	No	No	-	-
PCB - 105 : Dry Wt	0.0002	0.000248	No	No	-	-
PCB - 110 : Dry Wt	0.000511	0.000734	No	No	-	-
PCB - 118 : Dry Wt	0.000594	0.000767	No	No	-	-
PCB - 128 : Dry Wt	0.000149	0.000178	No	No	-	-
PCB - 138 : Dry Wt	0.000432	0.000554	No	No	-	-
PCB - 141 : Dry Wt	0.000108	0.000108	No	No	-	-
PCB - 149 : Dry Wt	0.000398	0.0006	No	No	-	-
PCB - 151 : Dry Wt	0.000116	0.000189	No	No	-	-
PCB - 153 : Dry Wt	0.000625	0.000814	No	No	-	-
PCB - 156 : Dry Wt	0.000083	0.0001	No	No	-	-
PCB - 158 : Dry Wt	0.000082	0.000088	No	No	-	-
PCB - 170 : Dry Wt	0.000144	0.00024	No	No	-	-
PCB - 180 : Dry Wt	0.000388	0.000533	No	No	-	-
PCB - 183 : Dry Wt	0.000108	0.000157	No	No	-	-
PCB - 187 : Dry Wt	0.000275	0.000374	No	No	-	-
PCB - 194 : Dry Wt	0.00009	0.000114	No	No	-	-

As shown above, concentrations of contaminants were not present in excess of Action Level 2 at any location within the proposed Tees GasPort dredge footprint. Minor exceedances of Action Level 1 were present for most metals, at most sample locations. The vast majority of PAH compounds were also present in concentrations above Action Level 1. PCBs were present in concentrations below Action Level 1 at all locations.

Comparison of the sediment quality data with the CSQG has identified elevated concentrations of metals above the TEL threshold at most locations. However, no exceedances of the PEL were recorded for trace metals, with the exception of lead at one location only. There were exceedances of the PEL for a number of PAH compounds.

Summary of previous sediment quality surveys in the Tees

The findings of sediment quality surveys undertaken in support of previously consented schemes in the Tees estuary is provided in Appendix 9 and summarised below.

A sediment quality survey was undertaken in the Tees estuary during July 2014 to inform the EIA for the York Potash Harbour Facilities project. A total of six vibrocores were taken within the footprint of the berth pocket and port terminal for the York Potash Harbour Facilities, with two vibrocores taken from the adjacent approach channel (that will be deepened as part of the NGCT project and the results are therefore directly applicable to the NGCT scheme). The vibrocore logs reported that the strata within the approach channel (from positions VC1A and VC2A) comprised soft extremely low strength clay, underlain by gravelly sand at 1.5m depth (VC1A) and rock debris at 0.9m depth (VC2A). The samples from all strata from VC1A and VC2A did not contain any concentrations of contaminants above Action Level 2. Minor exceedances of Action Level 1 only were identified.

Royal HaskoningDHV carried out an EIA on behalf of PDT in 2012 for proposed strengthening of the existing No.1 Quay at Tees Dock, and also the widening and deepening of the existing berth and adjacent areas within Tees Dock. Though showing signs of minor contamination, it was determined that the 'soft' sediments within 'Tees Dock Water Area' (identified in marine licence 34396) were suitable for offshore disposal.

The 2006 sediment quality survey undertaken to inform the 2008 HRO application involved the recovery of 13 surface samples from within and adjacent to the proposed dredge footprint for the NGCT scheme. Overall, the chemical data from the NGCT study indicated some level of contamination within the samples, particularly heavy metals and PAH compounds. However, levels were not deemed high enough to prohibit the material from being disposed of to sea (no exceedances of Action Level 2 were present). Concentrations of individual PAH compounds were found in concentrations greater than three times Action Level 1.

Physical characteristics

The 2006 ES presented data regarding the physical characteristics of sediment within the footprint of the proposed dredge, as well as that at a number of 'receptor sites' where the dredged material could ultimately become deposited following re-suspension into the water column (see Figure 7.2). The results of the particle size analysis undertaken on samples recovered during 2006 and 2019 are presented in Table 7.7 to 7.9.

The data from 2006 shows that sediments in the receptor sites in the intertidal areas close to the estuary mouth (TS02, TS03, TS05) predominantly comprise of sandy material (>75%) with low amounts of silt (<20%). Receptor sites located in existing channels (TS04 and TS11), however, comprise of more silty sediments (>60%) with varying amounts of clay and gravel. The percentage of organic matter varies between 0.4% and 6.4%.

Although additional sampling has not been undertaken at the receptor sites considered above post 2006, there is no reason to suggest that the nature of the sediments in the various locations has materially changed.

Royal HaskoningDHV

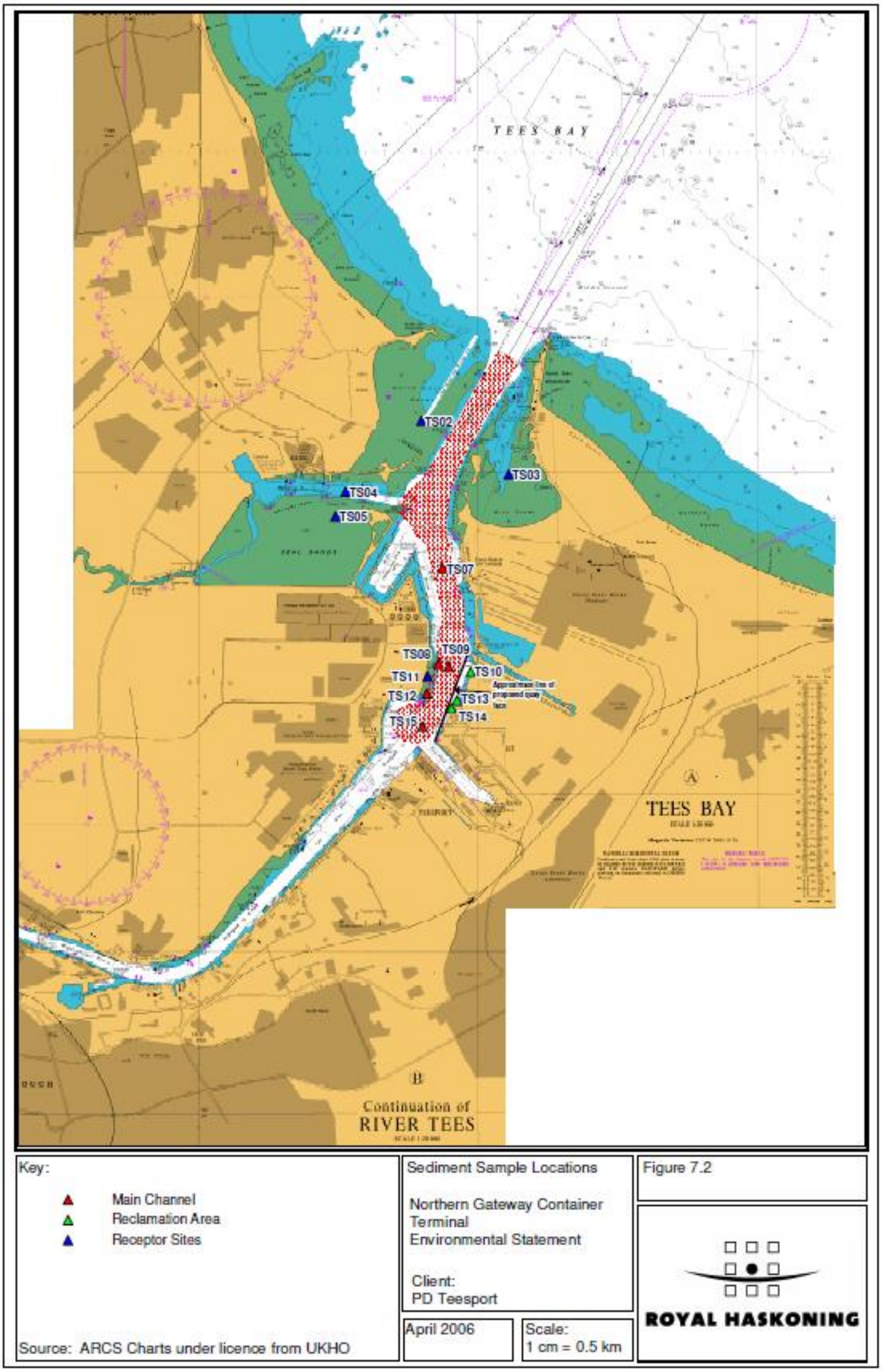

Figure 7.2 Particle size analysis sampling stations during 2006 (source: Royal Haskoning, 2006)

Table 7.7 Data from particle size analysis of sediments from the five receptors sites surveyed during 2006

Material type (% of each)	Sample site				
	TS02	TS03	TS04	TS05	TS11
Clay	2	8	16	5	3
Silt	0	0	62	18	82
Sand	80	92	22	77	15
Gravel	18	0	0	0	0
Cobbles	0	0	0	0	0
Boulders	0	0	0	0	0
Organic carbon	0.4	0.8	6.4	5.9	0.7

Table 7.8 Data from particle size analysis of sediments from within the main channel and the reclamation area in 2006

Sample site	Material type (% of each)						
	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Organic carbon
TS07	16.00	50.00	34.00	0.00	0.00	0.00	4.40
TS08	10.00	22.00	67.00	1.00	0.00	0.00	5.00
TS09	32.00	48.00	20.00	0.00	0.00	0.00	8.70
TS10	22.00	63.00	15.00	0.00	0.00	0.00	1.20
TS12	3.00	0.00	97.00	0.00	0.00	0.00	4.00
TS13	28.00	61.00	11.00	0.00	0.00	0.00	4.00
TS14	29.00	65.00	6.00	0.00	0.00	0.00	7.80
TS15	28.00	63.00	8.00	1.00	0.00	0.00	8.60

Table 7.9 Data from particle size analysis of samples recovered from the Tees offshore disposal sites as well as from within the Tees estuary during 2019 during the benthic ecological survey (see Figure 7.1)

Sample site	Material type (% of each)					
	Mud	Silt	Sand	Gravel	Cobbles	Boulders
Tees Bay A 1	14.09	0.00	85.23	0.68	0.00	0.00
Tees Bay A 2	14.57	0.00	81.97	3.47	0.00	0.00
Tees Bay A 3	21.85	0.00	78.15	0.00	0.00	0.00
Tees Bay A 4	2.46	0.00	95.41	2.13	0.00	0.00
Tees Bay A 5	13.44	0.00	86.56	0.00	0.00	0.00
Tees Bay A 6	4.85	0.00	95.15	0.00	0.00	0.00
Tees Bay A 7	48.68	0.00	51.32	0.00	0.00	0.00
Tees Bay A 8	3.29	0.00	96.71	0.00	0.00	0.00
Tees Bay C 1	23.32	0.00	59.88	16.80	0.00	0.00
Tees Bay C 2	24.63	0.00	33.97	41.40	0.00	0.00

Sample site	Material type (% of each)					
	Mud	Silt	Sand	Gravel	Cobbles	Boulders
Tees Bay C 3	30.25	0.00	69.75	0.00	0.00	0.00
Tees Bay C 4	20.99	0.00	50.88	28.13	0.00	0.00
Tees Bay C 5	16.87	0.00	47.42	35.71	0.00	0.00
Tees Bay C 6	Insufficient material to undertake PSA analysis					
Tees Bay C 7	25.28	0.00	28.87	45.85	0.00	0.00
Tees Bay C 8	18.03	0.00	34.68	47.29	0.00	0.00
Tees 1	42.36	0.00	57.64	0.00	0.00	0.00
Tees 2	30.17	0.00	69.83	0.00	0.00	0.00
Tees 3	56.77	0.00	43.23	0.00	0.00	0.00
Tees 4	2.86	0.00	94.65	2.49	0.00	0.00
Tees 5	4.17	0.00	95.83	0.00	0.00	0.00
Tees 6	42.66	0.00	57.34	0.00	0.00	0.00
Tees 7	31.23	0.00	68.77	0.00	0.00	0.00
Tees 8	47.32	0.00	52.68	0.00	0.00	0.00
Tees 9	74.07	0.00	25.93	0.00	0.00	0.00
Tees 10	76.50	0.00	23.50	0.00	0.00	0.00
Tees 11	85.96	0.00	14.04	0.00	0.00	0.00
Tees 12	90.62	0.00	9.38	0.00	0.00	0.00
Tees 13	91.38	0.00	8.62	0.00	0.00	0.00
Tees 14	84.45	0.00	15.55	0.00	0.00	0.00
Tees 15	63.24	0.00	36.76	0.00	0.00	0.00
Tees 16	17.53	0.00	80.50	1.97	0.00	0.00
Tees 17	89.98	0.00	10.02	0.00	0.00	0.00
Tees 18	91.09	0.00	8.91	0.00	0.00	0.00
Tees 19	19.48	0.00	80.52	0.00	0.00	0.00
Tees 20	87.19	0.00	12.81	0.00	0.00	0.00
Tees 21	94.36	0.00	5.64	0.00	0.00	0.00
Tees 22	92.47	0.00	7.53	0.00	0.00	0.00
Tees 23	93.97	0.00	6.03	0.00	0.00	0.00
Tees 24	91.16	0.00	8.84	0.00	0.00	0.00
Tees 25	89.76	0.00	10.24	0.00	0.00	0.00
QEII 1	92.70	0.00	7.30	0.00	0.00	0.00
QEII 2	92.46	0.00	7.54	0.00	0.00	0.00
QEII 3	91.65	0.00	8.35	0.00	0.00	0.00
Core (intertidal)	0.30	0.00	24.65	75.04	0.00	0.00

7.4.2 Water quality

Water Framework Directive baseline information
The proposed scheme is located within the Tees transitional water body (ID GB510302509900). The Tees transitional water body is heavily modified and has an overall potential of 'Moderate'. The chemical quality element of the water body has been assessed as 'Fail' in 2016, due to the presence of priority hazardous substances, notably tributyltin compounds.

Bathing Waters
The Environment Agency takes water samples at each of England's designated bathing waters during the bathing season, which is between May and September each year. The samples are analysed for bacteria that indicate the presence of faecal matter in the water. A classification for each bathing water is calculated annually based on samples from the previous four years. The classifications are:

- Excellent – the cleanest seas;
- Good – generally good water quality;
- Sufficient – the water meets minimum standards; and,
- Poor – the water has not met the minimum standards

The proposed scheme footprint is not located within a designated bathing water. However, there are bathing waters located to both the north and south of the proposed scheme footprint, the closest of which are:

- Seaton Carew North Gare - Carew North Gare Beach is the southern end of an extensive sandy beach close to the mouth of the Tees. The water quality has been classified as Excellent.
- Seaton Carew Centre - this designated bathing water is at the southern end of an extensive sandy beach fronting the town of Seaton Carew, approximately 1.5km north of the mouth of the Tees estuary. This bathing water has a classification of Excellent.
- Seaton Carew North – this designated bathing water is at the northern end of an extensive sandy beach fronting the town of Seaton Carew, approximately 2.5km north of the estuary mouth. This bathing water has a classification of Good.

7.4.3 Future evolution of the baseline in the absence of the proposed scheme

In the absence of the proposed scheme, there is no reason to believe that sediment and water quality within the Tees estuary is likely to materially change from the present-day conditions. PDT will continue to undertake maintenance dredging of the river to maintain the advertised dredge depths, with mid-licence sediment sampling being undertaken from the surface in accordance with the conditions on the maintenance dredge disposal licence (to ensure that the maintenance dredged material remains suitable for offshore disposal).

7.5 Potential impacts during the construction phase

7.5.1 Remobilisation, dispersion and redistribution of sediment during capital dredging

Remobilisation and dispersion of sediment during capital dredging
As described within Section 3, the construction phase of the proposed scheme involves capital dredging of the Tees estuary. The construction of the terminal would require the installation of piles through the seabed as well as the re-use of dredged material within the reclamation process.

The above activities within the marine environment have the potential to cause disturbance and re-suspension of sediments and release them into the water column as a plume. This would increase the TSS concentrations within the estuarine waters, thus increasing the turbidity of the water column. Additionally, increases in SSC could give rise to high oxygen demands, thus reducing the levels of dissolved oxygen within the water.

The analysis of sediment quality samples recovered from within the proposed dredge footprint has shown that concentrations of metals are marginally elevated above Action Level 1 only (no Action Level 2 exceedances are present). However, in all cases, the Action Level 1 exceedances for metals are very marginal. No exceedances of the Action Levels have been recorded for organotins.

In terms of the PAHs, there are elevated concentrations above Action Level 1 in all samples recovered. However, as noted above, the concentrations present are not significantly different to those recovered during 2006, and sampling efforts undertaken elsewhere in the Tees more recently have illustrated concentrations of PAHs at similar levels. This indicates that elevated concentrations of PAHs are widespread throughout the Tees estuary and have been for a number of years. In addition, PAHs have a low water solubility and hydrophobic nature, therefore they tend to be associated with inorganic and organic material within sediments and therefore remain bound. As a result, most PAHs will be strongly sorbed by particulate matter and biota in the aquatic environment (CCME 1992). It is therefore highly likely that a large percentage will remain bound to the material.

Very locally elevated concentrations of PCBs and OCPs were present above Action Level 1; no exceedances of Action Level 2 were present for PCBs (no Action Level 2 exists for OCPs). As the concentrations of PDBEs are lower than those found in upstream sediments (which Cefas has confirmed is suitable for offshore disposal), it is considered that the concentrations of PDBE are not of concern.

Based on the above, the consideration of potential impacts to water quality presented below is solely related to the potential resuspension of sediments from a turbidity perspective only (on the basis that the sediment is considered to be 'non-contaminated').

In general, suspended solids concentrations are low within the Tees estuary and Tees Bay. Background suspended solid levels in the vicinity of the proposed scheme are, for the most part, less than 20mg/l with short term peaks from 40mg/l to 80mg/l (HR Wallingford, 2005). The highest observed values are predicted to occur during spring tides with potentially greater suspended solid concentrations occurring during high rainfall or storm events (HR Wallingford, 2005).

The effect of capital dredging on SSC has been predicted for dredging using a CSD in the channel in the vicinity of the reclamation and in the Tees Dock turning circle and using a TSHD in the lower channel (the latter scenario incorporated the simulation of run-off from the reclamation site). The predicted impacts on water quality are presented below.

Cutter suction dredger

When the CSD is located in the Tees Dock turning circle, peak SSC of up to 500mg/l above background are predicted in the immediate vicinity of the dredger; however, effects on SSC are very localised to the area of the turning circle (see Figure 6.3). When the dredger is located in the area of the proposed quay wall, peak SSC are predicted to occur within the immediate vicinity of the dredger, but the sediment plume spreads further afield (along the tidal axis) compared to dredging in the Tees Dock turning circle. Suspended sediment concentrations 500m from the dredger are not, however, predicted to exceed levels experienced naturally in the estuary. Peak concentrations are also predicted to remain on the same side of the channel as the barge receiving the dredged material.

Trailing suction hopper dredger
Results for the use of a TSHD dredging sand in the lower channel and during reclamation show that peak increases in SSC of between 500mg/l and 1000mg/l above background are predicted along the dredger track. Increases of a similar magnitude are predicted due to run-off from the reclamation. Concentrations of up to 50mg/l are predicted over parts of Seal Sands and up to 25mg/l in the Seaton Channel (Figure 6.4).

Figure 6.6 illustrates the predicted peak increases and time histories of SSC arising during the dredging in the lower channel and the effect of run-off from the reclamation. Figure 6.6 demonstrates that peak concentrations of up to 50mg/l above background can occur over Seal Sands and in Seaton Channel. Such effects will occur over localised areas of Seal Sands and would occur under spring tide conditions. All other locations demonstrate lower peak increases in SSC (i.e. less than 20mg/l above background).

For both types of dredger (CSD and TSHD), peak SSC (i.e. up to 500mg/l above background) are predicted in the immediate vicinity of the dredger. This material is predicted to be quickly dispersed either in the water column or by settlement on the seabed. For example, for the CSD, SSC reduce to less than 50mg/l above background within approximately 100m either side of the dredger when the dredger is located in the vicinity of the proposed reclamation.

HR Wallingford identifies depth averaged mean concentrations of less than 20mg/l during calm periods at low tide and between 40mg/l and 80mg/l during short term peaks. Information provided in Tansley (2003) also indicates occasional peaks of up to 90mg/l at the Gares and over 100mg/l at Redcar Jetty.

It can, therefore, be concluded that the predicted suspended solids concentrations generated by dredging will lead to peak increases in concentration above those normally experienced in the estuary. However, the variation is considered to be acceptable given the temporary nature of the works and the intermittent nature of the peaks related to both tidal influence and location of the dredger.

Given the above, the potential impact to water quality associated with the increase in suspended solids in the water column is considered to be of **minor adverse** significance.

Redistribution of sediments
Changes to sediment quality could occur when sediment is released into the water column by dredging, dispersed by tidal currents and subsequently settling onto the seabed. The deposited material may therefore change the physical composition of the seabed sediments at locations in which it is predicted to settle.

In summary, sediment quality sampling has confirmed that sediments at the ‘receptor’ sites (shown on Figure 7.2) predominantly comprise of either silty/clay or sandy silt. Silt predominates in the more sheltered areas (i.e. in the main channel, away from the estuary mouth). Sampling indicates that Seal Sands comprises approximately 20% of fine sediments, the remainder being sand (Royal Haskoning, 2006). Other historic data shows, however, that sediment composition over Seal Sands is variable (University of Durham, undated) and, therefore, some areas of Seal Sands are likely to be composed of predominantly finer material (i.e. silts) and some predominantly sand.

Coarser sediments predominate in the more exposed areas such as close to the estuary mouth at North Gare Sands and Bran Sands. At these two potential receptor sites there is also a small percentage of silt present in the sediments (Royal Haskoning, 2006).

The dispersion and deposition of sediment caused by the capital dredging is described in Section 6.3. Two types of dredger were considered in the plume dispersion studies, namely a CSD dredging mudstone (which would generate fine material when dredged) in the channel in the vicinity of the reclamation, and a TSHD dredging sand in the lower channel and in the Seaton Channel turning circle area. For the TSHD simulation the runoff from the dredger pumping ashore at the reclamation site was also included in the simulations.

The plume dispersion studies predict that, during the dredging of sand in the lower channel using a TSHD, some deposition is predicted at Seal Sands, in the immediate vicinity of the dredger and elsewhere in the subtidal areas. At Seal Sands, deposition of a fraction of a millimetre of fine material per tide is predicted (up to 0.05mm for three tides) with total deposition of approximately 1mm for the duration of dredging in the lower channel. Fine material would only reach Seal Sands when dredging on spring tides.

Dredging using a CSD further upstream (e.g. in the vicinity of the reclamation) would not result in the deposition of fine material in intertidal areas. For the CSD, deposition of fine material would be focussed in the immediate vicinity of the dredger, with deposition of less than 5mm elsewhere in the subtidal area.

The deposition that is predicted in the immediate vicinity of the dredger is not considered to represent a significant effect since these locations form part of the capital dredging area (and would, therefore, already be significantly disturbed) and depositing sediment would be re-dredged.

For the intertidal areas, the magnitude of sediment deposition over the course of the dredging operations is predicted to be a maximum of 1mm. The rate of deposition and the overall magnitude of deposition is considered to be low.

When assessing the significance of the potential impact on intertidal areas, it is important to consider the processes affecting deposition and the behaviour of the material following deposition. Figure 7.3 demonstrates the nature of the deposition on Seal Sands. As the tide rises, suspended material is carried in the water column over the intertidal area and a proportion of this material settles out at slack water (in this instance, it is predicted that less than 0.05mm per tide will settle). Some of this material will subsequently be resuspended and redistributed by tidal currents on the following tide given that it will not be consolidated material. Over time, therefore, a proportion of the material settling on Seal Sands would be expected to disperse.

Notwithstanding the above, the capital dredging is likely to result in an overall slight increase in the proportion of fine material on Seal Sands as some of the material that settles will be reworked into the substratum (i.e. the sediment would be expected to become muddier). The presence of an extensive Enteromorpha mat on Seal Sands during the summer months would be expected to encourage the accumulation of fine sediment through physical trapping of fine sediment and would exacerbate the tendency of the substratum to become finer. The net effect of the dredging, however, is not to introduce an entirely different type of sediment into a receptor area.

Given the above, the physical impact of sediment deposited as a result of capital dredging on receptor areas is considered to be low and the potential impact is deemed to be of **negligible** significance.

Mitigation measures and residual impact

There are a number of controls that would be implemented to ensure that TSS is minimised during dredging. The main mitigation measure to limit sediment plume is selection of the dredging method. As noted above, dredging is proposed to be undertaken using a combination of a TSHD and CSD. Controls which would be implemented as presented below.

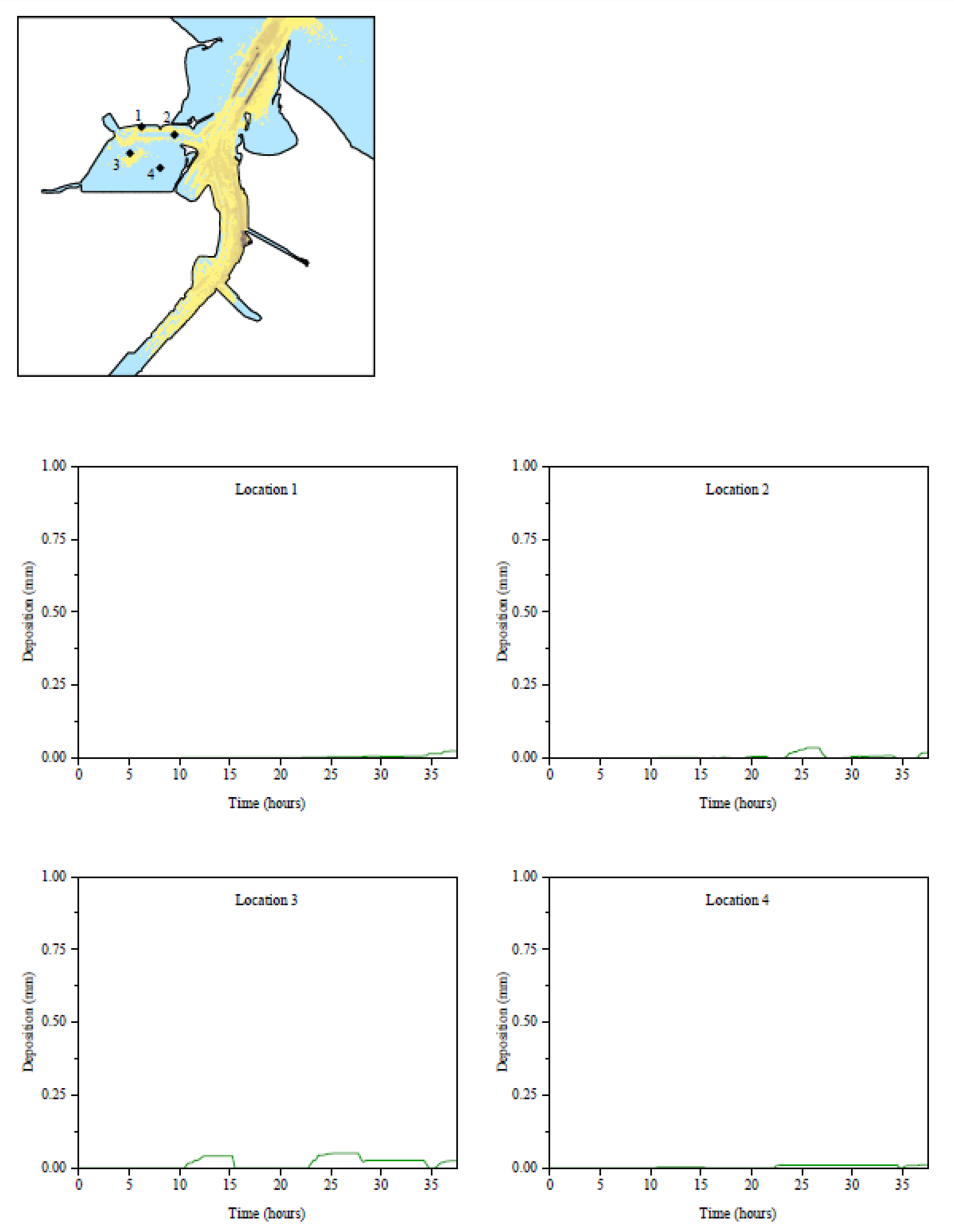

Figure 7.3 Time histories of deposition in Seaton Channel (locations 1 and 2) and Seal Sands (location 3 and 4) for TSHD dredging sand in Tees approach channel, spring tide, low flow conditions

Limiting re-suspension of sediment during TSHD can be achieved through the following good practice measures:

- Trailing velocity, position of the suction mouth and the discharge of the pump can be optimised with respect to each other.
- Any reduction in the intake of water by the suction head means a denser pay load, thus reducing or avoiding the need for overflowing. This can be achieved by directing the flow lines of the suction stream to the actual point of excavation, thus making better use of the erosive capacities of the flow of water into the suction head.

The re-suspension of sediment caused by CSD can be reduced through optimising the cutter speed, swing velocity and suction discharge, shielding the cutter head or suction head and optimising the design of the cutter head.

The residual impact is predicted to be of **negligible** significance.

7.5.2 Remobilisation, dispersion and redistribution of potentially biologically contaminated sediment during capital dredging

The majority of samples analysed during 2006 recorded values of less than the detection limits for both total coliforms and faecal enterococci. No further analysis was undertaken during 2019 (as this was not requested by the MMO within its sampling plan response). Based on the results from 2006, contamination of the sediments by bacteria is considered to be low. A review of readily available internet resources suggests there have been no significant pollution incidents in the Tees estuary which could have resulted in a material change to the concentrations of total coliforms and faecal enterococci in sediment recorded since 2006.

Additionally, the bathing waters are located outside of the estuary mouth so any bacterial contamination resulting from the dredging is likely to be significantly diluted before it reaches the designated monitoring points. There is also the potential for bacterial die-off to occur over the time period between sediment being transported and permanently deposited. **No impact** in terms of biological impact on the designated bathing waters is therefore predicted.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact**.

7.5.3 Effect of mobilising sediments on oxygen concentrations in the water column

The resuspension of sediment as a consequence of the proposed capital dredging could potentially affect dissolved oxygen levels in the water. This is due to the introduction of organic matter and nutrients into the water column which are broken down by microbial activity (i.e. respiration) resulting in a short-term demand on dissolved oxygen concentrations.

Of relevance to this potential impact is findings of water quality modelling undertaken in the River Tyne to predict the consequences of dredging on dissolved oxygen concentrations. In summary, under a variety of modelled conditions in the Tyne, such as dredging times, seasonal fluctuations and river flows, the modelling predicted only small differences between background and dredging impacted dissolved oxygen concentrations. No difference was noted between the summer and winter concentrations. Furthermore, the dredging on the Tyne is considered to represent a more conservative scenario, as dredging in the Tees will be undertaken in the lower reaches of the estuary where there is much greater opportunity for mixing.

Based on the above, in addition to the relatively unrestricted tidal flows in the estuary and the temporary nature of the peaks in suspended solids predicted by the hydrodynamic modelling, the potential impact on the water column is predicted to be of **minor adverse** significance.

Mitigation measures and residual impact
No mitigation measures are required. There would be a residual impact of **minor adverse** significance.

7.6 Potential impacts during the operational phase

7.6.1 Potential change in sediment quality

During the operational phase, there would be no change to the exiting situation in terms of inputs of pollutants to the environment. There would, however, be a positive impact in that the area of the Tees estuary to be reclaimed contains the most elevated levels of contaminants and this area will be effectively removed from the system due to the reclamation.

It is predicted, therefore, that there will be an overall impact of **minor beneficial** significance.

Mitigation measures and residual impact
No mitigation measures are required. There would be a residual impact of **minor beneficial** significance.

7.6.2 Potential impacts on water quality due to maintenance dredging

During the operational phase, maintenance dredging within the berth pocket and approach channel would be required to maintain the dredged depth. Such maintenance dredging would likely lead to an increase in TSS concentrations within the water column.

At present, there is an existing requirement for maintenance dredging of the approach channel and various berth pockets within the Tees estuary. The existing maintenance dredging regime is implemented and managed by PDT and the locations, volumes and frequency of dredging are well recorded.

As a result of the proposed scheme, it is envisaged that the newly deepened sections of berth pocket and channel would be incorporated into the existing maintenance dredging strategy. The material from the maintenance dredging would be disposed of at the existing disposal sites in Tees Bay (as currently occurs).

The implications of the proposed scheme on the maintenance dredging strategy have been established through numerical modelling studies. As noted above, it is concluded that there would be no change to the current maintenance dredging strategy during the operation of the proposed scheme. As such, it is concluded that there would be an impact of **negligible** significance on water quality given that the overall volume of material requiring dredging would not be significantly increased, its composition will be very similar to that dredged at present and no increase in the frequency of dredging will be required.

Mitigation measures and residual impact
No mitigation measures are required and the residual impact would be of **negligible** significance.

7.6.3 Potential effects on the sediment quality of the receptor sites due to maintenance dredging

As noted above, the implications of the proposed scheme on the maintenance dredging strategy have been established as part of the numerical modelling studies, and it is concluded that the effect of the scheme on the maintenance dredging will be insignificant, with no requirement to change the current strategy.

As such, it is concluded that there would be **no impact** on sediment quality as a consequence of maintenance dredging that is required due to the proposed scheme, given that the overall volume of material requiring dredging would not be significantly increased, its composition will be very similar to that dredged at present and no increase in the frequency of dredging will be required.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact**.

7.6.4 Potential changes in water quality due to erosion and remobilisation of potentially contaminated sediment caused by changes in hydrodynamics

As discussed in Section 6, the proposed scheme has the potential to result in effects on the hydraulic and sedimentary regime of the estuary system. For example, changes to tidal current speeds and directions and wave climate are predicted. Such changes could have associated water quality implications should they affect sedimentary areas that have elevated levels of contamination and result in mobilisation of such contaminants into the water column.

With regard to tides, changes to tidal current are predicted to be of low magnitude. Areas where small increases in current speed are predicted are not expected to experience erosion of sediments and, therefore, the potential for the scheme to result in mobilisation of potentially contaminated areas is considered to be very low.

The predicted effect of the scheme on waves generated within the estuary is predicted to be small, with changes to significant wave height being smaller than 10cm. The reflection of waves from the proposed terminal would increase the significant wave height over the lower parts of the intertidal area of North Gare Sands, but this additional effect would not be detectable in terms of effect on the substratum, particularly given that the effect of the proposed dredging on swell waves from offshore is a reduction in significant wave height. As a consequence, such changes are considered to be insignificant in terms of their potential to result in a trend of increased mobilisation of sediment.

The significant wave height for swell waves with an estimated return period of one year is predicted to increase by up to 30cm in ConocoPhillips Dock adjacent to the ConocoPhillips Oil Terminal. The potential for additional effects on the sediments of the seabed at this location in terms of mobilisation of sediment, is considered to be low as this area is subtidal. In addition, the area currently experiences significant wave heights of up to 2m.

Overall, the potential for the proposed scheme to result in changes to the mobilisation of sediment from intertidal areas is considered to be low and as such **no impact** is predicted on the likelihood of mobilisation of potentially contaminated sediments.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact**.

7.6.5 Potential effects on water quality due to changes to the dispersion characteristics of outfalls

Changes to flow characteristics around outfalls and other discharges to the Tees estuary could affect water quality due to effects on the dispersion of such outfalls. In view of the footprint of predicted changes to tidal current speeds and directions (see Section 6) the most notable discharge to be considered in the assessment is Dabholm Gut.

Given the above, the dispersion of discharges from Dabholm Gut has been specifically modelled. The aim of the modelling was to examine whether the proposed scheme would result in a change to the dispersion characteristics of the discharge and therefore whether there was a potential for the proposed scheme to result in the deterioration of water quality within the Tees estuary.

The modelling studies conclude that under existing conditions, the dispersion of material from Dabholm Gut is greater during spring tides compared with neap tides. Under existing conditions, the increase in deposits occurs in the eastern part of the river between Tees Dock and some 1,500m north of Dabholm Gut (see Figure 7.5). The maximum footprint of deposits over the tidal cycle (occurring at slack water) affects a wider area than this but some of this material is resuspended by higher current speeds either side of slack water.

Generally speaking, the distribution of deposited particles from Dabholm Gut as a consequence of the proposed scheme is predicted to be similar to the existing situation and, therefore, the maximum footprint of deposition is largely unchanged as a consequence of the proposed scheme (See Figure 7.6). The main difference is an enhancement in deposition near the eastern shore to the north of Dabholm Gut. Deposition is also enhanced in the Tees Dock turning circle.

Comparison of Figures 7.4 and 7.5 demonstrates the predicted effect of the proposed scheme on the existing pattern of deposition of material from Dabholm Gut during spring tide summer conditions. The pattern for spring tides in the winter is similar, although there is a tendency for less accumulation to the north of Dabholm Gut and more accumulation in the Tees Dock turning circle compared with the summer conditions.

Overall, it is concluded that the proposed scheme has a minor influence on the pattern of deposition of material exiting Dabholm Gut. Similar areas of seabed are predicted to be affected, with a predicted redistribution of deposited material within these areas. Consequently, although the dispersion of the discharge from Dabholm Gut is predicted to be affected, the impact in terms of effect on water quality is predicted to be of **negligible** significance.

Mitigation measures and residual impact
No mitigation measures are required. The residual impact would be of **negligible** significance.

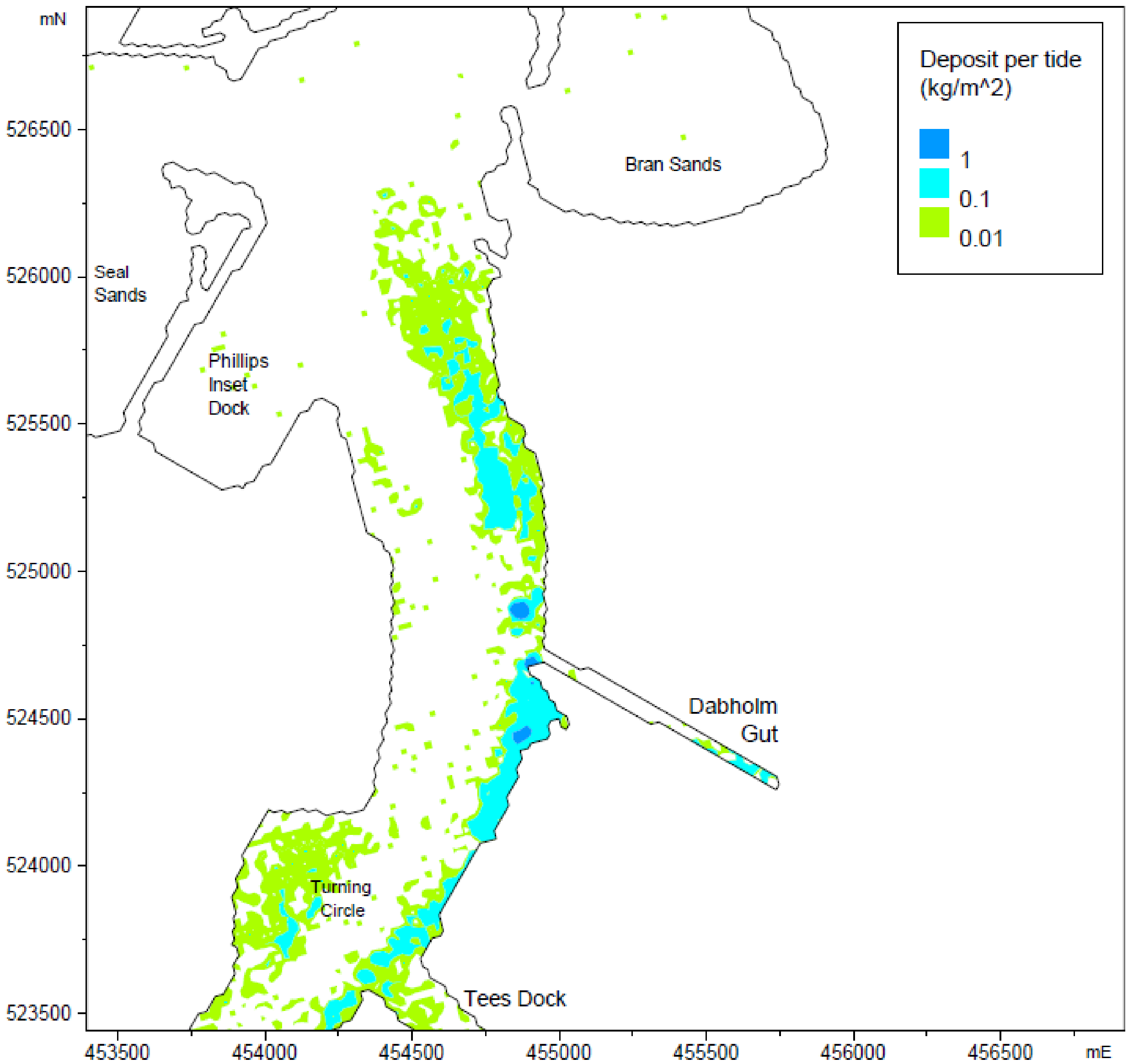

Figure 7.4 Predicted increase in deposits over a tidal cycle (existing layout, spring tide, summer conditions)

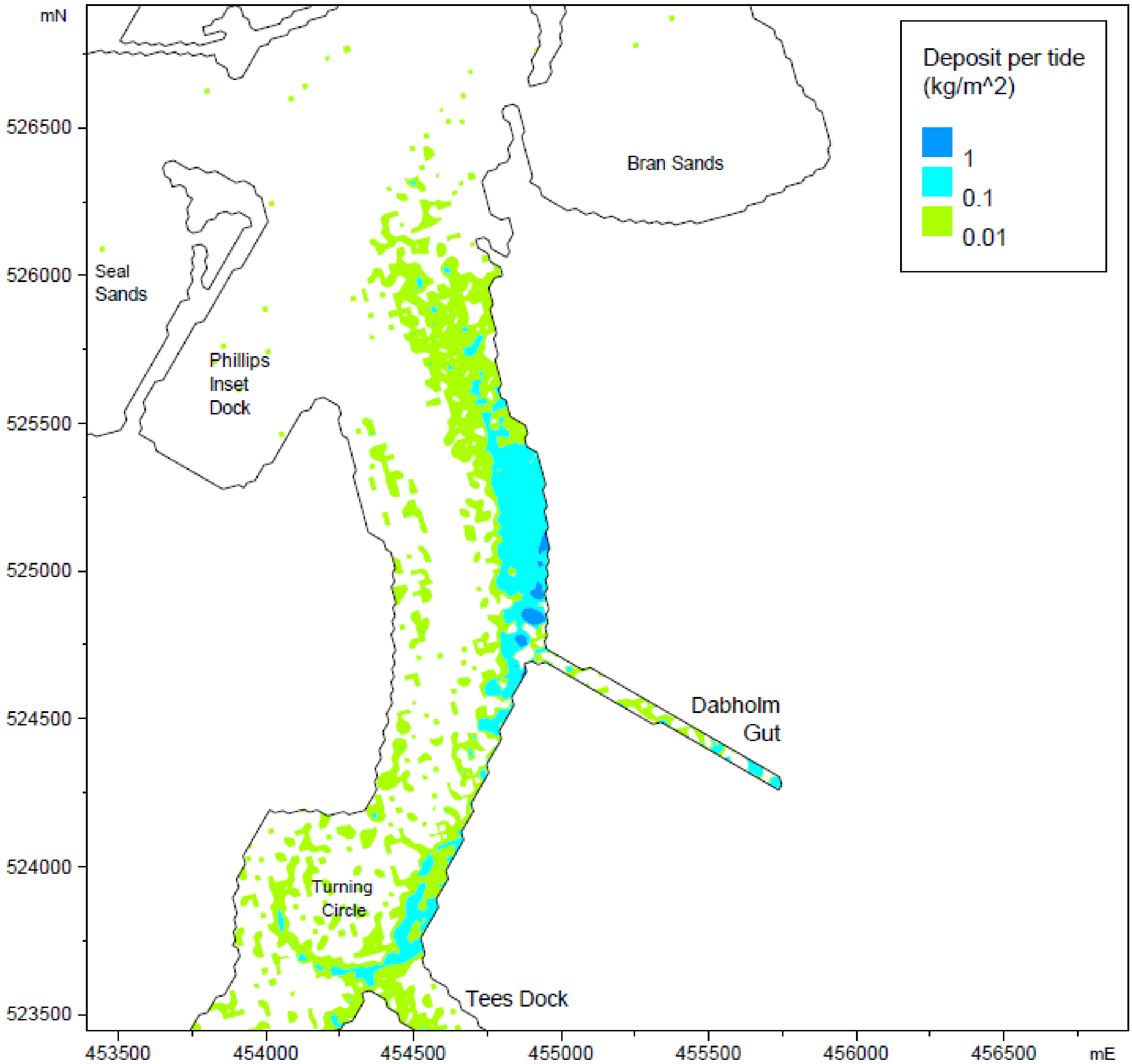

Figure 7.5 Predicted increase in deposits over a tidal cycle (proposed layout, spring tide, summer conditions)

7.6.6 Potential effect of surface water run-off and domestic wastewater from the proposed scheme

Surface water run-off from the proposed scheme has the potential to be exposed to oils in the paved terminal area and, therefore, could cause pollution when discharged to the estuary. To minimise this risk, the design incorporates a series of drainage arrangements. The surface water system (i.e. the system collecting rainfall run off) will consist of a number of channel drains running parallel to the quay. Outfalls will collect this water and discharge it to the estuary via oil interceptors located behind the quay wall. Foul water (i.e. sanitary waste) will be collected via a separate system and gravitated to a new pumping station which will lift flows to the mains sewer. Additionally, any areas with a high risk of producing washings containing silt and contaminating substances will be connected to the foul system for transfer to the mains sewerage. These areas include the RTG service areas and workshops, mechanical fuelling facilities and chassis washing areas.

Given the above, it is concluded that there would be **no impact** on water quality due to surface water runoff and domestic wastewater.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact**.

8 SOIL QUALITY AND GEOLOGY

As noted in Section 1, the landside elements of the scheme have commenced (under the planning permission granted by RCBC in 2007). PDT is not seeking new permissions or changes to the development that is already authorised and has commenced under the existing planning permission.

The 2006 planning permission granted by RCBC contained a number of conditions specific to soil quality and geology, which had to be discharged prior to the commencement of the works authorised by the planning permission. Details of the planning conditions which PDT has complied with, together with an update on current status, are provided in Table 8.1.

As noted in Table 8.1, the conditions imposed by RCBC with regard to soil quality and geology have been adequately discharged prior to the landside elements of the scheme being implemented. As agreed with RCBC during production of the 2015 Site Investigation and Monitoring Report (Royal HaskoningDHV, 2015), the future development of the wider NGCT (beyond the commencement works) will be subject to additional site investigation, and therefore there are controls in place to manage any risks associated with soil quality and geology.

Based on the above, no further assessment works are considered necessary and the findings of the 2006 ES remain valid.

Table 8.1 Planning conditions imposed on the NGCT by RCBC

Planning condition	Reason	Status
Condition 5: Pre-development: a) A desk top study is required of previous site uses, i.e. contaminants, including a model of geology / hydrogeology of the site. b) subsequently, SI designed & submitted to the LPA for approval before SIs commence, to include risk assessment of ground/ surface waters on & off site plus refinement of the model and method statement produced for remediation; c) SI/risk assessments to be undertaken as approved by the LPA; d) Method Statement detailing remediation, incl. measures to minimise impact on ground/surface waters approved by LPA before remediation carried out on site.	To protect controlled waters and ensure that the remediated site is reclaimed to an appropriate standard.	Condition 5a (desk top study) has been satisfied by the Phase 1 desk study undertaken as part of the 2006 ES. Condition 5b was satisfied following the submission of the Design and Site Investigation and Monitoring Programme (Royal HaskoningDHV, 2015). Condition 5c was satisfied following completion of a site investigation report (Royal HaskoningDHV, 2015) produced specifically for a section of pavement 50m long by 20m wide (referred to as the NGCT commencement works). The site investigation report concluded that the only contaminant of concern that may represent a risk to human health during construction is asbestos. Risks to construction workers were deemed manageable through the use of appropriate personal protective equipment. On completion, the commencement works were deemed to represent an adequate barrier to negate risks to end users. Based on the findings of the intrusive investigation and a qualitative assessment of the resulting data it was considered that the principle risk to controlled waters was from the migration of aqueous phase contamination into the River Tees. It was concluded that the loading of contamination reaching the river which originates within the footprint of the commencement works footprint will be significantly reduced on completion of the proposed works in comparison with the current situation due to the creation of a paved surface. It was concluded that, in the context of the proposed continued risk assessment and potential remediation (if required) of the wider NGCT site, the proposed commencement works pose a low risk and no further remedial measures are necessary. As agreed with RCBC, the site investigation, remediation requirements and mitigation measures described in the site investigation report relate only to the commencement works. The future development of the wider NGCT site will require additional site investigation, and the approach to site investigation and remediation described in the site investigation report should be understood in that context. As no significant contamination was identified during the 2015 site investigation, Conditions 6, 7, 8 and 9 did not need to be discharged prior to implementing the commencement works.
Condition 6: If significant contamination is found during construction, no further development is to take place until a method statement for remediation is submitted and agreed by the LPA.	To ensure that the development complies with the approved details in the interests of protection of controlled waters.	
Condition 7: Upon completion of remediation detailed above, verification report to be submitted to LPA, together with details of post remediation sampling & monitoring and details of future monitoring proposals/reporting.	To protect Controlled Waters by ensuring that the remediated site has been reclaimed to an appropriate standard.	
Condition 8: Development to be carried out in accordance with the approved Method Statement above.	To ensure that the development complies with approved details in the interests of protection of Controlled Waters.	
Condition 9: Piling of foundations to be agreed with LPA.	The site is contaminated/potentially contaminated and piling could lead to the contamination of ground water in the underlying aquifer.	

9 MARINE ECOLOGY

9.1 Introduction

This section of the EIA Report considers the following potential environmental impacts:

- Removal of habitat due to quay construction and capital dredging (and proposed offsetting measures).
- Impacts on marine ecology from increases suspended sediment during capital dredging and smothering following dredging.
- Underwater noise disturbance to marine mammals and marine invertebrates.
- Impacts on marine communities due to changes in flow regime.
- Impacts associated with decreased exposure of intertidal areas at North Tees mudflat.
- Impacts on the benthic community structure associated with increased supply of sediments to Seal Sands.
- Impacts on marine communities due to changes in the maintenance dredge regime.
- Impacts to marine mammals due to increased vessel movements.

9.2 Policy and consultation

9.2.1 Policy

National Policy Statement for Ports

The assessment of potential impacts to marine ecology has been made with reference to the policy guidance for this topic area contained within the NPS for Ports (Department for Transport, 2012). The particular assessment requirements relevant to marine ecology, as presented within the NPS for Ports, are summarised in Table 9.1.

Table 9.1 Summary of NPS for Ports requirements with specific regard to marine ecology and cross reference to section of this EIA Report where the requirement has been addressed

NPS requirement	NPS reference	EIA Report reference
Where the development is subject to EIA, the application should ensure that the ES clearly sets out any effects on internationally, nationally and locally designated sites of ecological interests.	Section 5.1.4	Impacts to designated sites are addressed in Section 28.
The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity conservation interests.	Section 5.1.5.	Section 9.5 and 9.6.
The ES should include an assessment of the effects on the coast. In particular, the applicant should assess the effects of the proposed project on marine ecology, biodiversity and protected sites.	Section 5.3.5.	Section 9.5 and 9.6. Impacts to designated sites are addressed in Section 28.
The applicant should be particularly careful to identify any effects on the integrity and special features of Marine Conservation Zones (MCZ), Special Areas of Conservation (SAC) and candidate SACs, Special Protection Areas (SPA) and potential SPAs, Ramsar sites,	Section 5.3.7	Impacts to designated sites (including SPAs, Ramsar sites and SACs) are addressed in Section 28. The proposed scheme footprint is not located within or adjacent to an MCZ. The closest MCZ is located approximately 20km to the south at Runswick Bay; given the separation

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NPS requirement	NPS reference	EIA Report reference
actual and potential Sites of Community Importance and Sites of Special Scientific Interest (SSSI).		distance between the sites, it is considered that there is no pathway for effect and MCZs have not been considered further.

9.2.2 Consultation

Summary of comments received during the HRO extension scoping phase

Table 9.2 provides a summary of the comments received from the MMO within its Scoping Opinion from the HRO extension process, which the MMO considered were more applicable to a marine licence application (than the HRO extension process) (Appendix 5). Table 9.2 also signposts to the relevant section of this EIA Report where the comment has been addressed.

Table 9.2 Summary of comments in the MMO's Scoping Opinion with regard to marine ecology

Scoping comment	Response / section of the EIA Report where comment has been addressed
The development should not encroach either physically, or via its associated infrastructure (roads, drains etc.) into the intertidal environment. There should be no net loss of habitat. When encroachment is shown in plans for any new works, considerable justification for this, together with details of mitigation and compensation would need to be included.	The proposed scheme would result in the loss of intertidal as a result of the proposed reclamation. Appendix 10 presents the findings of a study which presents the application of the 'net gain' biodiversity metric for the proposed scheme. The findings from the net gain study have also been incorporated into this EIA Report.
The decision regarding whether further benthic ecology survey is needed should be based on the suitability of more recent data (e.g., that identified from 2014) to allow an appropriate comparison with those acquired during 2006. For example, if the spatial representation of new data is not sufficient or relevant then this would dictate that additional contemporary, fit-for-purpose data should be acquired through targeted survey work.	Consultation with Natural England has been undertaken to agree a scope of benthic ecological survey specific to the proposed scheme. Further detail regarding this can be found below.
The MMO support the adoption of a 'soft-start' approach to any marine piling which occurs during construction. The highly audible percussive piling, in particular, has the potential to disturb, displace, injure or kill fish and marine mammals within the area. The Joint Nature Conservation Committee have guidance for the 'soft-start' approach to marine piling. The MMO would support the use of Auger Piling, as the noise and vibration disturbance is much lower than caused by other piling methods, such as percussive piling.	The assessment of impact with regard to noise from piling has been undertaken on a worst-case basis assuming percussive piling. PDT has confirmed that the use of a soft start approach would be possible and therefore this technique has been considered as mitigation, where required.
A biosecurity plan is expected to ensure best practice is used throughout the development.	A biosecurity plan has not been produced as part of the supporting documentation to the marine licence application. It is considered that if such a plan is required, this would be produced post consent.

Consultation on the proposed scope of benthic ecological sampling and analysis

Targeted consultation has been undertaken with Natural England to confirm the benthic ecological sampling and laboratory analysis requirements. This was undertaken through the submission of a combined benthic ecology (and sediment quality) sampling specification to Natural England for review and comment under a Discretionary Advice Service (DAS) agreement (Appendix 7). Natural England provides its comments on the proposed scope of survey and analysis in November 2018 (Appendix 11). The comments received from Natural England were adopted within the benthic ecological survey effort undertaken to inform this EIA Report.

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Consultation meeting with the Environment Agency and Natural England

A meeting was held with the Environment Agency and Natural England in November 2018. A number of comments were received from both parties with regard to the potential impacts on marine ecology. These are summarised in Table 9.3.

Table 9.3 Summary of comments received from the Environment Agency and Natural England during the pre-application consultation meeting

Comment / summary of discussion	Response / section of the EIA Report where comment has been addressed
The Environment Agency's position on no net loss of habitat (and potential net gain) arising from the proposed scheme (assuming that the intertidal habitat has some ecological value) was discussed. The Environment Agency confirmed that the 'no net loss' principle was linked to intertidal habitat only, and the principle is not specifically linked to SPA habitat, but biodiversity in general. The Environment Agency advised that the nature of the intertidal habitat is confirmed and its ecological value determined to inform consideration of measures potentially required to ensure no net loss.	The nature of the intertidal habitat has been determined through a targeted ecological survey. The implications of the survey findings have been assessed in Section 9.5.
The Environment Agency confirmed that opportunities for net habitat gain should be investigated, potentially by working with the Tees Estuary Partnership (TEP) and the habitat banking approach. The Environment Agency advised that the TEP would likely assist with development in the Tees estuary, but the details are not yet sufficiently advanced. The no net loss of intertidal policy remains in place and would be implemented through the marine licence process (in this case).	The possibility of beneficially re-using dredged material has been considered further in Section 4.7. Appendix 10 presents the findings of a study which presents the application of the 'net gain' biodiversity metric for the proposed scheme. The findings from the net gain study have also been incorporated into this EIA Report.
Natural England stated that Defra net gain metrics have been received by Natural England in draft form. These have been shared with the Industry Nature Conservation Association (INCA) to ground truth the metrics and assess their suitability in the Tees.	Consultation with INCA has been undertaken to determine the suitability of the net gain metrics in the Tees. INCA confirmed that the net gain metrics discussed at the time by Natural England were only applicable to terrestrial and freshwater habitat, and therefore it was not considered suitable to adopt these for the for intertidal to be affected by the proposed scheme. However, since the meeting with Natural England, revised metrics have been published (in April 2019) which are applicable to intertidal habitat and therefore this metric has been applied.
The Environment Agency and Natural England stated that commuted sums had been considered acceptable by both organisations to contribute towards habitat enhancement initiatives. Both the Environment Agency and Natural England agreed that (should it be required for the NGCT scheme), compensation off-site in a strategic manner could be a better solution for the Tees estuary (than trying to undertake a stand-alone scheme). However, both reiterated that government policy remains as no net loss of intertidal. The Environment Agency stated that if the intertidal is found to have some value, it would be necessary to demonstrate how the impact on the intertidal would be mitigated in the marine licence application, taking account of the above points.	The ecological value of the intertidal has been determined through a targeted intertidal survey. Appendix 10 presents the findings of a study which presents the application of the 'net gain' biodiversity metric for the proposed scheme.

9.3 Methodology

9.3.1 Study area

For this section of the EIA Report, the study area comprises the likely maximum extent over which potentially significant environmental impacts of the proposed scheme may occur. This has been informed by the hydrodynamic and sedimentary plume modelling undertaken. This section excludes consideration of potential impacts to the ecology of the Tees Bay C offshore disposal site; such impacts arising from the proposed disposal of dredged material to Tees Bay C are considered in Section 26.

9.3.2 Methodology used to describe the existing environment

This section of the EIA Report has been informed through a combination of desk-based assessment and site-specific benthic ecological survey. The desk-based assessment has included a review of readily available internet resources, specifically broad scale habitat maps (which have been developed using modelling technology (UKSeaMap)) and habitat maps which have been informed by research (Marine Environmental Mapping Programme (MAREMAP)). A review of findings from previous benthic surveys within the Tees estuary has also been undertaken.

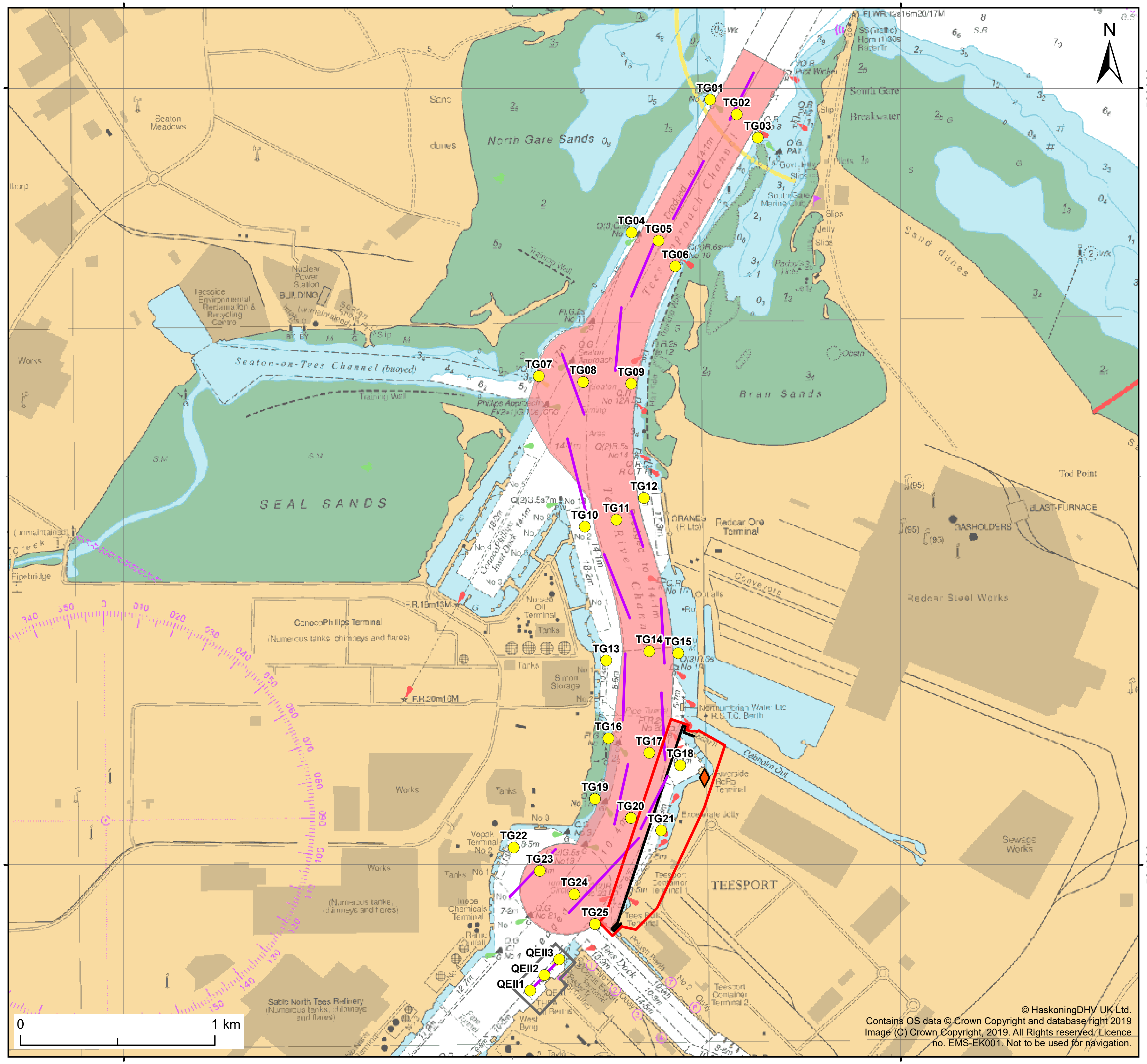
In order to describe the existing environment, a benthic ecological survey was undertaken within and adjacent to the footprint of the proposed scheme by Ocean Ecology in March 2019. The benthic survey consisted of the following elements:

- 44 subtidal 0.1m^2 Day grab samples recovered within and adjacent to the proposed capital dredge and construction area for the NGCT, and within the offshore disposal sites in Tees Bay. The sampling locations cover the area that would be directly affected by the marine works and the adjacent areas that potentially would be indirectly affected (e.g. through sediment deposition during capital dredging).
- Deployment of 16 scientific benthic trawls within the proposed dredge footprint using a 20mm mesh with a 5mm cod end, with the trawls evenly distributed across the dredge area. Fish, shrimp and other commercial invertebrates were counted and measured and all other epifauna were identified and recovered using a modified SACFOR scale based on trawl area, length and efficiency.

The location of the sampling positions in shown on Figure 9.1 and the benthic survey report is contained in Appendix 12.

Upon retrieval of the grab samples, the samples were released onto a 0.5mm mesh stainless steel sieve and examined for suitability and photographed to determine sample volume, visual characteristics of the sediment and presence of anoxia and epifauna. A sub-sample of the sediment was retained for PSA to enable any sediment community associations to be determined. The sub-sample for PSA analysis was recovered using a small core to remove sediment from the undisturbed surface of the sample. This PSA sub-sampling technique standardised the amount of sediment recovered from each core, standardised the sampled sediment depth profile between sampling stations, minimised bias of sampling of certain sediment types and reduced the volume of sediment required for PSA analysis.

The remainder of the sample was back-washed through the sieve and collected in a storage vessel, where it was preserved in formalin prior to further sieving and laboratory analysis. The laboratory analysis was undertaken by Ocean Ecology, who adopt the procedures set out in the UK National Marine Biological Analytical Quality Control (NMBAQC) scheme.



Legend

- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Limit of deviation for Works No. 2 (no longer proposed as part of NGCT scheme)
- Proposed quay face
- Benthic grab sample locations
- Intertidal core
- Benthic trawls
- Proposed dredge footprint

NOTE: Although survey has been undertaken, work No. 2 is no longer proposed by PDT as part of the proposed NGCT Scheme.

Client:	Project:
PD Teesport	Northern Gateway Container Terminal

Title: 2019 benthic grabs and trawls and intertidal core

Figure: 9.1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	21/10/2019	TC	SR	A3	1:20,000

Co-ordinate system: British National Grid

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At each of the trawl sites, the trawl was orientated into the most appropriate direction to enable it to be undertaken into the tide (which enables low survey speeds coupled with manoeuvrability). Tow duration was no more than five minutes with a speed not exceeding 2 knots. The vessel track was recorded along with start and end points of the trawl. The contents of each trawl were photographed and sorted and epibenthos identified. The total length of fish was measured to the nearest cm, rounded down. The sex of elasmobranchs and other adult fish was recorded where possible. Species were identified and enumerated on site. Any species which could not be identified on board the vessel were preserved on site and returned to the laboratories for subsequent analysis.

In addition to the survey work outlined above, a targeted intertidal biotope survey was undertaken at mean low water springs on 20th March 2019 by Ocean Ecology to determine the nature and ecological value of the intertidal. The survey was undertaken in line with guidance in the Marine Monitoring Handbook (Davies *et al*., 2001) and the CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn *et al.*, 2006), facilitated by the collection of high-resolution aerial imagery using an Unmanned Aerial Vehicle (UAV). Two separate drone flights were undertaken to map the area of intertidal at low tide, across two intertidal areas either side of TCT1. The first flight mapped the intertidal from the north-eastern corner of the TCT1 downstream to Dabholm Gut. The second flight mapped the intertidal from the south-western corner of TCT1 upstream to the entrance to Tees Dock. Following completion of the UAV flight, a walkover survey of the area was undertaken to collect ground-truthing information for subsequent biotope mapping based on the UAV imagery.

The intertidal walkover survey consisted of the following elements:

- Quadrat sampling, within areas representative of each key hard substrate habitat at different tidal heights. Quadrats were assessed by recording the epibiotal taxa present in randomly placed 0.25 m^2 (0.5 m x 0.5 m) quadrats. Identification was undertaken in field and taken to species level where possible.
- Core sampling where soft sediment was present using a 0.01 m^2 corer. Samples were collected to allow microbenthic and PSD analysis. Only one area was identified to be suitable for coring and therefore only one core was taken (see Figure 9.1).

During the walkover survey, biotopes were identified according to the EUNIS classification in line with relevant guidance (Parry, 2015) (and correlated to the MNCR biotopes), and where possible, boundaries of biotopes were tracked using a handheld Garmin E-Trex 10 GPS device.

The distribution of any features of conservation interest was recorded using photographs and GPS fixes where encountered. The presence of any invasive non-native species (INNS) (e.g. *Crepidula fornicata*) was also noted and their location recorded. Other information recorded included general site conditions, sediment surface features (e.g. Polydora sp. mats), sediment type and characteristics, topography and anthropogenic pressures.

9.3.3 Methodology for assessment of potential impacts

The methodology used to assess the potential environmental impacts associated with the proposed scheme is provided in Section 5.

Professional judgement has been used to determine potential environmental impacts which could arise during the construction and operational phases of the proposed scheme based on our existing knowledge of the sensitivity of the Tees estuary.

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The findings of the EIA with regard to the hydrodynamic and sedimentary regime, marine sediment quality, water quality and noise (specifically the underwater noise modelling exercise previously undertaken by Subacoustech for the adjacent and now consented Sirius Minerals Harbour facility) are of relevance to this section and reference to these topics is made in this section.

9.4 Existing environment

9.4.1 Existing habitats

Overview of proposed scheme footprint

The marine elements of the proposed scheme (i.e. the proposed dredge and construction of the quay) are located predominantly within the subtidal. The terminal itself is proposed to be constructed predominantly on land, but there would be an element of the terminal which would require reclamation of the subtidal and intertidal on the southern bank of the estuary. A review of the Priority Habitats Inventory (available on the MAGIC maps website) has determined that areas of mudflat are reported to be present within the proposed reclamation area for the terminal. No other priority habitats are reported to be present.

Description of habitat from online mapping resources

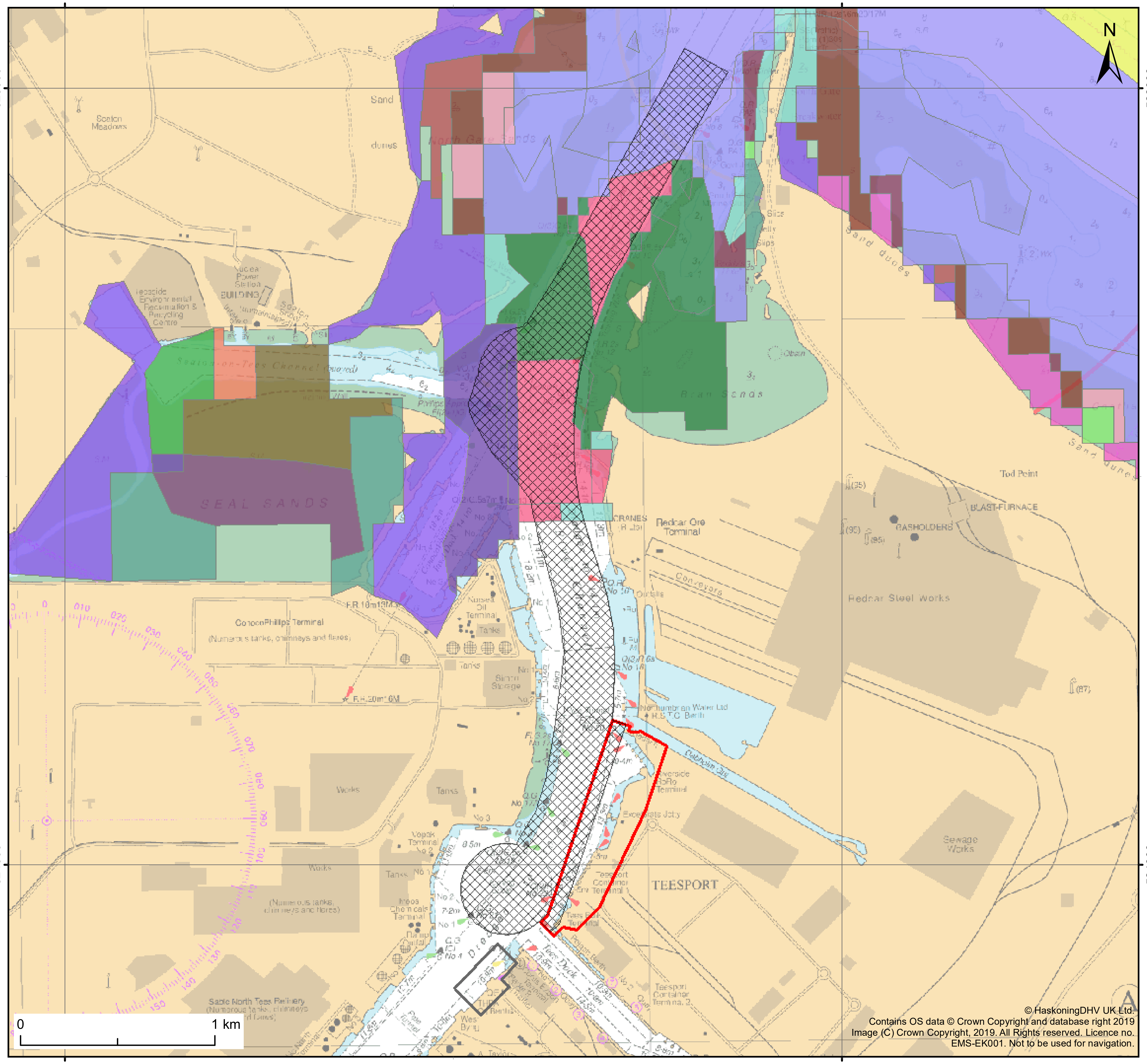
Habitat mapping (publicly available online) has been used to assist with the understanding of the habitats within and adjacent to the proposed scheme footprint. Information from two sources has been reviewed, namely:

- The UKSeaMap 2018, which was generated by the JNCC and is a by-product of the 2013-2016 European Marine Observation and Data Network (EMODnet) Seabed Habitats 2013-2016 consortium (available at http://jncc.defra.gov.uk/page-7682). The UKSeaMap 2018 broad-scale seabed habitat map is a composite of two broad-scale habitat maps, specifically an approximately 100m resolution broad-scale habitat map which covers the majority of the UK shelf area; and, a coarser resolution broad scale habitat map which covers all European seas.
- The Marine Environment Mapping Programme (MAREMAP) (available at https://www.bgs.ac.uk/research/marine/maremap.html). MAREMAP is a joint initiative led by the British Geological Survey, the National Oceanography Centre and the Scottish Association for Marine Science. Developments in multibeam echosounder (or swath) systems (MBES) in recent years have led to significant improvements in seabed mapping and scientific research. Charting data collected primarily to safeguard life at sea compliments geological and habitat mapping, as well as marine surveys carried out for fisheries management, conservation and industry. The result is a more abundant and readily available body of high-quality information (MAREMAP, 2017).

The UKSeaMap 2018 broadscale habitat mapping (Figure 9.2) provides information regarding the habitat anticipated to be present in the downstream part of the proposed dredge footprint only; no information is available for the footprint of the proposed terminal or the upstream part of the proposed dredge footprint. The mapping illustrates that the downstream part of the proposed dredge footprint is occupied by high energy circalittoral sandy mud or circalittoral fine mud (A5.35 or A5.36), and high energy infralittoral sandy mud or infralittoral fine mud (A5.33 or A5.34). The data from MAREMAP does not extend into the Tees estuary and therefore no information is available from this source.

9.4.2 Designated sites for marine ecological nature conservation

The proposed scheme is located within the Teesmouth and Cleveland Coast pSPA and Ramsar site. This site is, however, designated for its waterbird and seabird interest, and is therefore described and assessed in Section 11.



Legend

- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Limit of deviation for Works No. 2 (no longer proposed as part of NGCT scheme)
- Proposed dredge footprint

UKSeaMap2018

- High energy, A3.1: Atlantic and Mediterranean high energy infralittoral rock
- High energy, A5.23 or A5.24: Infralittoral fine sand or infralittoral muddy sand
- High energy, A5.25 or A5.26: Circalittoral fine sand or circalittoral muddy sand
- High energy, A5.33 or A5.34: Infralittoral sandy mud or infralittoral fine mud
- High energy, A5.35 or A5.36: Circalittoral sandy mud or circalittoral fine mud
- High energy, A5: Sublittoral sediment
- High energy, Na
- Low energy, A3.3: Atlantic and Mediterranean low energy infralittoral rock
- Low energy, A4.3: Atlantic and Mediterranean low energy circalittoral rock
- Low energy, A5.23 or A5.24: Infralittoral fine sand or infralittoral muddy sand
- Low energy, A5.35 or A5.36: Circalittoral sandy mud or circalittoral fine mud
- Low energy, A5: Sublittoral sediment
- Low energy, Na
- Moderate energy, A3.2: Atlantic and Mediterranean moderate energy infralittoral rock
- Moderate energy, A5.23 or A5.24: Infralittoral fine sand or infralittoral muddy sand
- Moderate energy, A5.35 or A5.36: Circalittoral sandy mud or circalittoral fine mud
- Moderate energy, A5: Sublittoral sediment
- Moderate energy, Na

Client:	Project:
PD Teesport	Northern Gateway Container Terminal

Title:

UKSeaMap 2018 broadscale habitat mapping

Figure: 9.2

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	21/10/2019	TC	SR	A3	1:20,000

Co-ordinate system: British National Grid

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As noted in Section 4, Natural England has undertaken a review of the existing SSSIs (notably the existing boundaries and interest features of these sites) around the Teesmouth and Cleveland coast. In July 2018, Natural England notified an enlarged SSSI that includes the majority of the area of the seven previous SSSIs around the Teesmouth and Cleveland Coast, linking and combining them with substantial extensions, including an extension into the Tees estuary (see Figure 9.3). As part of this process, Natural England also proposed to de-notify an approximately 22ha area within the Seal Sands SSSI, as part of that particular site is no longer considered to be of special interest. Natural England confirmed the notification of Teesmouth and Cleveland Coast SSSI on 18 April 2019 and, on the same date, confirmed the de-notification of part of the Seal Sands SSSI. The proposed scheme is therefore within the Teesmouth and Cleveland Coast SSSI.

Table 9.4 presents the reasons for notification. It should be noted that a number of reasons for notification are not of relevance to this section of the EIA Report (shown in italics), however have been included for completeness.

The proposed scheme footprint is not located within or adjacent to an MCZ. The closest MCZ is located approximately 20km to the south at Runswick Bay. Impacts to MCZs are therefore not considered further within this EIA Report.

9.4.3 Summary of results from previous benthic surveys in the Tees estuary

The findings of relevant benthic surveys undertaken in 2006 and 2014 within the Tees estuary are presented in full within Appendix 13 and summarised below.

2006 NGCT benthic survey

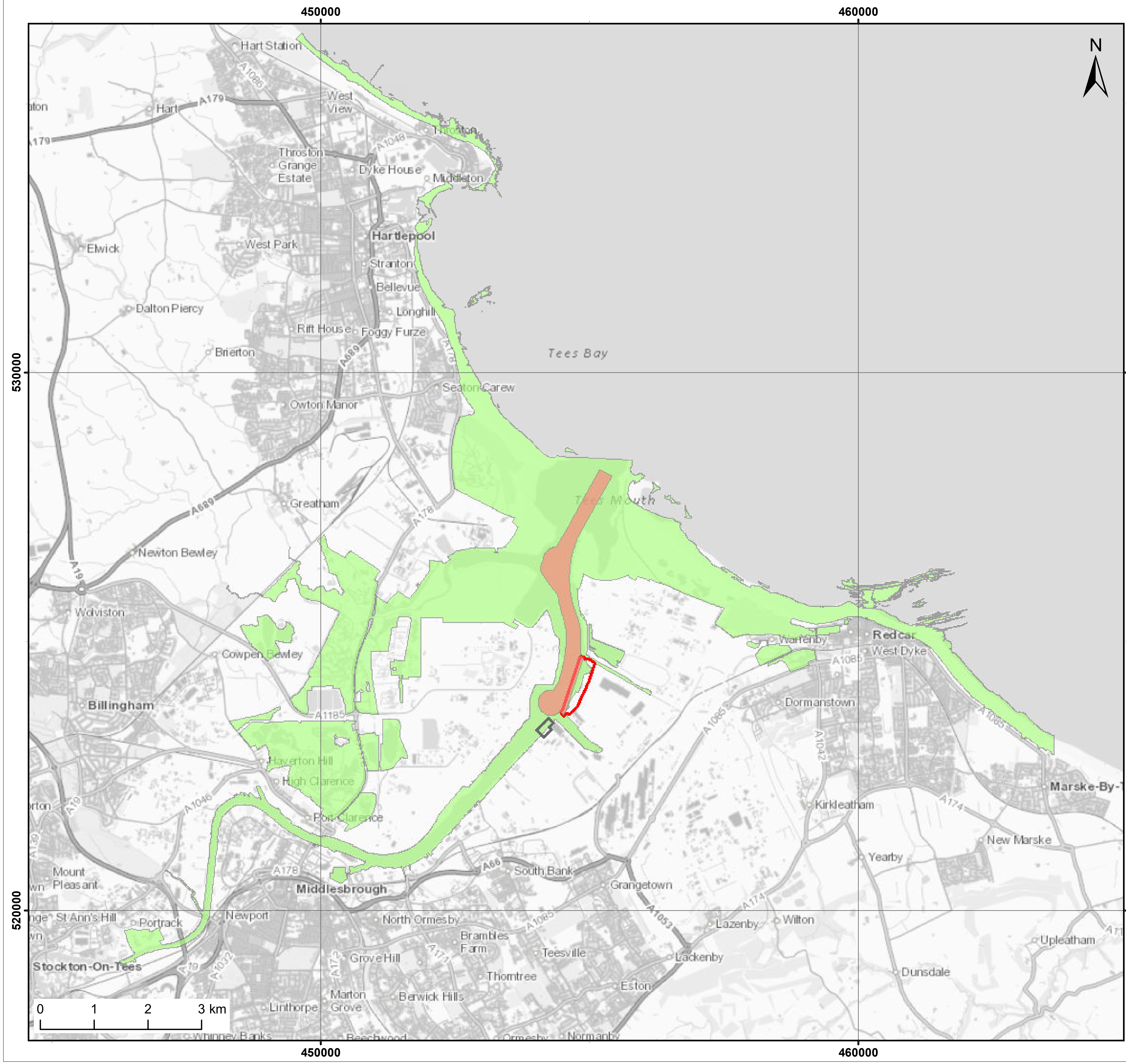
The 2006 benthic survey undertaken for the NGCT HRO application confirmed that none of the species present in sediments from the survey area are rare and therefore, in this respect, the species present were considered typical of the estuarine environment. The proposed reclamation area, as well as the turning circle were found to contain low abundance and diversity.

The most abundant species recorded during the 2006 trawl survey was shrimp *Crangon* sp., which was recorded throughout the estuary, followed by shore crab *Carcinus maenas* which was more abundant in the middle section of the estuary adjacent to the proposed NGCT quay. Lower abundances of epifauna was recorded at the mouth of the estuary. Infaunal species were also recorded, the most abundant being *A alba*.

2014 York Potash Harbour Facilities benthic survey

The survey undertaken in 2014 for the York Potash Harbour Facilities identified the dominant biotope complex recorded in the Tees navigation channel was SS.SMU.ISaMu (Infralittoral sandy mud). This biotope is typically dominated by a rich variety of polychaetes, and a common characterising species of this biotope is *A. alba*.

The outer channel adjacent to the proposed NGCT terminal was found to contain two biotopes, namely SS.SMu.ISaMU.Cap (*Capitella capitata* in enriched sublittoral muddy sediments) and SS.SMU.SMuVS.CapTubi (*Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment), where *C. capitata* dominated and was accompanied by large numbers of *Ophryotrocha* sp. These species are characteristic of fine sediments, usually with some level of organic pollution and associated depleted oxygen levels. The epifaunal survey identified that the most abundant species recorded was shrimp *Crangon crangon*. *C. maenas* and *A. alba* were also abundant, and the species were three of the ten most abundant species present in 2014.



Legend

- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Limit of deviation for Works No. 2 (no longer proposed as part of NGCT scheme)
- Teesmouth and Cleveland Coast Site of Special Scientific Interest (SSSI)
- Proposed dredge footprint

Client:	Project:
PD Teesport	Northern Gateway Container Terminal

Title: Teesmouth and Cleveland Coast SSSI

Figure: 9.3

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	21/10/2019	TC	SR	A3	1:70,000

Co-ordinate system: British National Grid

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Table 9.4 Reasons for notification of the Teesmouth and Cleveland Coast SSSI (features in italics are not of relevance to this section of the EIA Report, but are addressed elsewhere as necessary)

Feature	Description
Jurassic geology	*The foreshore between Redcar Rocks and Coatham Rocks (both located to the south of the Tees estuary) provides exposures of parts of the Lower Jurassic succession that are otherwise unexposed in the Cleveland Basin. These complement the younger Lower Jurassic successions exposed further south in Robin Hood's Bay and are sedimentologically distinct from rocks of the same age to the south of the Markey Wighton Axis.*
Quaternary geology	*Tees Bay includes a feature known as the 'submerged forest' which has been well studied on the foreshore at Hartlepool between Carr House Sands and north of Newburn Bridge. On the Hartlepool foreshore, there is a complex of peats, estuarine and marine sediments deposited during the Holocene, which overlie the glacial deposits from the last Ice Age. Within the peats there are tree stumps and branches. This sequence is also rich in fossils and contains archaeological evidence from the Mesolithic to the Romano-British periods. The location of Hartlepool between areas of crustal uplift to the north and subsidence to south makes these sediments crucial in interpreting Holocene sea level changes.*
Saltmarsh	The Tees estuary supports the largest areas of saltmarsh between Lindisfarne and the Humber estuary. Its saltmarshes show a succession of vegetation types, from pioneer marshes of glassworts and annual sea-blite, through common saltmarsh-grass communities to stands dominated by common couch at the limit of tidal influence.
Sand dunes	The site supports an extensive complex of dunes flanking both sides of the Tees estuary. It is the largest dune system complex between Druridge Bay and Spurn Point. The dunes support a large area of semi-natural vegetation. There are a number of damp depressions in the dunes which support a range of wetter vegetation types.
Harbour seal	Harbour seals (also known as common seals) have lived at the mouth of the Tees for hundreds of years but were lost from the estuary for much of the 20th Century, principally due to pollution. They recolonised in the estuary in the 1980s and have established a regular breeding colony which is the only pupping site in the north-east of England. Harbour seals are present in the estuary and the tidal Tees throughout the year, with regular haul outs at Greatham Creek and Seal Sands. Pupping tends to occur in June and July on the intertidal mud of Seal Sands.
Breeding birds	*The site supports nationally important numbers of three breeding species, namely avocet, little tern and common tern. Avocets and common terns both nest within the SSSI. Little terns from a large nearby colony at Crimdon (in the adjacent Durham Coast SSSI), use the SSSI for foraging and pre- and post-breeding gatherings, with only occasional recent nesting attempts.* *The extensive sand dunes, saltmarshes and wetlands across the site support a diverse assemblage of breeding birds. This includes a number of scarce and declining species, such as shoveler, pochard, ringed plover and little ringed plover.*
Non-breeding birds	*The extensive areas of open water, grazing marsh and intertidal habitats within the site provide safe feeding and roosting opportunities for large numbers of waterbirds throughout the year. The site is of special interest for its non-breeding populations of ten species, namely shelduck, shoveler, gadwall, ringed plover, knot, ruff, sanderling, purple sandpiper, redshank and Sandwich tern, and an assemblage of over 20,000 non-breeding waterbirds. Shoveler, gadwall and ruff are predominantly associated with the extensive freshwater wetlands of the site, while ringed plover, knot, sanderling, purple sandpiper and sandwich tern mostly use the open coast. Redshank are widespread across the site, but the greatest foraging concentrations occur, along with the largest numbers of shelduck, on the intertidal mud of Seal Sands and Greatham Creek. Seal Sands and Bran Sands are also regularly used by ringed plover and knot.*
Invertebrate assemblage	The extensive complex of sand dunes within the site supports a nationally important invertebrate assemblage, including at least 14 threatened species. The assemblage is diverse and makes use of a wide range of niches, with a strong dependency on open but consolidated sand exposures within which to nest and hunt.

9.4.4 Results of the NGCT benthic survey 2019

Sediment type

Sediment types, as classified using the Folk triangle (Folk, 1954) for each of the sample stations across the 2019 survey area are provided in Figure 9.4. A variety of sediment types were present across the survey area and most samples ranged from poorly sorted to extremely poorly sorted. The samples in the Tees estuary were generally mud and sandy mud in the most upstream locations, becoming sandier with distance downstream.

Sediment biotopes

Biotopes were determined based on the 2019 PSD and macrobenthic data; the distribution of these biotopes is shown in Figure 9.5. The biotopes that occurred most frequently in the estuarine locations was EUNIS biotope A5.323 '*Nephtys hombergii* and *Tubificoides* spp. in variable salinity infralittoral soft mud'. One station, TG15, was classified as EUNIS biotope A5.325 '*Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment'. Several stations were unable to be classified further than the EUNIS level 4 biotopes A5.32 'Sublittoral mud in variable salinity' and A5.22 'Sublittoral sand in variable salinity', based on the fauna present.

Benthic grabs – macrobenthic composition

The majority of species recorded during the 2019 benthic survey are typical of sublittoral microbenthic communities (Ocean Ecology, 2019 (Appendix 12)). As has been observed in previous surveys within the Tees (reported above), annelid taxa, particularly polychaetes, dominated the assemblages in terms of abundance and diversity across all stations. Mollusc taxa generally contributed most to biomass. Crustaceans, echinoderms and other taxa all generally contributed little to abundance, diversity and biomass, except for 'other taxa' in the intertidal (discussed below). Unlike the findings from the 2006 and 2014 surveys in the Tees, the opportunistic species *Capitella capitata* was only recorded in high numbers at one station (TG-15) (this species was widespread in the 2006 and 2014 surveys).

There was no obvious dominance of a single taxon in the macrobenthic community during the 2019 survey. The polychaete worm Dialychone was the most abundant taxon sampled and accounted for 8% of all individuals recorded. Nemetode worms occurred most frequently in samples (31%) (Ocean Ecology, 2019).

Benthic grabs – macrobenthic faunal groups

Cluster analysis of square-root transformed macrobenthic abundance data was carried out on a resemblance matrix calculated using the Bray-Curtis similarity coefficient in order to graphically represent the similarity of the epibenthic communities recorded in each sample.

The resulting SIMPROF test identified 10 statistically significant faunal groups and eight outliers (an ungrouped single sample). A 30% similarity slice was overlain onto the cluster analysis dendrogram which identified three faunal groups and five outliers (Figure 9.6). The corresponding non-metric multidimensional scaling (nMDS) ordination plot (Figure 9.7) graphically displays the similarity between the samples based on the distance between the sample points. The degree of clustering of intra-group sample points demonstrates the level of within group similarity whilst the degree of overlap of inter-group sample points is indicative of the level of similarity of the different faunal groups (Ocean Ecology, 2019).

The stress value of the nMDS ordination (0.15) indicates that the two-dimensional plot provides a relatively representative interpretation of the similarity between the samples. The results of the SIMPER routine enabled the characteristic taxa within each of the faunal groups to be determined by providing a level of percentage contribution (%Contrib) to the group similarity which are discussed for each faunal group in detail below (Ocean Ecology, 2019).

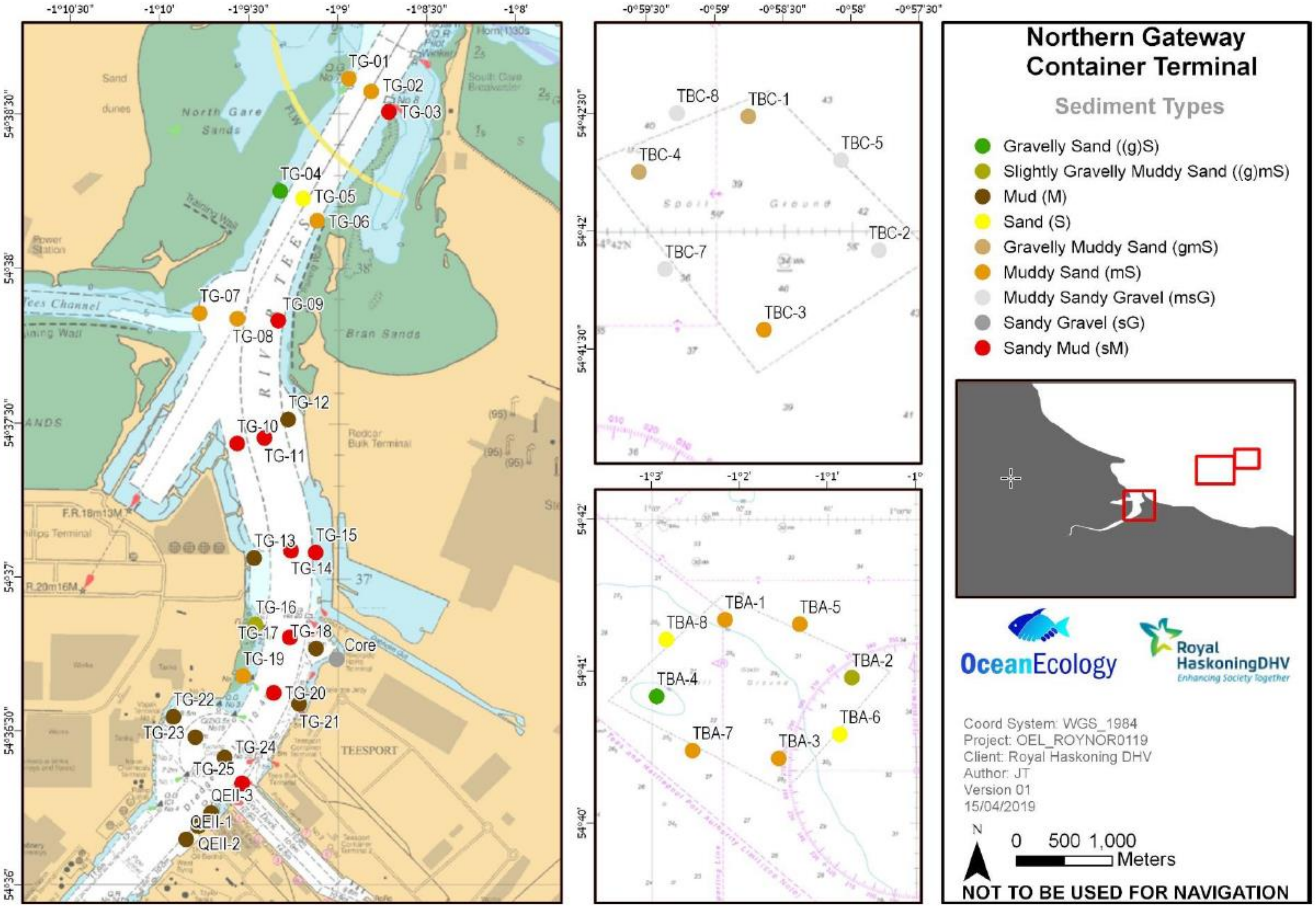

Figure 9.4 Comparison of Folk (Folk, 1954) sediment types as determined from PSD analysis of samples acquired during the 2019 survey

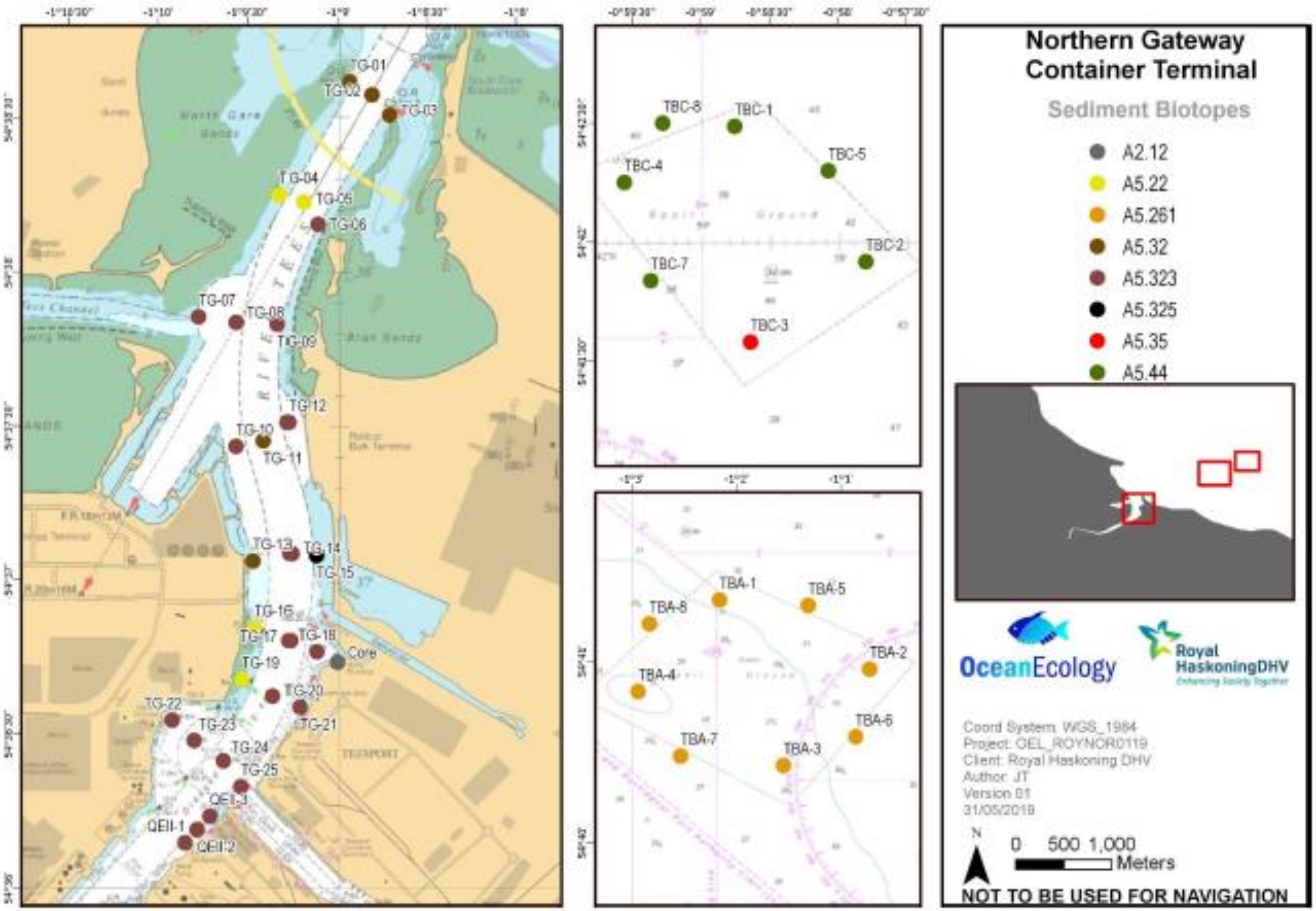

Figure 9.5 ***Distribution of biotopes determined from PSD and macrobenthic analysis of samples recovered during the NGCT sediment and marine ecology survey, 2019***

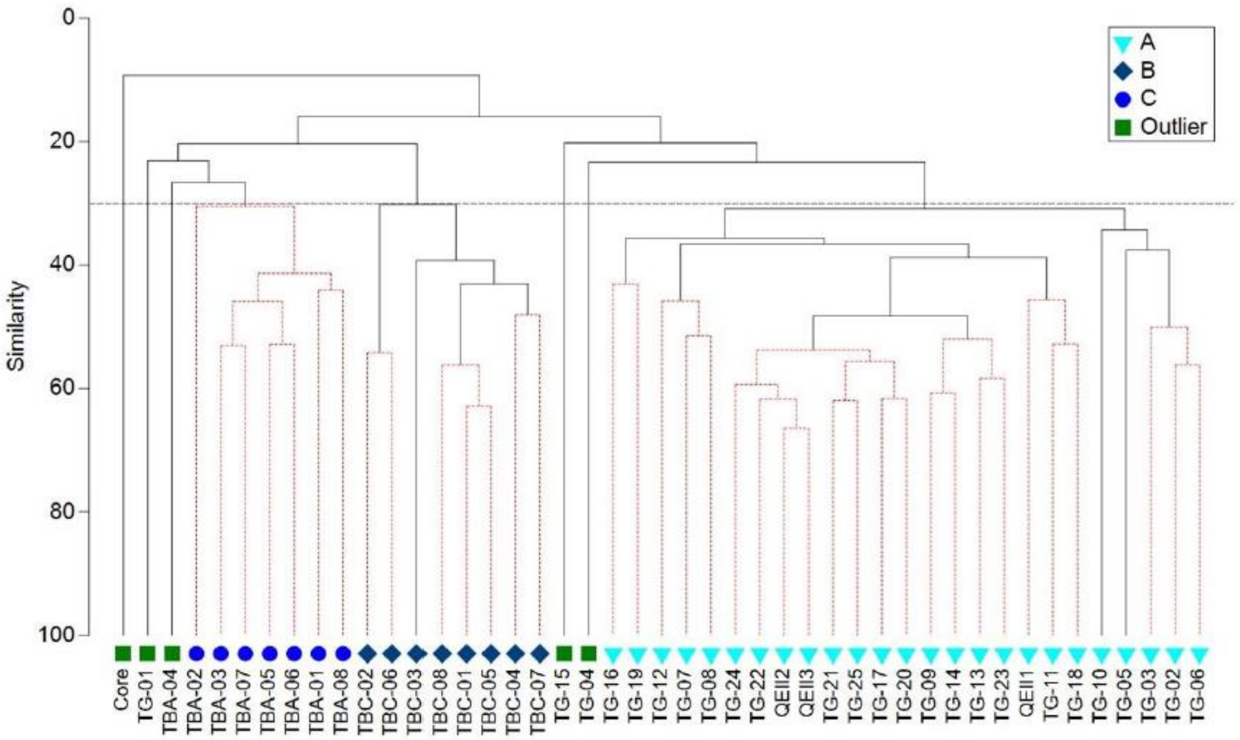

Figure 9.6 ***Dendrogram, with overlain 30% similarity slice, based on square root transformed Bray-Curtis similarity abundance data (Ocean Ecology, 2019)***

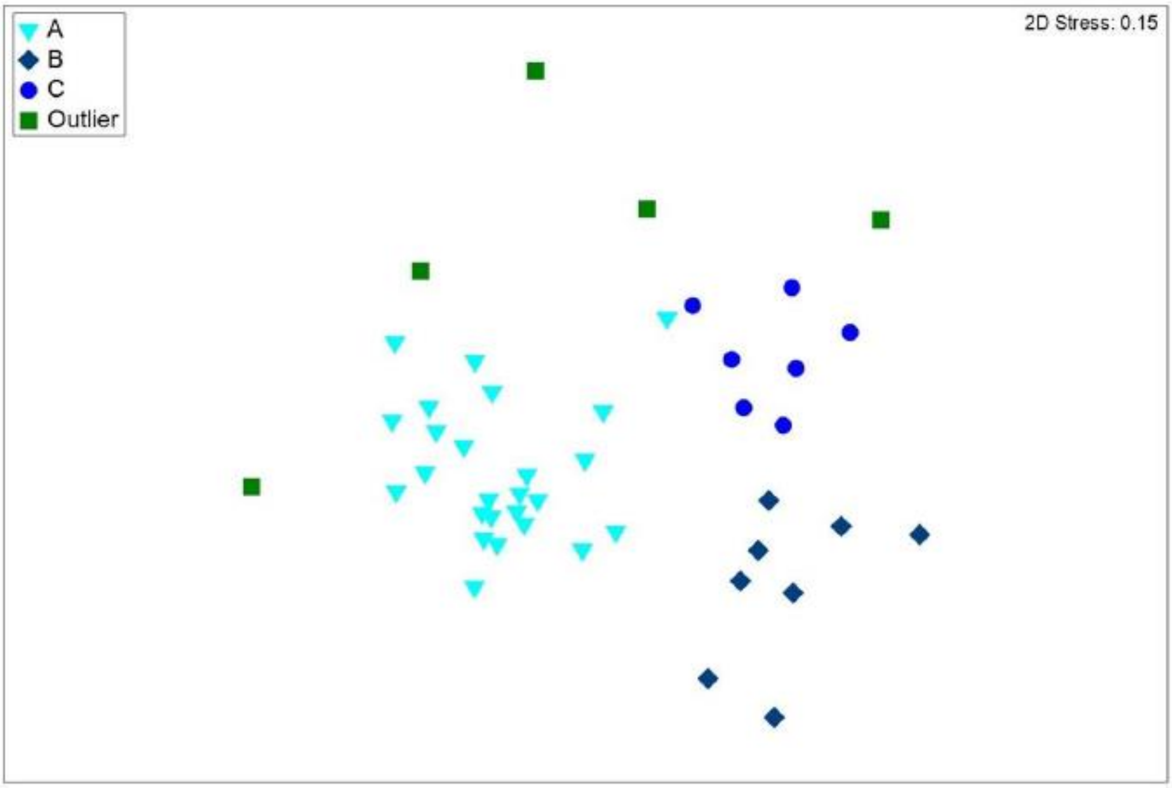

Figure 9.7 ***Non-metric MDS ordination plot of square root transformed Bray-Curtis similarity macrobenthic abundance data***

Faunal Group A was identified at 25 of the 2019 trawl stations (representing 56% of macrobenthic samples) and all grab sampling stations within the Tees estuary. These communities were comprised of a range of taxa with no dominance of a single taxa. The polychaetes *Chaetozone gibber* and Dialychone contributed most to within group similarity (11% and 9% respectively). However, *Tubificoides swirencoides, Abra alba*, and Nematode worms also contributed 8%, 6% and 6% to the within group similarity respectively.

Faunal Group B and C occurred at the offshore disposal sites (namely Tees Bay C and Tees Bay A respectively). Further detail regarding these faunal groups is provided in Section 26.

Benthic grabs - species of conservation interest and non-natives
Most species present in the Tees estuary are typical of sublittoral macrobenthic and epibenthic communities (Ocean Ecology, 2019). However, two non-native species and two species that receive designation under nature conservation legislation were recorded.

With regard to the species of conservation interest, juvenile specimens of the ocean quahog, *Arctica islandica* and the Ross worm *Sabellaria spinulosa* were identified. *A. islandica* is on the OSPAR List of threatened and/or declining species and habitats and is also a Feature of Conservation Importance (FOCI) in England and Wales. *A. islandica* was found in very low numbers (maximum of two individuals) within only three of the 25 grab samples from the Tees estuary. *S. spinulosa* is also on OSPAR List of Threatened and/or Declining Species and Habitats and is listed in Annex 1 of the Habitats Directive. *S. spinulosa* was identified in very low numbers (maximum of eight individuals in one sample) within only seven of the 25 grab samples recovered from the Tees estuary. Larger populations of both species were found within samples recovered from the offshore disposal sites in Tees Bay; *S. spinulosa* was confined to Tees Bay C only, whilst *A. islandica* was found at both offshore disposal sites. The benthic ecology of the offshore disposal sites is considered separately in Section 26.

Dense subtidal aggregations of tubes created by *S. spinulosa* may form biogenic reefs that can stabilise cobble, pebble and gravel habitats and provide a consolidated habitat for epibenthic species (Pearce *et al.* 2011). These reefs form solid, raised structures above the surrounding seabed, thus increasing local habitat complexity and creating a biogenic habitat onto which various other species may become established. *S. spinulosa* is therefore only an Annex I habitat when it is present in reef formation. However, visual inspection of the grab samples containing *S. spinulosa* determined that the individuals recorded were not deemed to meet the Annex I reef qualifying criteria as described by Gubbay (2007) (Ocean Ecology, 2019). It was therefore concluded that the *S. spinulosa* tube aggregations sampled within the Tees estuary were not deemed to be representative of biogenic reef habitat.

Two individuals of the invasive species *Theora lubrica* were found at station TG-23, located within the northern half of the turning circle at the entrance to Tees Dock. *T. lubrica* is a small bivalve that belongs to the family Semelidae. Multiple specimens of *Yoldiella* species were collected at seven stations. Following discussions with expert bivalve taxonomists at the National Museum of Wales, they were assigned to *Yoldiella c.f hyperborea*.

Taxa within the Tees estuary were similar to previous surveys including nematode worms, *Chaetozone gibber*, and *Tubificoides swirencoides* (Royal Haskoning 2009, Fugro 2014). One macrobenthic faunal group was identified within the Tees estuary (Group A), occurring at all stations within the estuary. These communities were comprised of a range of taxa with no dominance of a single taxa. The polychaetes *Chaetozone gibber* and *Dialychone* contributed most to within group similarity (11% and 9% respectively). However, *Tubificoides swirencoides*, *Abra alba*, and Nematode worms also contributed 9%, 7% and 7% to the within group similarity respectively.

Epibenthic trawls

A total of 40 epibenthic species were identified from the 2019 trawls, including 18 fish species. This is comparable to previous surveys in 2006 (47 species in total and 10 fish species, (Royal Haskoning 2006)) and 2013 (58 species in total and 19 fish species, (Fugro 2014)). Further information regarding the fish species encountered within the epibenthic trawls is provided in Section 12 of this report.

The discrepancy in the number of species present between the various surveys appears to be related to the number of annelids recorded (Ocean Ecology, 2019). Annelids contributed to 5% of species in 2019 as opposed to 21% in 2013. Several annelids were removed prior to analysis of the epifaunal data in 2019 due to them having infaunal traits during (Ocean Ecology, 2019). This is the most likely cause of the reduction in species from previous surveys (Ocean Ecology, 2019).

A large increase in the numbers of brittlestars (Ophiura sp.) was observed in the 2019 survey when compared to previous survey data. Echinodermata only accounted for 1% of total numbers of individuals in 2013 (Fugro 2014) compared to 85% in 2019, with Ophiura sp. alone accounting for 80% of individuals recorded. Ophiura sp. was reported to be abundant at station BT08 in 2006 (Royal Haskoning, 2006) however the highest numbers were observed at stations BT06, BT05, BT10, and BT12 in 2006 where its occurrence across the survey area has also increased. Brittlestars can occur in very dense beds on sediments and in estuarine environments (Wolff 1968, Hughes 1998). The beds can play an important role in improving water quality due to their filter-feeding nature contributing to wider ecosystem function (Hughes 1998).

Overall, the epibenthic communities in the Tees appear to be stable with similar taxa observed over multiple surveys. Brown shrimp (*Crangon* sp.) and plaice (*Pleuronectes platessa*) have remained abundant across all surveys since 2006 and occurred at all or most (81%) of stations in 2019 and in 2013. Additionally, the shore crab (*Carcinus maenas*) was also abundant in 2006 which suggests that the main characterising species of the epibenthic communities remain largely unchanged.

9.4.5 Results of the NGCT intertidal survey 2019

Intertidal areas (which can be sedimentary, such as sand and mudflat, or rocky habitats) represent important marine and estuarine habitat and generally have a high abundance of species. They are typically highly productive areas which support predatory birds and fish. Within the Tees estuary, the extent of intertidal habitat has been significantly reduced as the banks of the estuary have been developed. Existing areas of intertidal habitat, especially intertidal mudflat, within the Tees estuary are fragmented and, in this context, intertidal areas are a sensitive resource.

Intertidal mudflat is a UK Biodiversity Action Plan (BAP) priority habitat. In 2012, the UK BAP was succeeded by the UK Post-2010 Biodiversity Framework, but the UK list of priority BAP habitats remains an important reference source.

An intertidal area is present within the footprint of the proposed terminal. The nature of the intertidal has been assessed through survey work undertaken in 2019; this targeted two distinct areas for intertidal biotope mapping, namely, (1) the area from the north eastern corner of the TCT1 quay up to the end of the breakwater north of the Riverside RoRo Terminal and (2) the area from the south western corner of the TCT1 quay to the end of the breakwater to the south west. Biotope maps provided in Figure 9.8 were derived from UAV imagery alongside Phase 1 walkover survey and quadrat mapping. As shown in Figure 9.9, both areas showed similar zonation patterns with a limited number of biotopes observed. A summary of the biotopes recorded during the walkover survey is provided in Table 9.5.

Table 9.5 Key biotopes recorded in the 2019 Phase 1 intertidal survey

Habitat	EUNIS code	EUNIS description
A1 – Littoral rock and other hard substrate	A1:32	Fucoids in variable salinity
	A1:33	Red algal turf in lower eulittoral, sheltered from wave action
	A1:45	Ephemeral green or red seaweeds (freshwater or sand-influenced) on non-mobile substrate
A2 – Littoral sediment	A2:12	Estuarine coarse sediment shores

The intertidal within the proposed scheme footprint was predominantly artificial due to industrial developments. This restricts the ability for a more natural rocky shore community to develop and as such was relatively species poor with only a few biotopes present (Ocean Ecology, 2019).

The survey area was generally characterised by ephemeral green algae on non-mobile substrate along the upper shore, fucoids on rock and boulders along the mid shore and red algal turf along the lower shore. Occasional areas of impoverished coarse sediment was also found along the low-mid shore (Ocean Ecology, 2019).

The shoreline was backed by industrial developments and the upper shore was characterised by ephemeral algae on non-mobile substrate (A1.45) along the entirety of the survey area. These areas then gave way to areas of rock and boulders, often dominated by fucoids (A1.33 – Fucoids in variable salinity). The lower rocky shore areas were dominated by the biotope A1.33 - Red algal turf in lower eulittoral, sheltered from wave action. In some areas, coarse sediment beaches occurred on the lower to mid shore (A2.12 – Estuarine coarse sediment shores) and occasionally formed a mosaic with A1.33 - Red algal turf in lower eulittoral, sheltered from wave action.

Intertidal habitats recorded during the 2019 walkover survey were relatively similar to those identified in 2008 (Royal Haskoning, 2009). It is important to note that no areas of mudflat (reported to be present on Magic mapping) were present during the survey.

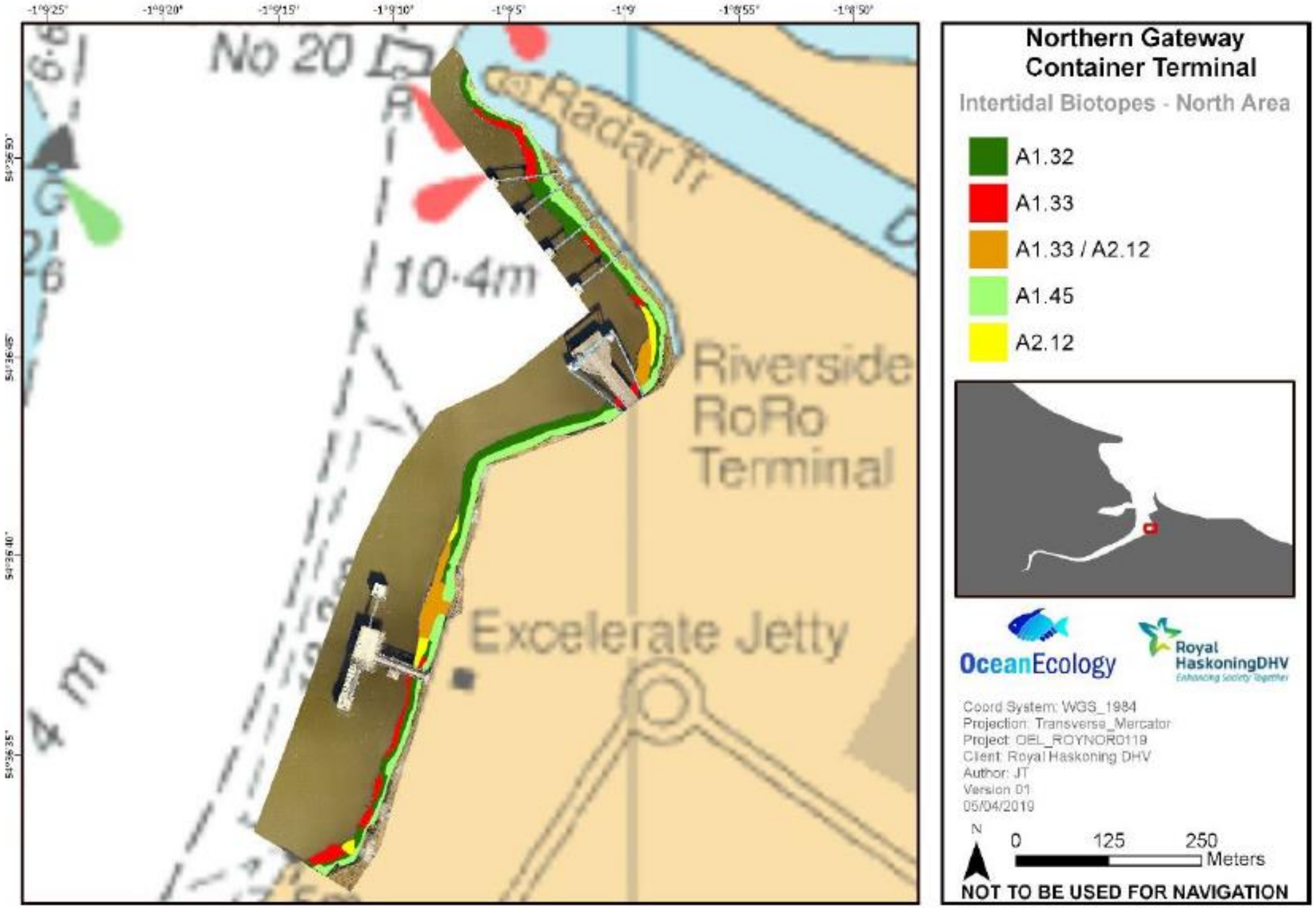

Figure 9.8 Intertidal biotope map from the north-eastern corner of the TCT1 to Dabholm Gut, overlain on the UAV imagery derived orthomosaic (note that the brown area shown above is representative of the water surface)

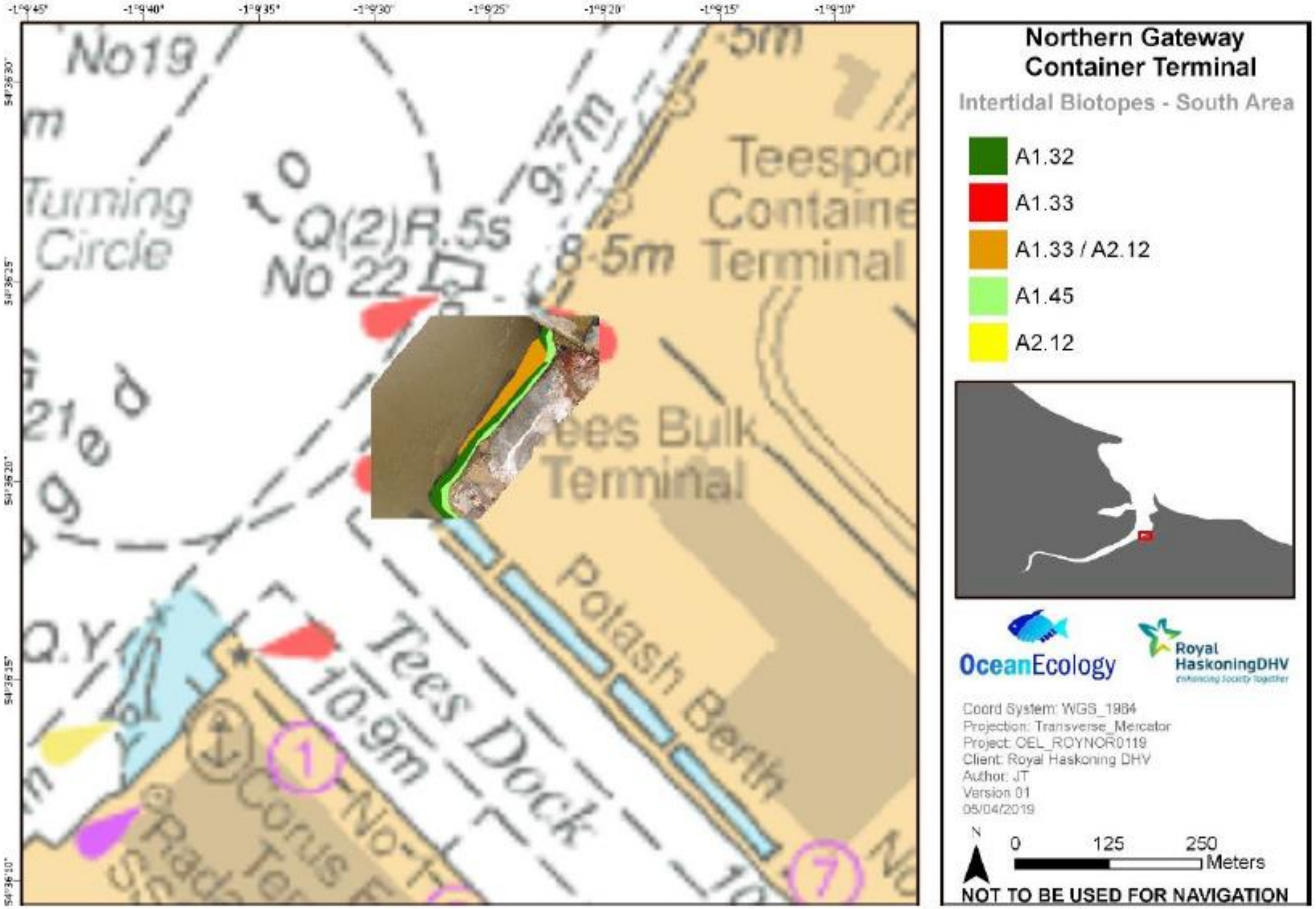

Figure 9.9 Intertidal biotope map from the south-western corner of the TCT1 to Tees Dock overlain on the UAV imagery derived orthomosaic (note that the brown area shown above is representative of the water surface)

9.4.6 Marine mammals

The Tees Seals Research Programme (INCA, 2018) undertake yearly surveys for assessing the abundance and distribution of the two seal species that are present in the Tees estuary, specifically the common (harbour) seal *Phoca vitulina* and the grey seal *Halichoerus grypus*. The 2018 surveys occurred within the pupping season and covered a period of 40 days from mid-June to mid-July 2018. The maximum count for grey seal hauled out at any one time over the 2018 survey period was 45, a decrease over previous years (2017 maximum count was 71).

A total of 21 harbour seal pups were counted in the 2017 season; a slight increase over previous years. The number of harbour seals at the site has been steadily increasing over previous years. The maximum harbour seal count in 2018 was 112, similar to the count for the 2017 which was 128 (INCA, 2017). The maximum count was recorded in July during pupping season, however the maximum count is typically between August and September during moulting season.

Although the numbers of both species have increased, the latest monitoring report indicates that the behaviour of seals has largely remained the same, and the same key haul out sites are still utilised by both species at Seal Sands (INCA, 2018). Greatham Creek (a tributary of the River Tees) has also become an important haul out site for common seals in particular. The latest monitoring report describes that since 2015, it has been noticed that seals are also hauling out on a small sandbank at the Bailey Bridge, where Greatham Creek joins Seal Sands.

Natural England has confirmed that it has undertaken a review of the existing SSSIs around the Teesmouth and Cleveland Coast. In addition to extending the boundaries of the existing SSSIs (to include additional areas of coastal habitat and the species such habitat supports, shown in Figure 9.4), Natural England has also confirmed the addition of common seal into the Teesmouth and Cleveland Coast SSSI designation.

9.4.7 Future evolution of the baseline in the absence of the proposed scheme

In the absence of the proposed scheme, the marine ecological communities within the area potentially affected by the proposed scheme are unlikely to significantly change from the present day. PDT would continue to undertake maintenance dredging of the river and berths to maintain the advertised dredge depths, which would continue to influence the benthic communities present within the sediments.

9.5 Potential impacts during the construction phase

9.5.1 Direct removal of habitat due to quay construction and capital dredging

Dredging

The dredging that would be required to deepen the approach channel and the berth pocket would result in the removal of subtidal benthic community within the footprint of the dredge (an area approximately 120ha in size). However, it should be noted that the vast majority of this area (approximately 116.5ha) comprises the existing navigation channel and is therefore, already dredged. The area of seabed that will be dredged that is currently outside of the existing channel comprises 3.5ha. The capital dredging, which involves dredging adjacent to the Vopak foreshore opposite the proposed reclamation area (to locally realign the channel), does not result in a direct impact on this area of foreshore. Consequently, no loss of intertidal area would arise as a result of the capital dredging.

The impact on the subtidal due to the proposed dredge does not constitute a long-term habitat loss (as subtidal habitat would still be present below the dredged footprint), but, in the short-term, the benthic community would be removed from within the capital dredged areas.

Available geotechnical information which was used to inform the scheme design and the anticipated dredge volumes (per material type) suggests that the nature of the seabed (and consequently the habitat present) within the proposed dredge footprint would not materially change following completion of the dredge.

A review of the MarLIN website has been undertaken to determine the sensitivity of the key characteristic species identified from the March 2019 survey to changes in habitat as a result of dredging activity. As reported above, there was no obvious dominance of a single taxon in the macrobenthic community. Information has therefore been sourced and presented in Table 9.6 below (where available) for the species which were present in the greatest abundance and frequency (occurrence).

A. alba was reported in 24 of the 28 grab sampling stations within the Tees estuary, with an overall abundance of 814 individuals (the sixth most abundant species (no information was available on MarLIN for the five most abundant species)). MarLIN reports that this species is highly tolerant to substratum loss, with very high recoverability following abrasion and physical disturbance. *A. alba* can also reportedly recolonise rapidly following dredging, recruiting from surrounding population within the year (Diaz-Castaneda *et al*., 1989). Based on the above, it is concluded that *A. alba* has a low sensitivity to physical disturbance from dredging.

The two species of conservation importance, namely *S. spinulosa* and *A. islandica* are reported by MarLIN as being highly intolerant to substratum loss. *A. islandica* is found buried in sandy and muddy sediments from the low intertidal zone down to 400m and is protected due to its slow growth and longevity (OSPAR, 2009). The species is protected as a Feature of Conservation Importance (England & Wales) although no MCZ has been designated in this area. Resilience of *A. islandica* is low given sporadic and variable recruitment. Recruitment is continuous at a low level but successful peaks in recruitment occur at intervals in excess of 10 years depending on location (Hennen, 2015). A highly limited number of individuals were recorded during the survey from three samples (a total of four individuals). Additionally, individuals were found both within and outside of the existing maintenance dredge footprint, indicating a relatively widespread population rather than being simply focussed in one area.

S. spinulosa is an occasionally gregarious segmented worm that builds tubes from sand or shell fragments. This species is reported by MarLIN to be found subtidally in exposed areas on hard substrata; it does not form reefs over much of its range, being found mostly individually but may form thin crusts or reefs up to several metres across and 60cm in height. A total of 20 individuals were found across seven sampling stations within the Tees estuary. Given the regular disturbance to the bed of the Tees as a result of almost daily maintenance dredging, as well as the presence of this species in low abundance, it is highly unlikely that reef formations are present.

Based on the above, *A. islandica* and *S. spinulosa* are considered to have high sensitivity to physical disturbance from dredging. The magnitude of the impact is considered to be low given the very small number of individuals that have been recorded, and therefore the significance of the disturbance impact from capital dredging on *A. islandica* and *S. spinulosa* is predicted to be **minor adverse**.

Table 9.6 Summary of sensitivity of characteristic species (and species of conservation importance) in the Tees estuary which could be directly impacted by the proposed dredge (Source: MarLIN website)

Species	Pressure	Intolerance	Recoverability	Resistance	Resilience	Sensitivity	Evidence / confidence
Abra alba	Abrasion and physical disturbance	Intermediate	Very high	-	-	Low	Moderate
	Substratum loss	High	High	-	-	Moderate	High
	Increase in turbidity	Low	Very high	-	-	Very low	Low
	Nosie	Tolerant	Not relevant	-	-	Not sensitive	Moderate
Sabellaria spinulosa	Substratum loss	High	High	-	-	Moderate	High
	Abrasion and physical disturbance	Intermediate	High	-	-	Low	Low
	Increase in turbidity	Tolerant	Not relevant	-	-	Not sensitive	Low
	Noise	Tolerant	Not relevant	-	-	Not sensitive	Low
Arctica islandica	Habitat structure changes – removal of substratum	-	-	None	Very low	High	-
	Abrasion / disturbance of the surface	-	-	Low	Very low	High	-

The remaining sensitivity of the infaunal community within the subtidal zone is considered to be low. Given the size of the proposed dredge, the magnitude of the effect is predicted to be medium, however the proposed dredge would not present an irreversible loss of habitat. The benthic community would be expected to recover to one that is similar to that present throughout the existing dredged approach channel across the majority of the proposed dredge footprint. Taking the above into account, as well as the low sensitivity of the key species present in the dredge footprint (apart from the species of conservation interest discussed above), it is concluded that the potential impact on subtidal habitat as a result of the dredge would be of **minor adverse** significance.

Piling and reclamation

In addition to the above, the proposed scheme would result in the direct loss of intertidal and subtidal habitat within the footprint of the proposed piles required for the quay wall and more importantly within the reclamation area (assuming the closed quay structure is constructed). The permanent loss of intertidal and subtidal as a result of the proposed scheme equates to 1.19ha and 8.5ha respectively. In light of the quality of intertidal and subtidal habitat present, the receptor is considered to be of low value; the magnitude of the effect would be medium. All of the area that would be lost represents available 'habitat' for waterbirds and fish but, taken as a whole, it is on poor quality. Hence it is predicted that the impact associated with the loss would be of **minor adverse** significance.

Findings of the biodiversity offsetting study

Appendix 10 presents the findings of the application of the methodology to define the biodiversity offsetting requirement for the predicted impact of the proposed scheme on intertidal habitat. The study has been undertaken in accordance with the methodology set out in Version 3.2 (Natural England, 2019) of the metric.

Natural England (2019) notes that a key element of the 'net gain' approach is the development of a metric, which is a tool that allows biodiversity losses and offset requirement to be measured. The metric allows the biodiversity impact of a development to be quantified so that the offset requirement, and the value of any proposed 'intervention' (i.e. habitat creation or improvement measures), can be clearly defined.

As reported in Appendix 10, the proposed scheme is predicted to result in the loss of 6.3 biodiversity units. This is comprised of 0.6 units of natural coastal intertidal, and 5.7 units of man-made rocky shore.

To offset the predicted loss of intertidal, PDT proposes to work in partnership with the Tees Rivers Trust to deliver the habitat improvement measures along a 265m stretch of intertidal area downstream of Newport Bridge (an area of 0.54ha). The proposed measures comprise recharging the intertidal area with maintenance dredged silt, thereby enhancing the ecological value of the intertidal area from its current degraded condition.

The biodiversity metric (Natural England, 2019) has been applied to predict the gain in biodiversity units achieved by the proposed habitat improvement measures (Appendix 10). It is concluded that the effect of the habitat improvement measures (referred to a 'post-intervention' in the metric) is to increase the value of the intertidal area from an existing 2.4 biodiversity units to 12.2 biodiversity units. Taking account of the predicted effect of the proposed NGCT (loss of 6.3 biodiversity units), a net gain of approximately 40% is achieved.

Mitigation measures and residual impact

It is recognised that the port terminal and capital dredging would have an impact on biodiversity that is unavoidable (and it is proposed that this is offset through the habitat improvement measures described above). To this end, the footprint of the proposed capital dredging and quay construction has been minimised as far as possible, within the constraint of delivering a port terminal that meets the operational requirements of the project.

9.5.2 Potential impacts to marine ecology from increased total suspended sediment during dredging

Sediment resuspension

During capital dredging, a proportion of the material that is dredged would be disturbed and re-suspended into the water column, dispersed and deposited onto the seabed. Hence, the construction phase would result in increases in the TSS concentrations of the water column. Based on the findings of sediment quality sampling undertaken in July 2019 and reported in Section 7, it is concluded that there would be no risk of contaminated sediment being released into the water column. The assessment below therefore focusses on the potential impact to marine ecology associated with the resuspension of non-contaminated sediment (i.e. sediment which does not contain elevations beyond Action Level 2).

An increase in the TSS concentration in the water column would increase turbidity and reduce the depth of water that light can penetrate and, therefore, the amount of light available for primary production by phytoplankton and marine algae. At high levels and/or for prolonged periods of time, an increase in TSS concentrations can inhibit or prevent benthic organisms from feeding by clogging feeding apparatus (e.g. filter feeding molluscs). In addition, high concentrations of suspended sediment may impact on fish through clogging of gill lamellae, potentially leading to death, whilst lower concentrations can result in sub-lethal stress or avoidance reactions. Further consideration of the potential impacts of increased TSS concentrations of fish is provided in Section 12.

In general, sediment plumes induced by dredging are considered to pose only a limited risk to water quality (and subsequently marine ecological species) since the affected water usually has the capacity to accommodate an increased oxygen demand, particularly where dredging takes place in open sea or estuaries (CIRIA, 2000). The tidal exchange within the Tees estuary would remain unrestricted during the construction phase and significant peaks in TSS would only occur on a short-term basis during the proposed dredging periods.

Background suspended solid levels in the vicinity of the proposed scheme are, for the most part, less then 20mg/l with short term peaks from 40mg/l to 80mg/l (HR Wallingford, 2005). Information provided by Tansley (2003) indicates occasional peaks of up to 90mg/l at the Gares and over 100mg/l at Redcar Jetty. For both types of dredger (CSD and TSHD), peak suspended solids concentrations (i.e. up to 500mg/l above background) are predicted in the immediate vicinity of the dredger. Sediment plume modelling predicts that these increases will be quickly dispersed either in the water column, or by settlement on the seabed. For example, for the CSD, SSC reduce to less than 50mg/l above background within approximately 100m either side of the dredger when it is located in the vicinity of the proposed reclamation.

As noted earlier, Faunal Group A was identified at all stations within the Tees estuary. These communities were comprised of a range of taxa with no dominance of a single taxa. The polychaetes *Chaetozone gibber* and *Dialychone* contributed most to within group similarity (11% and 9% respectively). However, *Tubificoides swirencoides, Abra alba*, and Nematode worms also contributed 9%, 7% and 7% to the within group similarity respectively. A review of the MarLIN website has been undertaken to determine the sensitivity of the key species present within the Tees estuary (where information is available) to increases in suspended sediment. This information is presented below.

The key bivalve species within the sample results, namely *A. alba* does not require light and therefore changes in turbidity are not directly relevant, though increases in turbidity may affect primary production in the water column and therefore reduce the availability of phytoplankton food (Budd, 2007; Rayment, 2008).

MarLIN reports that *A. alba* has a very high recoverability and very low sensitivity to increases in turbidity. Based on the above, this characteristic species within the footprint of the proposed dredge is considered to be of low sensitivity to increases in suspended sediment.

The dominant sediment biotope present within the dredge footprint is EUNIS biotope A5.323, *Nephtys hombergii* and *Tubificoides* spp. in variable salinity infralittoral soft mud. MarLIN reports that this has a high resistance and resilience to changes in suspended sediment, and low sensitivity (to changes in suspended sediment).

Given the temporary and localised nature of the predicted increase in suspended sediment, in addition to the low sensitivity of the key species present in the estuary to increased suspended sediment, an impact of **negligible** significance is predicted.

Mitigation measures and residual impact
No mitigation measures are required. The residual impact is predicted to be of **negligible** significance.

9.5.3 Potential impacts to marine ecology from smothering following dredging

Smothering caused by sedimentation of material resuspended by capital dredging within intertidal areas
During the capital dredging a proportion of the material that is dredged would be disturbed and re-suspended into the water column, dispersed and deposited onto the seabed. The dispersion and deposition of fine material during dredging is described in Sections 6 and 7.

With respect to the potential for impact on intertidal communities as a result, the most important effect is that predicted on Seal Sands (as this location is predicted to be affected by the deposition of fine material generated by capital dredging of sand in the lower Tees estuary). The dredging is not predicted to result in the deposition of sediments at Bran Sands or North Gare Sands.

It is predicted that peak deposition during the capital dredging would be up to 0.05mm per tide and is likely to occur on Seal Sands. The predicted total maximum depth of sediment deposition over the course of dredging sand will be up to 1mm. As described in Section 6, this sediment will be subject to a number of processes following deposition such as remobilisation and redistribution. However, it is predicted that a proportion of the dredged material would be reworked into the substratum. As a worse-case scenario, it is predicted that the net effect of the dredging and dispersive processes acting on the sediment following deposition, could be the deposition of up to 1mm of fine sediment overall.

Sediment deposition has the potential to affect benthic organisms of the intertidal areas of Seal Sands through physiological effects. Ultimately, significant overall deposition, or high rates of deposition, could exceed the tolerance of the organisms resulting in the loss of components of the benthic community and therefore a change in community structure.

The communities present on Seal Sands have been well described by a number of historic studies. In summary, the species present are typical species that characterise fine sediment habitats within estuarine areas. As such, they are tolerant of fluctuating environmental conditions, such as periodic sediment disturbance due to storms and are not considered sensitive in this respect. It is concluded therefore, that the rates of sediment deposition, and the overall degree of sedimentation, that is predicted in this instance would be tolerated by those species present within the intertidal area at Seal Sands. It is predicted that the proposed dredging would not give rise to the loss of a component of the benthic community.

Given the above, an impact of **negligible** significance on benthic community structure is predicted to arise as a result of the deposition of fine sediments at Seal Sands.

Deposition of fine sediment within areas of saltmarsh
Saltmarsh is mapped (on MAGIC) as being present at isolated locations at the eastern end of Seal Sands, in the sheltered location in the lee of the peninsula that extends along the eastern margin of Seal Sands. The numerical modelling studies predict minimal dispersion of fine material within this area, resulting in localised peak deposition of up to 1mm of sediment.

Peak deposition of this order of magnitude is not predicted to adversely affect the benthic communities or saltmarsh vegetation given that this is considered to be of low magnitude and is for a limited time period (as the deposited material will be subject to a number of processes following deposition such as remobilisation and redistribution). Consequently, an impact of **negligible** significance is predicted

Smothering caused by sedimentation of material resuspended by capital dredging within subtidal areas
Capital dredging is predicted to result in the deposition of fine sediment within the subtidal zone. Much of the area affected by this deposition is within the footprint of the dredging and, therefore, this area will be directly impacted by the dredging activity itself. The deposition of fine material within this area is therefore not considered to represent an additional impact on the benthic community.

Elsewhere in the subtidal area (i.e. outside of the footprint of the capital dredging) peak deposition of up to 50mm is predicted (depending on location) and is generally predicted to be of low magnitude (less than 5mm). This deposition occurs over the slack water period and would be subsequently resuspended and dispersed as tidal current increase. It is expected, however, that the dredging would result in a layer of fluid mud over the seabed which, over time, would gradually disperse.

The benthic survey undertaken in 2006 indicates that the biological communities of the mid to lower part of the estuary are dominated by polychaete and oligochaete species. The majority of species recorded during the 2019 benthic survey are typical of sublittoral microbenthic communities (Ocean Ecology, 2019). Annelid taxa, particularly polychaetes, dominated the assemblages in terms of abundance and diversity across all stations. These species are typically found in fine estuarine sediment. As such, they are tolerant to some degree, to elevations in near-bed SSC and periodic sediment deposition. In view of the temporary nature of this potential impact, it is concluded that an overall impact of **negligible** significance would arise, with **no impact** on these communities in the longer term.

Mitigation measures and residual impact
No mitigation measures are required. The residual impact would be of **negligible** significance. Although mitigation measures are not required, studies undertaken to assess the impacts of the proposed scheme on hydraulic parameters indicate that placement of the barge on the eastern side of the estuary will reduce the potential for material to be transported to Seal Sands. The barge will, therefore, be placed on this side of the estuary where possible to reduce the risk of material being transported to Seal Sands.

9.5.4 Underwater noise disturbance to marine mammals

During the scoping consultation exercise on the HRO extension, Natural England confirmed that the environmental implications of noise disturbance (to marine mammals) anticipated to be generated during construction of the NGCT should be carefully considered. This is particularly relevant given the amendments to the SSSI boundaries and interest features around the Teesmouth and Cleveland Coast, specifically the notification of harbour seal as an interest feature of the SSSI (outlined in **Section 7.2.3**).

A detailed underwater noise survey and modelling exercise was undertaken by Subacoustech in 2014, the findings of which were used to inform the EIA for the York Potash Harbour Facilities (Royal HaskoningDHV, 2014). Although the underwater noise assessment was undertaken to inform the EIA for the York Potash Harbour Facilities rather than the NGCT, the findings of the assessment provide useful context for the NGCT as a number of the input parameters used in the study are directly applicable to the NGCT, specifically:

- The underwater noise assessment assumed the use of both driven tubular steel piles and king piles which are linked with secondary drive steel sheet piles. The NGCT scheme proposes the use of driven piles.
- Source noise levels from a TSHD were used in the underwater noise assessment to represent a worst-case scenario (this form of dredging is proposed for a proportion of the NGCT dredge). The noise emissions from a BD were also assessed within the York Potash Harbour Facilities EIA. As reported in Section 3, Phase 2 of the dredging involves the removal of mudstone using a CSD and/or BD loading into hopper barges. In addition, there may be a requirement to use a BD for small, confined areas of dredging, for example, alongside the existing quay wall, to dredge berth pockets or for construction of new quays.
- The footprint of the York Potash Harbour Facilities scheme is approximately 100m downstream of the NGCT scheme and, therefore, the projects are immediately adjacent to each other.

Based on the above, it is concluded that the findings of the York Potash Harbour Facilities underwater noise assessment can be used to inform this report. A summary of the findings of the assessment is provided below. The full noise modelling study report is included as Appendix 14**.** The noise assessment was undertaken with regard to the following three categories:

- Physical traumatic injury.
- Auditory damage.
- Behavioural avoidance.

In order to assess the environmental effects that impact piling and dredging could have on marine mammals, the following noise metrics were used:

- Unweighted metrics (developed by Parvin *et a*l., 2007); lethal and physical impacts of underwater noise on marine receptors.
- The dB_{ht} (species) metric (developed by Nedwell *et al.,* 2007). This metric is built around a species' hearing ability by referencing the sound to the species' hearing threshold.
- M-Weighted Sound Exposure Levels (SELs) (developed by Southall *et al.,* 2007). Instead of using species specific audiograms to determine hearing sensitivity, these criteria group marine mammals into four M-weighted groups, specifically low, mid and high frequency cetaceans and pinnipeds (in water).

Further detail regarding the above categories can be found in Appendix 14.

Modelling of underwater noise from piling operations shows that for the York Potash Harbour Facilities scheme, using unweighted sound power level (SPL) noise criteria, noise levels are not predicted to be high enough for marine mammals to suffer a lethal effect. Physical traumatic injury could occur, but only out to 4m and 8m, for all marine species from impact piling a 914mm and 2000mm diameter pile respectively. Modelling of underwater noise from the proposed dredging operations shows that noise levels are not predicted to be sufficient to reach the unweighted criteria for lethal effect, physical injury or behavioural response.

The largest estimated ranges out to which traumatic hearing damage may occur from impact piling of a 914mm diameter pile and 2000mm diameter pile using the 130 dBht (species) criteria for the York Potash Harbour Facilities scheme is predicted to be 34m and 62m respectively for harbour seal. The modelled dBht (species) sound propagation for backhoe and suction dredging is not predicted to reach the level at which traumatic hearing damage could occur.

The impact range for behavioural response is indicated using the 90 and 75 dBht perceived level criteria. Modelling for behavioural response shows that the impact range from impact piling for harbour seal is 3.01km, for 90 dBht (914mm diameter pile) and 4.47km (2000mm diameter pile). For 75 dBht, the maximum range reached 4.89km for harbour seal for both the 914mm and 2000mm diameter pile (the distance to the bankside from the noise source). The 90 and 75 dBht impact ranges for backhoe and suction dredging are predicted to be 10m or less.

Using the M-Weighted SEL for assessing auditory injury in marine mammals from impact piling, the ranges have been calculated for the 186 dB criteria in pinnipeds for both the 914mm and 2000mm diameter pile. For the 914mm diameter pile, the single pulse SEL impact range was predicted to be a maximum of 6m, whereas the maximum impact range for the multiple phase SEL was calculated at 310m. For the 2000mm diameter pile, the single pulse SEL impact range was predicted to be a maximum of 16m, whereas the maximum impact range for the multiple phase SEL was predicted at 880m.

It should be recognised that piling activities would not represent a constant noise source, and there would be periods between pile driving (e.g. when repositioning the piling barge) which would allow for unimpeded movement of seals up and down the estuary. In addition, the noise disturbance to seals due to piling and dredging would be removed in full following completion of these activities. The modelling results predicted that the noise levels generated from the York Potash Harbour Facilities scheme (which is located immediately adjacent to the NGCT scheme and was undertaken using the same input parameters as the NGCT scheme) would not result in a lethal effect on marine mammals.

Based on the information presented above, the magnitude of the potential effect to marine mammals due to underwater noise is considered to be medium. However, the sensitivity of the receptor is considered to be high. Without mitigation, an impact of **moderate adverse** significance is predicted to arise.

Mitigation measures and residual impact

Within its scoping response, Natural England recommended the adoption of the JNCC's guidelines 'Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise' (JNCC, 2010) during the piling works. This would include checking for marine mammals during a pre-piling search prior to piling operations commencing, the establishment of a mitigation zone (i.e. an area within which a marine mammal could be exposed to sound levels which could cause damage) and the use of soft start techniques to allow any marine mammals time to leave the area of greatest disturbance.

Whilst it is recognised that the soft start approach would extend the construction programme (by an estimated six to 12 weeks), it is concluded that the soft start approach to piling would be appropriate given the sensitivity of the Tees estuary for marine mammals. In addition, it is considered that the implementation of a marine mammal check and the establishment of a mitigation zone would further reduce the potential for impact to marine mammals, alongside the proposals to adopt soft start techniques.

The JNCC's 2010 guidance states that a mitigation zone is an area in which a marine mammal observer either visually and/or acoustically monitors before piling commences. The guidance states that the radius of this zone should be no less than 500m from the pile location. Piling should not be commenced if marine mammals are detected within the mitigation zone or until 20 minutes after the last visual or acoustic detection

(JNCC, 2010). The marine mammal observer should track any marine mammals detected and ensure they are satisfied the animals have left the mitigation zone before they advise the crew to commence piling activities. The JNCC's guidance also notes that when piling at full power, there is no requirement to cease piling or reduce the power if a marine mammal is detected in the mitigation zone (it is deemed to have entered "voluntarily").

With the implementation of the above mitigation measures, a residual impact of **minor adverse** significance is predicted.

9.5.5 Underwater noise disturbance to marine invertebrates during construction

The sensitivity of benthic species to noise and vibration is poorly understood, however studies have shown that some species of marine invertebrates are able to detect sound. Horridge (1996) found that the hair-fan organ of the common lobster *Homarus vulgaris* acts as an underwater vibration receptor. In addition, Lovell *et al* (2005) showed that the common prawn *Palaemon serrattus* is capable of hearing sounds with a range of 100 to 3,000Hz, whilst Heinisch and Weise (1987) found that the brown shrimp *Crangon* illustrates behaviour changes at frequencies of around 170Hz.

The potential therefore exists for noise created by the NGCT scheme (particularly that arising from the piling for the construction of the terminal and the increased shipping required during the construction phase) to be audible to certain benthic species. Taking a conservative approach, the sensitivity of benthic species to underwater noise is considered to be medium.

In addition, Williams *et al.* (2015) states that "*underwater noise from shipping is increasingly being recognised as a significant and pervasive pollutant with the impact to impact marine ecosystems on a global scale*". Williams *et al.* (2015) showcased the effects of noise in two species-specific case studies, one vertebrate and one invertebrate. The findings of the case study regarding underwater noise on invertebrates are of particular relevance to this report and a summary of the findings are presented below.

A tank-based experiment was undertaken by Wale *et al.* (2013) (and reported in Williams *et al.,* 2015) to investigate how the playback of ship noise affects both the behaviour (foraging and anti-predator) and physiology (oxygen consumption) of the shore crab (*Carcinus maenas*). With regard to behavioural changes, the experiment found that ship noise playback was more likely than ambient noise playback to disrupt feeding, although crabs experiencing the two sound treatments did not differ in their likelihood, or speed, of finding a food source in the first place. Whilst crabs exposed to ship noise were just as likely as the crabs exposed to ambient noise to detect and respond to a simulated predator attack, they were slower to retreat to shelter. Ship noise playback also resulted in crabs that had been turned on their backs righting themselves faster than those experiencing ambient noise playback; remaining immobile may reduce the likelihood of further predatory attention (Wale *et al.*, 2013).

With regard to physiological effects, a single exposure to the playback of ship noise was found to result in significantly higher oxygen consumption in shore crabs (indicating a higher metabolic rate and potentially increased stress), with larger individuals affected more strongly. The study also identified that, when repeatedly exposed to ship-noise playback, crabs continued to consume oxygen at an elevated level, providing no obvious evidence of habituation or tolerance.

The above study indicates that the potential exists for both behavioural and physiological responses in shore crabs as a result of underwater noise generated by shipping. It is currently unknown if the findings of such a focussed study (in terms of the invertebrate and noise source studied) would be applicable to other marine invertebrates. For the purposes of this assessment, it has been assumed that such findings would be applicable to other invertebrates found in the Tees estuary.

As reported in Section 12, there is a small amount of fishing targeted at lobster (*Homarus gammarus*) and velvet swimming crab (*Necora puber)* in the lower estuary during summer, however most of this activity is located seaward of the Gares. This activity has been carried out for a number of years, within an estuary which is subject to a significant number of shipping movements on a daily basis (see Section 13). Although statistical information is not available to validate this statement, there has been no reported decline in the number of velvet swimming crab or lobster caught from the Tees estuary. Furthermore, although the study discussed above concluded that shore crabs did not appear to become habituated to noise from shipping, the ongoing lobster and velvet crab fishing undertaken in the lower Tees estuary during the summer (which has been undertaken for a number of years) suggests that noise disturbance from routine shipping movements in the Tees estuary is not adversely affecting these species.

The spatial extent of underwater noise and vibration impacts on benthic receptors as a result of piling (required for the terminal) and shipping noise is currently largely unknown. However, the installation of piles for the terminal (as well as shipping movements required during construction to undertake the dredge and disposal and to support the terminal construction) would be a temporary activity, and therefore any noise disturbance to marine invertebrates would also be temporary. In addition, the piling would not be continuous over the construction period; there would be times when piling is not being undertaken, for example, when the piling rig is being moved to a new location. Piling would also be undertaken within a localised area of the estuary. Given the temporary nature of construction works, the magnitude of the noise disturbance effect (from piling and shipping movements) is considered to be low; therefore, in accordance with the impact assessment matrix presented in Section 5, an impact of **minor adverse** is predicted during construction.

Mitigation measures and residual impact

It is not possible to remove the sources of noise from the construction phase of the scheme. However, in order to minimise the construction related disturbance, the construction programme has been minimised as far as practicable. PDT proposes to adopt a soft-start approach to piling, however it is currently unknown (due to a lack of research in this area) whether such a technique would benefit marine invertebrates). Hence the residual impact will be of **minor adverse** significance.

9.6 Potential impacts during the operational phase

9.6.1 Potential impact on marine communities due to a change in flow regime

The predicted effects of the proposed scheme on the hydraulic regime are presented in Section 6. The scheme is predicted to have very minor effects on the flow regime, with very small decreases in flows being predicted for the navigation channel (generally decreases of up to 0.1m/s). Minor increases in flow speeds of up to 0.1m/s are predicted for some locations (e.g. opposite and immediately downstream of the proposed scheme), with localised increases of up to 0.2m/s.

It is predicted that the scheme would result in an increase in the tidal range of approximately 4mm near the Tees Barrage and less than this amount adjacent to the proposed reclamation. No changes to tidal range are predicted for the area downstream of the proposed scheme.

The studies on the effects of the proposed scheme on waves indicate that the intertidal area of North Gare Sands would experience some changes in wave height, but such changes are of very low magnitude and unlikely to affect benthic community structure. Overall, the impact of the proposed scheme on marine communities due to changes in the hydraulic regime is predicted to be of **negligible** significance.

Mitigation measures and residual impact

No mitigation measures are required and the residual impact would be of **negligible** significance.

9.6.2 Effect of decreased exposure of intertidal area at North Tees mudflat on benthic community structure

Changes to the cross-sectional area of an estuary due to capital dredging and reclamation can influence tidal propagation. As a consequence, the level of high and low water can be affected. This can change the extent of intertidal area exposed at low water.

The modelling studies reported in Section 6 conclude that for the zone of the estuary that supports the most significant intertidal habitat (i.e. downstream of the proposed terminal), the effect on tidal propagation would be insignificant. **No impact** on these areas is, therefore, predicted.

The North Tees mudflat (upstream of the proposed scheme) is the key area of intertidal that has the potential to be impacted by the predicted increase in tidal range (4mm for spring tides). The predicted changes, however, will not affect the intertidal area at high water as the water level will not change against the river walls. For low water, it is concluded that the predicted increase on spring tides has the potential to convert up to 40m^2 of intertidal area to very shallow subtidal. In essence, the predicted change represents the conversion of intertidal area to very shallow subtidal area under spring tide conditions.

However, it should be noted that this up to 40m^2 of habitat will not be lost; rather the frequency at which it will be submerged will change. This change in low water level would result in a notional shift of the low water line 10cm towards the river edge and a narrow strip of presently drying intertidal area remaining wet. The water depth in this area would be up to 2mm.

Benthic community structure is influenced by the tidal regime to which it is subjected and, therefore, a change from intertidal habitat to very shallow subtidal at only certain states of the tide has the potential to impact on community structure. In this instance the change is considered to be of very low magnitude and, in terms of an effect on the physical environment to which the benthic community is exposed, the predicted effect would not result in a change in benthic community structure. As a consequence, an impact of **negligible** significance is predicted.

Mitigation measures and residual impact

No mitigation measures are required, and the residual impact would be of **negligible** significance.

9.6.3 Potential effect of increased supply of fine sediment to Seal Sands on benthic community structure

It is predicted that, as a consequence of the proposed scheme, there would be a small (in the order of 10%) increase in the supply of fine material to Seaton Channel and, therefore, potentially to Seal Sands. Given that the existing rate of accumulation of material on Seal Sands is quoted as being of the order of 3mm/year (Appendix 6), the proposed scheme is predicted to increase this rate by 0.3mm/year (assuming that the increase in supply to Seaton Channel accumulates on Seal Sands in the same proportion as at present).

In terms of effect on benthic communities, the trend for an increased supply of fine material is not predicted to directly adversely affect the structure of the benthic community of Seal Sands. In some areas of Seal Sands, there has been a trend for an increase in the coarse component of the substratum which is likely to lead to a reduction in the diversity of the benthic community in these areas. The increase in supply of fine sediment to areas which are currently muddy is not considered to be an issue which would result in an adverse effect on community structure.

It is important to consider the effects of the extensive *Enteromorpha* mats on Seal Sands on particle size distribution of the sediments and consequently on benthic community structure. A number of studies have been undertaken on the causes of *Enteromorpha* development and its effects on the benthic community. In summary, it can be concluded that the relationship between these factors is complex. However, studies by the University of Durham into the relationship between particle size and *Enteromorpha* coverage conclude that areas with *Enteromorpha* are generally siltier and areas without *Enteromorpha* are generally sandier although between 1992 and 1999 there was no easily discernible correlation between particle size distribution and *Enteromorpha* cover (Tansley, 2003).

Tansley (2003) concludes that sediment type and sediment changes that have taken place on Seal Sands are influencing factors in determining the location of *Enteromorpha* mats. It may be that the sediment type on Seal Sands may have become siltier over time thus making the substratum more cohesive, favouring the colonisation of *Enteromorpha*. The presence of *Enteromorpha* itself subsequently reduces the erodibility of the bed and the removal of *Enteromorpha* and has the effect of favouring retention of silt (i.e. trapping) within the mat itself.

The presence of *Enteromorpha* and its effects on the benthic community are of vital importance to feeding waterfowl (see Section 11). Again, studies show that the relationship is complex although it is generally recognised that the presence of thick and extensive algal mats are detrimental to benthic community diversity.

The above comments are of relevance when considering the implications of the proposed scheme for the ecology of Seal Sands. It is predicted that the proposed scheme would make a minor contribution to the supply of fine material to Seal Sands and, therefore, it is likely that more fine material would be trapped within the *Enteromorpha* mats on Seal Sands. It is, however, considered unlikely that the scheme would encourage accumulation of fine material in areas which are currently comprised of sandy sediments as the hydraulic regime of such areas would not favour deposition of fine material. It is important to note in this respect that the proposed scheme is not predicted to result in changes to tidal current speeds over Seal Sands.

In terms of the effect of the potential increase in supply of material to Seal Sands on intertidal elevation, the magnitude of effect is predicted to be very small and effectively undetectable from background change. Potential changes due to the scheme are quantified as being a fraction of a millimetre change per year and are likely to be confined to those areas colonised by *Enteromorpha* which is likely to act as a sediment trap.

Overall, the increase in supply of fine material to Seal Sands as a consequence of the scheme is not expected to result in a significant change in the structure of the benthic community itself or to encourage indirect effects by resulting in an increase in the fine component of sandy areas, which may encourage *Enteromorpha* colonisation. The overall impact of the scheme is predicted to be of **negligible** significance.

Mitigation measures and residual impact

No mitigation measures are required and the residual impact would be of **negligible** significance.

9.6.4 Potential impact on marine communities due to changes in the regime for maintenance regime

The predicted changes to the rate of infill of the navigation channel as a consequence of the proposed scheme are minimal. It is concluded that the predicted changes are insignificant with respect to potential effects on the existing maintenance dredging strategy, and no changes to the present-day maintenance dredging strategy are necessary. As such, there would be **no impact** on marine communities as a result of the maintenance dredging requirement arising from the proposed scheme.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact**.

9.6.5 Recovery of the benthic community following completion of capital dredging

The impact of capital dredging on the existing marine communities is described in Section 9.5. Following the completion of the dredging, the marine community within the dredge footprint would be expected to recolonise the impacted area. The nature of the communities that would recolonise the seabed compared with those which are currently present is largely dependent on the change in nature of the sediments that are exposed at the surface of the seabed.

Given that the navigation channel is dredged to geological material, the proposed capital dredging would be expected to result in the exposure of a similar sediment type to that which is currently present. As such, over time the marine communities that colonise within the proposed dredge area would be expected to be of a similar structure to those which are currently present. Any recolonisation of the seabed following the capital dredging would be beneficial compared with the immediate post-dredge situation but maintenance dredging would restrict continuous recovery.

Based on the above, it is concluded that there would be an impact of **negligible** significance on the benthic community following completion of the capital dredge.

Mitigation measures and residual impact
No mitigation measures are required, and the residual impact would be of **negligible** significance.

9.6.6 Underwater noise disturbance to marine ecology

As reported in Section 13, the operational phase of the proposed scheme will result in more frequent movements of larger vessels in the Tees estuary compared with the existing situation. In addition, it is predicted that the NGCT will result in an increase in vessel traffic in the order of 100 movements per month, or an increase of approximately 10% on the average number of existing vessel movements per month.

The potential therefore exists for an increased level of noise disturbance to marine invertebrates and marine mammals during operation.

As noted above, the spatial extent of underwater noise and vibration impacts on marine invertebrates as a result of shipping noise is currently largely unknown given the lack of research into this subject. However, given the mobile nature of vessels, the magnitude of shipping related noise disturbance is likely to be localised, affecting discrete areas of the river bed as the vessel moves through the estuary. An impact magnitude of low is therefore predicted. Using the impact assessment methodology presented in Section 5, therefore, the impact significance is predicted to be **minor adverse** (assuming that the receptor has a medium sensitivity).

Marine mammals are considered to have high sensitivity given the recent changes to the interest features of the Teesmouth and Cleveland Coast SSSI (i.e. inclusion of harbour seal as a feature of the site). It should be noted that the Tees estuary is an industrialised environment with high levels of existing shipping and construction along its shores. The Tees estuary is also subject to existing maintenance dredging on an almost daily basis all year round which will generate underwater noise. It is therefore concluded that there are a number of existing anthropogenic sources of noise within the Tees. It is recognised that the proposed scheme will result in increased number of vessel movements within the Tees, however, in the context of the existing sources of underwater noise disturbance to marine mammals, and the acclimatisation individuals will likely have developed to existing sources of underwater noise, the magnitude of the potential impact is considered to be low. It is therefore concluded that the impact to marine mammals is of **minor adverse** significance.

Mitigation measures and residual impact

There are no mitigation measures that can be adopted to minimise potential operational phase noise disturbance issues, as operational phase vessel movements are a fundamental element of the scheme. However, it is the Harbour Master's statutory duty and responsibility to enforce the local byelaws which state that ships must slow to a specific speed within the estuary. Such a control measure has the potential to minimise the noise disturbance from operational phase shipping. As there is no available research to confirm any thresholds of potential shipping related noise disturbance to marine invertebrates, it is conservatively assumed that the residual impact will be **minor adverse** during operation. This conclusion is also conservatively applied to marine mammals.

9.6.7 Vessel interactions (collision risk)

Marine mammals in the area are likely to be habituated to the presence of vessels and would be able to detect and avoid vessels. Therefore, harbour porpoise, minke whale, grey seal and harbour seal are considered to have a low sensitivity to the risk of a vessel strike. Taking into account the existing vessel movements in and around the proposed scheme area, and the potential disturbance from vessels, the potential increased collision risk as a result of vessels during the operational phase is considered to be **negligible**.

Mitigation measures and residual impact

No mitigation measures are required, and the residual impact would be of **negligible** significance.

10 TERRESTRIAL AND COASTAL ECOLOGY

As noted in Section 1, the landside elements of the proposed scheme have commenced (under the planning permission granted by RCBC in 2007). PDT is not seeking new permissions or changes to the development that is already authorised and commenced under the existing planning permission.

The 2006 planning permission granted by RCBC contained two conditions with regard to terrestrial and coastal ecology, which had to be discharged prior to the commencement of the works authorised by the planning permission. Details of the planning conditions with which PDT has complied, together with an update on the current status, are presented in Table 10.1.

As noted in Table 10.1, the conditions imposed by RCBC with regard to terrestrial and coastal ecology were adequately discharged prior to the landside elements of the proposed scheme being implemented. The future development of the wider NGCT (beyond the commencement works) will be subject to the same controls and therefore there are measures in place to manage any risks associated to terrestrial and coastal ecology.

Based on the above, no further assessment works are considered necessary and the findings of the 2006 ES (with specific regard to terrestrial and coastal ecology) remain valid.

Table 10.1 Planning conditions imposed on the NGCT by RCBC with regard to terrestrial and coastal ecology

Planning condition	Reason	Status
Condition 12: Prior to the commencement of development, a programme for the reclamation and construction works, which avoids disturbance to breeding birds, shall be submitted to and approved in writing by the Local Planning Authority. Construction work shall thereafter be carried out in accordance with the approved programme.	To prevent unacceptable disturbance to breeding birds.	INCA produced a protocol for nesting birds in May 2015 on behalf of PDT. The protocol stated that PDT will comply with the control measures to minimise the risk of disturbance to breeding birds.
Condition 29: Prior to development commencing, a mammal and amphibian survey shall be carried out and the survey and any necessary mitigation measures shall be submitted to and agreed with the Local Planning Authority.	To protect any mammals or amphibians which may be present on the site.	A mammal and amphibian walkover survey was undertaken by INCA during April 2015. As no legally protected species and no other significant mammal populations would be affected by the landside elements of proposed works, INCA considered it inappropriate to carry out any form of mammal survey prior to works commencing. INCA also concluded that there are no habitats suitable for breeding amphibia on or adjacent to the proposed development, stating that further survey work is unlikely to find any amphibia.

11 ORNITHOLOGY

11.1 Introduction

This section of the EIA Report considers the following potential environmental impacts:

- Impacts to bird feeding resource due to reductions in water quality.
- Direct loss of intertidal feeding resource due to reclamation.
- Indirect impacts on intertidal habitat due to predicted effects on tidal prism.
- Effects of sediment deposition on intertidal food resources due to capital dredging.
- Construction and operational phase noise disturbance.
- Effects of underwater noise on prey resource.
- Potential effect on the morphology of intertidal habitats and implications for waterbird populations.
- Potential effect of increased supply of fine sediment to Seal Sands on feeding resource for waterbirds.
- Disturbance to feeding and roosting waterbirds due to increased shipping activity (shipwash).
- Potential effect of maintenance dredging on food resources.

11.2 Policy and consultation

11.2.1 Policy

National Policy Statement for Ports

The assessment of potential impacts to marine and coastal ornithology has been made with reference to the policy guidance for this topic area contained within the NPS for Ports (Department for Transport, 2012). The particular assessment requirements relevant to marine and coastal ornithology, as presented in the NPS for Ports, are summarised in Table 11.1.

Table 11.1 Summary of NPS for Ports requirements with regard to marine and coastal ornithology

NPS requirement	NPS reference	Section of EIA report where requirement has been addressed
Where the development is subject to EIA, the application should ensure that the ES clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological interests.	Section 5.1.4	Section 11.4 and 11.5 and HRA presented in Section 8
The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests.	Section 5.1.5	Section 11.4 and 11.5
The applicant should be particularly careful to identify any effects on the integrity and special features of MCZs, SACs and candidate SACs, SPAs and potential SPAs, Ramsar sites, actual and potential Sites of Community Importance and Sites of Special Scientific Interest (SSSI).	Section 5.3.7	Section 8 (HRA) (note that there are no MCZs relevant to the assessment)

Marine Policy Statement

The UK Marine Policy Statement (HM Government, 2011) (adopted in March 2011) provides the framework for marine planning and decisions affecting the UK marine area. The Marine Policy Statement will facilitate and support the formulation of marine plans, ensuring that marine resources are used in a sustainable way in high level marine objectives, thereby:

- promoting sustainable economic development;
- enabling the UK to move towards a low carbon economy, in order to mitigate the causes of climate change and ocean acidification and adapting to their lives;
- ensuring a sustainable marine environment which promotes healthy, functioning marine habitats, species and our assets; and,
- contributing to the societal benefits of the marine area, including the sustainable use of marine resources to address local and social economic issues.

The MPS requires that all public authorities taking authorisation or enforcement decisions that affect, or might affect, the UK marine area do so in accordance with the MPS, unless relevant considerations indicate otherwise.

11.2.2 Consultation

A summary of the comments provided in the MMO's Scoping Opinion received during the HRO extension process that are of relevance to marine and coastal ornithology is presented in Table 11.2.

Table 11.2 Summary of comments in the MMO's Scoping Opinion with regard to marine and coastal ornithology

Scoping comment	Response / section of the EIA Report where comment has been addressed
A Habitats Regulations Assessment will need to be submitted and reviewed prior to any works being consented.	Please see HRA in Section 28.
Works to the watercourse should not be undertaken between the start of October and the end of April in any given year.	The assessment has been undertaken on a worst-case scenario whereby construction works would be occurring at any point during the year.

Consultation meeting with the Environment Agency and Natural England

A summary of comments received from the Environment Agency and Natural England in November 2018 with regard to the potential impacts to marine and coastal ornithology is presented in Table 11.3.

Table 11.3 Summary of comments received from the Environment Agency and Natural England during the pre-application consultation meeting

Comment / summary of discussion	Response / section of the EIA Report where comment has been addressed
The Environment Agency advised that the seasonal restrictions to manage the risk of disturbance to birds outlined within Table 11.2 are a starting point, in terms of measures to avoid adverse impacts. The Environment Agency confirmed that sufficient evidence would need to be provided to demonstrate that seasonal restrictions would not be required, should PDT wish to undertake works all year round.	The assessment has been undertaken on a worst-case scenario whereby construction works would be occurring at any point during the year.

11.3 Methodology

11.3.1 Study area

The study area for this section of the EIA Report comprises the area which has the potential to be both directly and indirectly impacted by the proposed scheme. In this case, the maximum extent of the potential impact has been determined to be the area over which the potential effects of the proposed scheme on hydrodynamic and sedimentary regime may occur.

11.3.2 Methodology used to describe the existing environment

Baseline data to inform this EIA Report with regard to the assessment of potential impact to waterbirds using the intertidal areas comprises Wetlands Bird Survey (WeBS) counts for the most recent five years available from the British Trust for Ornithology (i.e. 2013/14 to 2017/18), WeBS count data within the Departmental Brief for the Teesmouth and Cleveland Coast pSPA and Ramsar site (Natural England, 2018a) and waterbird survey data provided by INCA.

The Cleveland Bird Report 2017 (Teesmouth Bird Club (TBC), 2018) has also been reviewed, as it includes site specific counts of breeding and non-breeding species within the Tees estuary. In addition, data referenced within the Departmental Brief for the Teesmouth and Cleveland Coast pSPA (Natural England, 2018a) has also been reviewed to assist with the understanding of how seabirds and terns use the estuary. A review of tern verification surveys undertaken on behalf of Natural England at a number of marine sites across the UK has also been undertaken.

Data from the WeBS are routinely used when assessing the ornithological interest of estuarine and coastal areas potentially affected by development. WeBS core count data concentrate primarily on the winter period, but at selected sites, counts are made once per month throughout the year. Counts are usually made at high tide when birds are most easily counted at roosts. Low tide counts are conducted at most large estuaries at least one winter every six years, with up to four counts being made through the period November to February. Low tide counts are designed to complement the estuarine Core Count data and are principally concerned with illustrating bird distributions, allowing the identification of those parts of estuaries, inlets or bays which are important for birds. The proposed scheme footprint is partly located within the Bran Sands South sector (52427), Bran Sands North sector (52428) and North Gare Sands sector (52413), all of which form part of the wider Tees estuary parent site. The most recent data for these sectors have been used to inform the understanding of the baseline environment.

The Defra MAGIC website has been reviewed to confirm the location of international and nationally designated sites for nature conservation of relevance to this section of the report (shown on Figure 9.4 and 11.1).

11.3.3 Methodology for assessment of potential impacts

The overarching environmental assessment process and methodology follows a matrix approach to inform the impact assessment, using best practice, best available scientific understanding and relevant guidance (e.g. Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland (CIEEM, 2016)).

As a first stage in the assessment process, the waterbird and seabird receptors which may be affected by the proposed scheme were identified on the basis of the WeBS data, consultation documents issued by Natural England for the Teesmouth and Cleveland Coast pSPA and the notifiable / qualifying features of the national and international sites for national conservation located within 2km of the proposed scheme.

The impact assessment on waterbirds and seabirds was then determined by following the process outlined below:

- Determining the nature conservation value of the receptors present within the study (this section focusses on species and populations covered by national and international designations (namely SSSI, pSPA and Ramsar site);
- Determining the scale and magnitude of the potential impacts of the proposed scheme.

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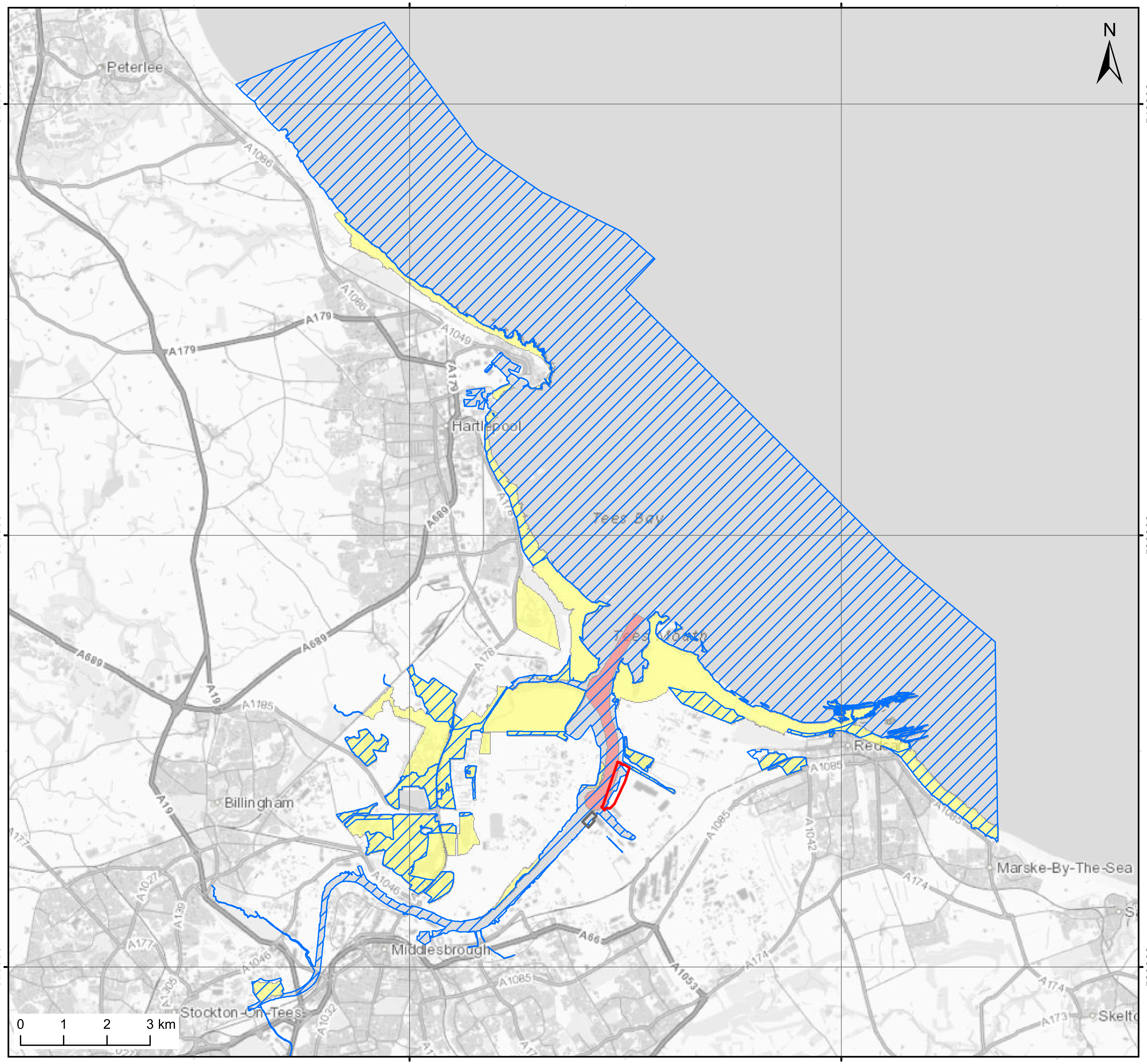

Legend

- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Limit of deviation for Works No. 2 (no longer proposed as part of NGCT scheme)
- Teesmouth and Cleveland Coast Proposed Ramsar Site
- Teesmouth and Cleveland Coast Potential Special Protection Area (pSPA)
- Proposed dredge footprint

Client:	Project:
PD Teesport	Northern Gateway Container Terminal

Title: European and Ramsar sites

Figure: 11.1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	21/10/2019	TC	SR	A3	1:90,000

Co-ordinate system: British National Grid

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- Determining the significance of the potential impacts on the different receptors, based on the predicted magnitude of the impacts and on the nature conservation value of the bird populations which are likely to be affected.
- Identifying mitigation measures, as required.
- Determining the significance of any residual impacts after assessing the impact of the prescribed mitigation measures.

The assessment of significance of potential impacts has been undertaken in accordance with the generic assessment criteria defined in Section 5.

The findings of the following sections have been used to inform the impact assessment:

- Hydrodynamics and sedimentary regime (Section 6).
- Marine sediment and water quality (Section 7).
- Marine ecology (Section 9).
- Fish and fisheries (Section 12).
- Noise and vibration (Section 16)

11.4 Existing environment

11.4.1 Statutory designated and non-statutory sites

Teesmouth and Cleveland Coast pSPA and Ramsar site

Natural England has reviewed the suite of nature conservation designations in the Teesmouth and Cleveland Coast area, including the Teesmouth and Cleveland Coast SPA and Ramsar site. Natural England recommended to Government that the existing SPA and Ramsar site be revised to include extensions and additional qualifying interests. In July 2018, Defra announced that it was commencing consultation on the proposals. During the consultation process, seven responses were received which supported the proposal, whilst 18 objections were received (11 of which were resolved). Following receipt of the comments, Natural England has submitted its final advice to Defra for consideration and a decision will then be made on the proposals for the Teesmouth and Cleveland Coast SPA and Ramsar site.

The existing Teesmouth and Cleveland Coast SPA is classified for breeding little tern, passage Sandwich tern, non-breeding red knot, passage common redshank and a non-breeding assemblage of over 20,000 waterbirds. An extension to the existing SPA has been proposed to protect the at sea foraging areas for little tern and common tern which breed at the existing coastal SPA. Additionally, the proposals include the addition of breeding avocet and non-breeding ruff as new features to the site. The designation also includes new additional wetland areas such as saltmarsh, wet grassland and intertidal areas which are important for other foraging and roosting waterbirds.

It is proposed that the existing Teesmouth and Cleveland Coast SPA boundary site is extended to cover an area from Castle Eden Denemouth in the north to Marske-by-the-Sea in the south and includes the River Tees up to the Tees Barrage. The seaward boundary includes waters out to 3.5km from Crimdon Dene to include the areas of greatest importance to the little terns at that colony, and to around 6km offshore further south to include the areas of greatest importance to the common terns at the Saltholme colony. Additional terrestrial areas are included in the extension as they provide important habitat for the waterbird assemblage. It is also proposed to extend the existing Teesmouth and Cleveland Coast Ramsar site boundary to include additional wetland areas. The Ramsar site will not extend outside of the pSPA extension and will only cover those terrestrial areas of the pSPA down to the mean low water.

Information from surveys and consultation documents

Consultation documents produced for the Teesmouth and Cleveland Coast pSPA and Ramsar site (Natural England, 2018a) state that counts of most breeding, wintering and passage birds for the pSPA have been derived from Cleveland Bird Reports 2009 to 2013 and WeBS core counts for the years 2011/12 to 2015/16. The Teesmouth and Cleveland Coast pSPA and Ramsar site includes a section of the coast which falls outside of the Tees estuary WeBS site. This area is covered by two WeBS core count sectors, specifically the Durham Coast Sector 1a (53408) Durham Coast Sector 1b (53409). The consultation documents state that no recent data was available for Durham Coast Sector 1b, and therefore population estimates were derived by combining counts from Tees estuary core count WeBS sectors (excluding the Reclamation Pond sector 52421) and the Durham Coast Sector 1a. The Reclamation Pond sector was excluded as this area is not included in the pSPA extension.

A summary of the interest features of the site is provided below, in Table 11.4. In addition to the below information, the department brief (Natural England, 2018a) provides details of the key ornithological interests in each of the extension areas that justify their inclusion within the extended pSPA.

The vast majority of the proposed reclamation footprint is located within the Bran Sands South WeBS count sector (the most upstream part of the proposed reclamation is not covered by WeBS counts). The proposed dredge footprint overlaps with Bran Sands North sector (52428), North Gare Sands sectors (52413) and the Peninsula East sector (52424). Table 11.5 shows the use of these different sectors by waterbirds in the pSPA and Ramsar site using data from 2013/14 to 2017/18. Given that the proposed dredge extends only marginally into the Peninsula East sector, data from that sector is not presented below.

Table 11.4 Summary of the interest features of the Teesmouth and Cleveland Coast pSPA and Ramsar site

Species	Population in GB (Natural England, 2018a)	Currently a feature of the existing SPA and Ramsar site (Natural England, 2018a)	pSPA population (Natural England, 2018a)	Usage of the pSPA and Ramsar site (Natural England, 2018a)
Annex 1 species				
Pied avocet *Recurvirostra avosetta (new qualifying feature)*	Estimated to be 1,500 pairs, representing 6.2% of the West Europe and North-west Africa breeding population.	No.	Between 2010 and 2014 the pSPA and Ramsar site supported an average of 18 breeding pairs, representing 1.2% of the GB population. The species does not qualify as a Ramsar feature as it does not meet the 1% biogeographic threshold.	The majority of birds breed on Number 4 Brinefield, mainly on the saline lagoon south of Greatham Creek, with smaller numbers on Greenabella Marsh (i.e. approximately 8km south of Hartlepool).
Ruff *Calidris pugnax (new qualifying feature)*	The non-breeding population of ruff in GB is estimated at 800 individuals, representing about 0.05% to 0.08% of the Northern Europe and Western Siberia / West Africa population (1M to 1.5M individuals during 1950 to 2000).	No.	Between 2011/12 and 2015/16 the pSPA, including proposed extensions, supported an average of 19 individuals which represents 2.4% of the GB non-breeding population.	Ruff occur at shallow waterbodies (inland reservoirs) across the site, in particular on the pools at RSPB Saltholme and North Tees Marshes (TBC, 2018).
Common tern *Sterna hirundo (new qualifying feature)*	The breeding population of common terns in Great Britain is estimated to be 10,000 pairs, representing at least 15% of the Southern & Western European breeding population	No	Between 2010 and 2014 the pSPA, including the proposed extensions, supported an average of 399 breeding pairs of common terns, which represent about 4% of the GB breeding population.	Nesting birds are typically concentrated on islands within the various waterbodies at Saltholme (11km south of the proposed scheme at Hartlepool), with variable and smaller numbers of nests on the saline lagoon in No. 4 Brinefield south of Greatham Creek, and on rafts at Cowpen Marsh. Two pairs also bred on Portrack Marsh in 2014.
Sandwich tern *Thalasseus sandvicensis (existing qualifying feature)*	The passage population of Sandwich terns in Great Britain is estimated to be 44,300 individuals, representing about 26% of the Western Europe/West Africa population.	Yes (both the SPA and Ramsar site)	The SPA citation (dated 2000) lists 1,900 individuals. The Natura 2000 Standard Data Form (JNCC, updated 2000) also states 1,900 individuals as the 5-year mean (1988-1992) at the time representing 6.8% of the GB breeding population or 4.3% of the GB passage population. Numbers on the site have since declined and between 2011/12 and 2015/16 the pSPA/Ramsar site, including the proposed extensions, supported an average of 134 individuals, representing around 0.3% of the GB passage population	Highest numbers occur from mid-July to September when adults and juveniles disperse from breeding colonies. The majority use roosts at Coatham Sands, Seal Sands, North Gare Sands/Seaton Snook and Bran Sands (all approximately 7 to 10km south of the proposed scheme footprint at Hartlepool). They feed in shallow inshore waters in and around the estuary mouth.

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Species	Population in GB (Natural England, 2018a)	Currently a feature of the existing SPA and Ramsar site (Natural England, 2018a)	pSPA population (Natural England, 2018a)	Usage of the pSPA and Ramsar site (Natural England, 2018a)
Little tern *Sterna albifrons (existing qualifying feature)*	The breeding population of little terns in Great Britain is estimated to be 1,900 pairs, representing about 10% of the Eastern Atlantic breeding population	Yes. Little tern is also a non-qualifying species of interest for the existing Ramsar site.	The SPA citation (dated 2000) lists 40 pairs. The Natura 2000 Standard Data Form (JNCC, updated 2000) also states 40 pairs as the 4-year mean (1995-1998) at the time representing 1.7% of the GB breeding population. Between 2010 and 2014 the pSPA, including the proposed extensions, supported an average of 81 breeding pairs of little terns, which represent 4.3% of the GB breeding population. Because the little tern population data should, ideally be contemporary with the foraging tern distribution data used to inform the proposed revision to the site boundary (2011-2013), it is proposed that this new, updated population estimate should replace the earlier SPA population estimate.	All British little terns nest on the coast, using sand and shingle beaches and spits, as well as tiny islets of sand or rock close inshore. Virtually all breeding birds are currently located at Crimdon Dene, approximately 6.5km north of the proposed scheme footprint at Hartlepool. The feeding grounds of the little terns that nest at Crimdon Dene lie predominantly in marine areas within 5km alongshore of the colony and within 3.5 km offshore.
Regularly occurring migratory species				
Red knot *Calidris canutus (existing qualifying feature)*	In 2000 the non-breeding population in Great Britain was estimated to be 290,000 individuals, representing about 84% of the NE Canada & Greenland/Iceland/UK population	Yes (both the SPA and Ramsar site)	Between 1991/92 and 1995/96 the SPA/Ramsar site supported an average of 5,509 individuals which, at that time, represented 1.6% of the NE Canada/Greenland/Iceland/UK population. Numbers have since declined, however the department brief does not propose an amendment to the notified population of 5,509 individuals.	Birds feed at low tide on intertidal mudflats, mussel beds and rocky shores on both sides of the estuary. Formerly present in large numbers in the estuary on Seal Sands, particularly when the rising tide covered other foraging habitats, the birds are now increasingly located outside the estuary, on Coatham Sands, Redcar Rocks and around Hartlepool Headland.
Common redshank *Tringa totanus (existing qualifying feature)*	In 1995 the non-breeding population of common redshank in Great Britain was estimated to be 75,400 individuals, representing about 69% of the north-west European component of the East Atlantic flyway population.	Yes (both the SPA and Ramsar site)	Between 1987 and 1991 the SPA/Ramsar site supported an average of 1,648 individuals which, at that time, represented 1.1% of the East Atlantic population (SPA Citation, 2000). Numbers on the site have since declined and between 2011/12 and 2015/16 the pSPA/Ramsar site, including the proposed extensions, supported an average of 881 individuals representing around 0.3% of the Iceland & Faroes/Western Europe population. No change to the	Within the site birds feed on intertidal mudflats including Seal Sands, North Tees Mudflat, Bran Sands and Hartlepool Bay, saltmarsh areas at Greatham Creek and intertidal rocky shores at Hartlepool Headland, Redcar and Coatham.

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Species	Population in GB (Natural England, 2018a)	Currently a feature of the existing SPA and Ramsar site (Natural England, 2018a)	pSPA population (Natural England, 2018a)	Usage of the pSPA and Ramsar site (Natural England, 2018a)
			reported population of 1,648 individuals is proposed within the departmental brief.	
Waterbird assemblage				
Assemblage *(existing qualifying feature)*	The site qualifies under Article 4.2 of the Birds Directive (79/409/EEC) as it is used regularly by over 20,000 waterbirds, including all Annex 1 species and regularly occurring migratory species outlined above.	Yes	During the period 2011/12-2015/16 the Teesmouth and Cleveland Coast pSPA/Ramsar site, including the proposed extensions, supported an average peak of 26,014 (SPA assemblage) / 26,786 (Ramsar assemblage) individuals. Waterbird species present in nationally important numbers or where their numbers exceed 2,000 individuals comprise: • Eurasian wigeon *Anas penelope* – 2,660 individuals (5-year peak mean 2011/12 to 2015/16) • Gadwall *Anas strepera* – 428 individuals (5-year peak mean 2011/12 to 2015/16). • Northern shoveler *Anas clypeata* – 180 individuals (5-year peak mean 2011/12 to 2015/16) • Northern lapwing *Vanellus vanellus* – 3,892 individuals (5-year peak mean 2011/12 to 2015/16) • Sanderling *Calidris alba* – 242 individuals (5-year peak mean 2011/12 to 2015/16) • Herring gull *Larus argentatus* – 3,243 individuals (5-year peak mean 2011/12 to 2015/16) • Black-headed gull *Chroicocephalus ridibundos* – 2,273 individuals (5-year peak mean 2011/12 to 2015/16)	The departmental brief provides the following information regarding the use of the pSPA / Ramsar site by the cited species in the column to the left during the winter: • Wigeon are found in greatest numbers on the brackish and freshwater pools and adjacent saltmarsh and grasslands around Saltholme, Seaton Common and Greatham Creek. • Gadwall are found in particular concentrations in several locations around the North Tees Marshes. • Northern shoveler are found in greatest numbers in several locations around the North Tees Marshes. • Foraging sanderlings are found in greatest numbers on the wide sandy beaches at Redcar and Coatham Sands, with smaller numbers in Hartlepool Bay. • Herring gulls congregate in large numbers on the intertidal and near-shore waters of Hartlepool Bay and on the open coast north of Hartlepool. • Black-headed gulls are found in greatest numbers on the intertidal habitats and near-shore waters of Bran Sands, Hartlepool Bay and the open coast north of Hartlepool, and the freshwater pools at Saltholme.

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Table 11.5 Number of each species of European and international importance and key waterbird assemblage species present in relevant WeBS count sectors within the pSPA / Ramsar site from 2013/14 to 2017/2018

Species	Total pSPA and Ramsar site peak mean 2011/12 to 2015/16 (individuals) (Natural England, 2018)	Number of individuals and proportion of the SPA / Ramsar site total present in sector (Natural England, 2018)							
		Bran Sands South (sector 52427)		Bran Sands North (sector 52428)		North Gare Sands (52413)		Peninsula East (52424)	
		Number	%	Number	%	Number	%	Number	%
Eurasian Wigeon	2,660	2	0.1	13	0.5	1	0.03	0	0
Gadwall	428	6	1	0	0	0	0	0	0
Northern shoveler	180	0	0	0	0	0	0	0	0
Pied avocet	52	0	0	0	0	0	0	0	0
Northern Lapwing	3,892	**290**	**7**	**454**	**11**	160	4	0	0
Red knot	867	0	0	**247**	**28**	**239**	**27**	0	0
Ruff	19	0	0	0	0	**1**	**5**	0	0
Common redshank	881	**180**	**20**	**168**	**19**	**57**	**6**	1	0.1
Black headed gull	2,273	**286**	**12**	35	1.5	95	4	5	0.2
Herring gull	3,243	**540**	**16**	146	4	103	3	54	1
Little tern	23	0	0	0	0	1	4	0	0
Sandwich tern	134	**8**	**6**	**88**	**65**	**128**	**95**	1	0.7
Common tern	385	13	3	18	4	**81**	**21**	4	1
SPA assemblage	26,014	**2539**	**9**	**2,002**	**7**	**2,341**	**9**	343	1.3
Ramsar site assemblage	26,786	**2539**	**9**	**2,002**	**7**	**2,341**	**9**	343	1.3

*Figures in bold represent counts for which 5% or more of the total site population occurs in a particular sector

The data in Table 11.5 shows that the Bran Sands South WeBS count sector supports important populations of a number of key bird species of the Teesmouth and Cleveland Coast pSPA and Ramsar site, namely northern lapwing, common redshank, black-headed gull, herring gull as well as the bird assemblage. Of particular note is the absence of common tern, Sandwich tern and little tern in significant numbers at Bran Sands South (i.e. greater than 5% of the pSPA and Ramsar site population[1]) within which the terminal is to be located. None of the species present in the Peninsula East sector are present in greater than 5% of the pSPA and Ramsar site population.

[1] *The 5% threshold was used by Natural England to determine significant populations within the Teesmouth and Cleveland Coast pSPA and Ramsar site Departmental Brief, which is consistent with assessments of the importance of prospective extensions to other sites in England (Natural England, 2018)*

The Bran Sands North sector supports significant (i.e. greater than 5% of the pSPA and Ramsar site population) numbers of northern lapwing, red knot, sanderling, common redshank and sandwich tern. The North Gare Sands sector supports significant populations of red knot, sanderling, ruff, redshank, Sandwich tern and common tern. In the case of Sandwich tern, 95% of the pSPA and Ramsar site population is reported to be found at North Gare Sands.

Tern verification surveys

In 2015, Natural England commissioned ECON Ecological Consultancy Ltd to carry out survey work at a number of sites in England to verify the predicted patterns of tern usage generated by JNCC's modelling work. One of the sites of particular interest was the Teesmouth and Cleveland Coast pSPA. This was because the proposed amendments to the existing boundary of the SPA were founded on the results of the predictions of a generic model of patterns of common terns' foraging activity; the model itself being based on analysis of patterns of common tern foraging elsewhere around the UK, rather than at Teesmouth. A review of the findings from the verification studies has been undertaken to inform the understanding of tern use within the Tees estuary.

Method

Three surveys were undertaken on 18th June, 2nd July and 22nd July 2015. All survey work was conducted from a boat. The survey vessel was moored in Hartlepool Marina and the survey route began and ended there, taking in Victoria Harbour on the outward or return leg. The survey route ran across Hartlepool Bay and up the River Tees as far as the tidal barrage and back again. En route, three different types of data recording methods were used to record tern activity:

- Timed counts of the total numbers of terns seen over a 30-minute period within 300m of the boat (within an arc of 180º forward of the boat) while the boat was held stationary at a series of c17 observation points.
- A series of instantaneous snapshot counts of the numbers of terns seen within the same area taken every minute while the timed counts were carried out at each station.
- An instantaneous snapshot count of the numbers of terns seen within 300m of the boat (within an arc of 180º forward of the boat) taken every 300m as the vessel moved along the transect route so as to give continuous coverage along the transect when travelling at 10 knots.

Common terns at Saltholme, the relevant common tern colony to the Teesmouth and Cleveland Coast pSPA, often appear to breed later than at other sites around the UK (Perrow *et al*., 2010). It was therefore considered that the survey period was likely to encapsulate the chick-rearing period (as well as part of incubation) rather than fall within the post-fledging period in a more typical colony in a normal season.

Results of the verification surveys

A total of 957 common terns were recorded over the three surveys (Perrow *et al*., 2010). There were no survey locations which did not support common terns at least once during timed counts. The number of overall records was concentrated at the mouth of the Seaton Channel (35%) (Perrow *et al.*, 2010). Apart from this concentration of common terns, records were rather equally distributed between survey locations (from 2 to 8% of records) all the way along the length of the Tees from the Tees Barrage at the survey location furthest upstream (8% of records) to Middlesbrough Dock (5% of records), Tees Dock (2% or records), and across the bay to Victoria Harbour and Hartlepool Marina at Hartlepool (3% and 2% of records respectively) some 12 km from the colony, as the tern flies (Perrow *et al.,* 2010). The use of most survey locations such as Middlesbrough Dock (3-7% of records between occasions) and Tees Dock (0.6-3% of records) in what could be described as the middle to lower reaches of the river, was rather consistent at a lower level compared to the estuary at Seaton Channel or Tees Barrage (Perrow *et al.*, 2010). The raw data from the surveys for the Tees estuary are provided in Appendix 15 and summarised below with regard to common tern and Sandwich tern.

Of the 957 common terns recorded, most were in directional flight (58%) or foraging with no clear direction (41%) (Perrow *et al.,* 2010). A few birds were noted resting on posts, quays or buoys at various points along the river (0.6%) (Perrow *et al.,* 2010). Snapshot surveys suggested a greater preponderance of foraging activity (84%), compared to birds engaged in directional flight (13%) and resting (2%) (Perrow *et al.*, 2010). The proportion of foraging was found to increase considerably over time from a consistent level in the first two surveys (57% and 58% respectively) to 92% in late July (Perrow *et al.,* 2010).

In 2016, INCA was commissioned by Natural England to repeat the 2015 tern verification surveys for the stretch of the River Tees between Tees Barrage and Seaton Channel to obtain additional information to verify the JNCC modelling work. Another three surveys were carried out. The survey method and type of data recorded were essentially identical to those in 2015. In addition to repeating the 2015 survey, which focused on tern numbers and activity, the INCA surveys also intended to gather data about whether existing anthropogenic activities on the river were causing disturbance to terns.

The results of the 2016 survey confirmed the results of the 2015 survey, in that common terns were found throughout the entire length of the River Tees between Seaton Channel and Tees Barrage and in each of the “off-river” locations surveyed. Sandwich terns were found at Dabholm Gut, Bran Sands cranes and Seaton channel only. The results from the disturbance work were inconclusive and further survey work is required to determine to what extent foraging common terns are sensitive to specific activities along the River Tees (Natural England, 2018).

Teesmouth and Cleveland Coast SSSI

The SSSI citation states that the Teesmouth and Cleveland Coast SSSI is of special interest for the following nationally important ornithological features that occur within and are supported by the wider mosaic of coastal and freshwater habitats (note the SSSI is also designated for other features not listed below but which are considered elsewhere in this EIA Report):

- Breeding avocet *Recurvirostra avosetta*, little tern *Sternula albifrons* and common tern *Sterna hirundo.*
- A diverse assemblage of breeding birds of sand dunes, saltmarsh and lowland open waters and their margins.
- Non-breeding shelduck *Tadorna tadorna*, shoveler *Spatula clypeata*, gadwall *Mareca strepera*, ringed plover *Charadrius hiaticula*, knot *Calidris canutus*, ruff *Calidris pugnax*, sanderling *Calidris alba*, purple sandpiper *Calidris maritima*, redshank *Tringa totanus* and Sandwich tern *Thalasseus sandvicensis*.
- An assemblage of more than 20,000 waterbirds during the non-breeding season.

Breeding birds

The Teesmouth and Cleveland Coast SSSI is nationally important for breeding avocet *Recurvirostra avosetta*, little tern *Sternula albifrons* and common tern *Sterna hirundo*, and for its diverse assemblage of breeding birds associated with sand dunes, saltmarsh and lowland open waters and their margins.

Avocets were first confirmed breeding on the Tees estuary in 2008 and numbers have subsequently increased. They nest at a range of sites, with Number 4 Brinefield, Greenabella Marsh and RSPB Saltholme regularly used.

Little terns formerly nested in the site in large numbers, but since the late 1990s they have largely relocated to a large colony at Crimdon, approximately 12km north of the Tees in the adjacent Durham Coast SSSI. Small numbers of little tern have been recorded breeding at South Gare in recent years. The site remains a critical foraging area for little tern and supports important pre- and post-breeding gatherings.

The majority of common tern breed on islands and artificial rafts within the RSPB Saltholme reserve, with small numbers scattered at a number of other locations around the estuary. Common tern feed out at sea as well as along the tidal Tees and its main tributaries.

The extensive sand dunes, saltmarsh and wetlands across the site support a diverse assemblage of breeding birds. In addition to avocet and little and common terns, this includes a number of scarce and declining species, such as shoveler *Spatula clypeata*, pochard *Aythya ferina*, ringed plover *Charadrius hiaticula* and little ringed plover *C. dubius.*

Non-breeding birds

The extensive areas of open water, grazing marsh and intertidal habitat provide safe feeding and roosting sites for large numbers of waterbirds throughout the year. The site is of special interest for ten species (shelduck *Tadorna tadorna*, shoveler, gadwall *Mareca strepera*, ringed plover, knot *Calidris canutus*, ruff *Calidris pugnax*, sanderling *Calidris alba*, purple sandpiper *Calidris maritima*, redshank *Tringa totanus* and Sandwich tern *Thalasseus sandvicensis*) and an assemblage of over 20,000 non-breeding waterbirds in the non-breeding season. The assemblage comprises a wide variety of waterbirds, including (in addition to the aforementioned species that are reasons for notification in their own right), large numbers of wigeon *Mareca penelope*, lapwing *Vanellus vanellus*, black-headed gull *Chroicocephalus ridibundus* and herring gull *Larus argentatus*.

Shoveler, gadwall and ruff are predominantly associated with the extensive freshwater wetlands of the site, while ringed plover, knot, sanderling, purple sandpiper and Sandwich tern mostly use the open coast. Redshank are widespread across the site, but the greatest foraging concentrations occur, along with the largest numbers of shelduck, on the intertidal mud of Seal Sands and Greatham Creek. Seal Sands and Bran Sands are also regularly used by ringed plover and knot.

11.4.2 WeBS data

WeBS is a partnership between the BTO, the Royal Society for the Protection of Birds (RSPB) and the JNCC in association with the Wildfowl and Wetlands Trust (WWT). Data from WeBS are routinely used when assessing the ornithological interest of estuarine and coastal areas potentially affected by development.

WeBS core count data concentrates primarily on the winter period but, at selected sites, counts are made once per month throughout the year. Counts are usually made at high tide when birds are most easily counted at roosts (BTO, 2010). Low tide counts are conducted at most large estuaries at least one winter every six years, with up to four counts being made through the period November to February. Low tide counts are designed to complement the core count data and are principally concerned with illustrating bird distributions, allowing the identification of those parts of estuaries, inlets or bays which are important for birds (BTO, 2010).

The Teesmouth and Cleveland Coast pSPA and Ramsar site scientific brief (Natural England, 2018a) states that pSPA and Ramsar site population estimates were derived by combining counts from Tees estuary WeBS core count sectors (excluding the Reclamation Pond sector 52421) and the Durham Coast Sector 1a. The scientific brief (Natural England, 2018) includes the WeBS count data from Bran Sands South (which contains the proposed container terminal footprint). The dredge footprint overlaps with other WeBS count sectors in the Tees estuary, namely Bran Sands North, Peninsula East and North Gare Sands (see Figure 11.2). Data for these sectors has therefore been purchased from the BTO and is presented below in Table 11.8 to 11.11.

Table 11.8 Five-year summary for the Bran Sands South sector (sourced from the BTO)

Year	Peak monthly total	Autumn peak	Winter peak	Spring peak
13/14	1,836 (February)	666	2,277	508
14/15	2,120 (March)	883	2,932	1,685
15/16	1,205 (December)	1,712	1,667	486
16/17	946 (November)	905	1,491	278
17/18	1,911 (January)	652	2,387	615
Mean	1,604	964	2,151	714

Table 11.9 Five-year summary for the Bran Sands North sector (sourced from the BTO)

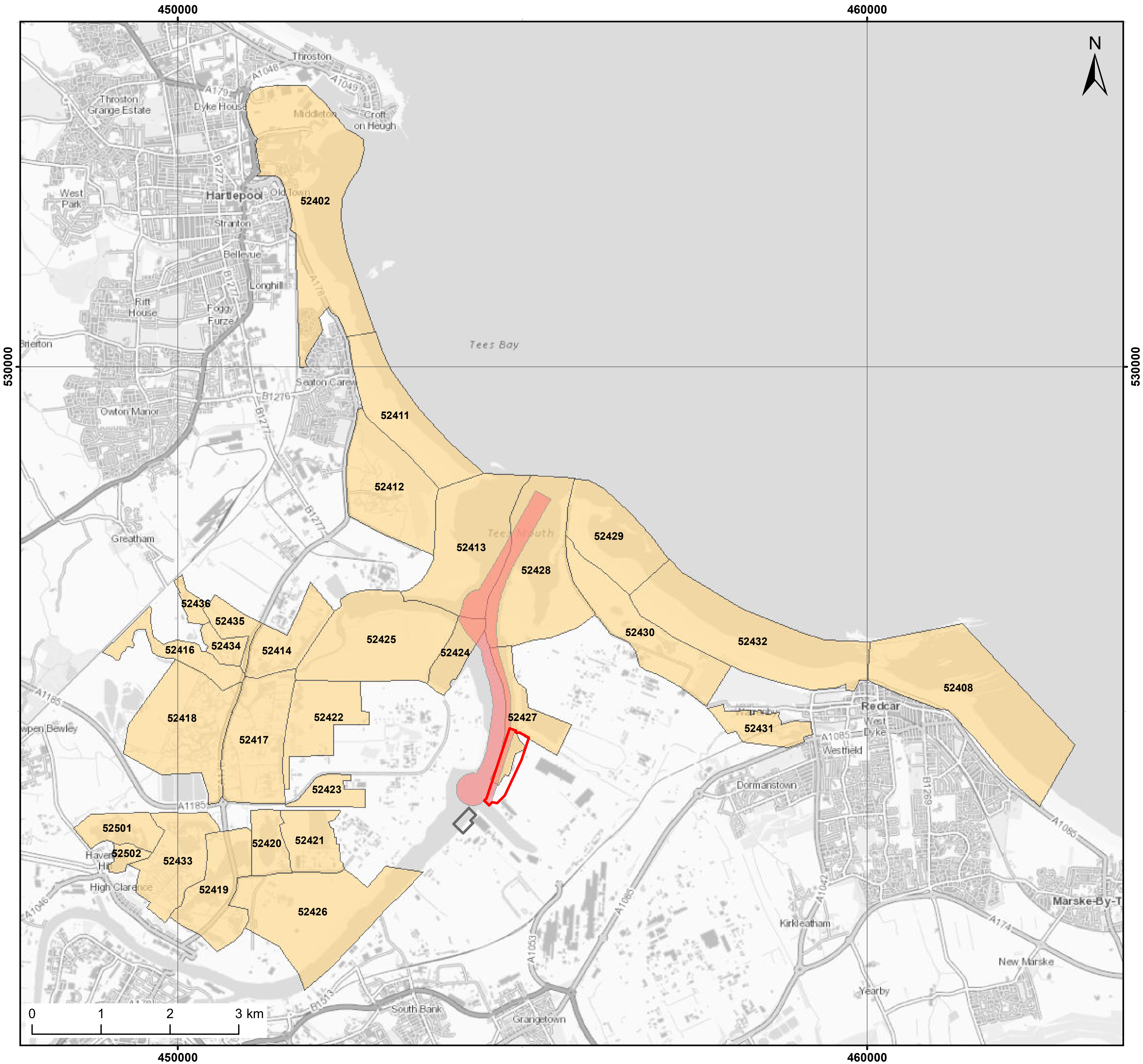
Year	Peak monthly total	Autumn peak	Winter peak	Spring peak
13/14	621 (December)	1130	966	597
14/15	826 (November)	464	1503	463
15/16	1022 (December)	777	1672	277
16/17	1809 (December)	613	2026	405
17/18	688 (July)	1013	1048	253
Mean	993	799	1443	399

Table 11.10 Five-year summary for the North Gare Sands sector (sourced from the BTO)

Year	Peak monthly total	Autumn peak	Winter peak	Spring peak
13/14	1021 (September)	1291	1233	459
14/15	594 (December)	443	1141	294
15/16	2594 (January)	863	3169	452
16/17	1613 (December)	1922	1939	382
17/18	1230 (August)	1503	1424	401
Mean	1410	1204	1781	398

Table 11.11 Five-year summary for the Peninsula East sector (sourced from the BTO)

Year	Peak monthly total	Autumn peak	Winter peak	Spring peak
13/14	94 (September)	94	81	72
14/15	198 (September)	270	63	69
15/16	185 (September)	210	136	146
16/17	404 (September)	450	62	95
17/18	365 (July)	399	54	100
Mean	249	285	79	96



Legend

- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Limit of deviation for Works No. 2 (no longer proposed as part of NGCT scheme)
- Wetland bird survey count core sectors
- Proposed dredge footprint

Client:	Project:
PD Teesport	Northern Gateway Container Terminal

Title: Wetland bird survey count sectors

Figure: 11.2

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	21/10/2019	TC	SR	A3	1:55,000

Co-ordinate system: British National Grid

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11.4.3 Bird survey data from the Teesmouth Bird Club

A number of seabird species, not covered by the Teesmouth and Cleveland pSPA, Ramsar and SSSI or WeBS counts, may also utilise the Tees estuary for foraging. Sightings are collected on an irregular basis by TBC and presented in their annual reports. The Cleveland Bird Report 2017 (TBC, 2018) has been reviewed to determine the presence of any seabirds in significant numbers throughout 2017 not previously mentioned. These are presented with peak numbers recorded, in Table 11.12.

Table 11.12 Breeding and non-breeding seabird species (non-designated) recorded from and adjacent to the Tees estuary (TBC, 2018)

Species	Behaviour	Comments
Pale bellied brent goose	Fairly common autumn migrant, uncommon winter visitor.	Three individuals recorded at Seal Sands during January.
Whooper swan	Fairly common migrant and winter visitor.	Four adults and a juvenile were reported at RSPB Saltholme in January. March is typically the main passage month, with over 40 birds flying over Seal Sands.
Shelduck	Fairly common breeder, migrant and winter visitor.	High numbers present during January and December underlining the importance of the Tees estuary to wintering shelduck. Additional winter counts came from Dabholm Gut with 138 on 3rd January, 108 on 14th February and 82 on 2nd November.
Wigeon	Common migrant and winter visitor.	Spring passage at coastal locations was minimal, with 74 north at North Gare on 4th April.
Teal	Rare breeder, common migrant and winter visitor.	179 birds were recorded on Bran Sands lagoon on 1st February. 346 were present on the lagoon on 15th November.
Tufted duck	Fairly common breeder, migrant and winter visitor.	There was an increase in numbers of this species at locations away from the key area used by tufted duck (namely Longnewton Reservoir), with eight individuals recorded at Greatham.
Scaup	Uncommon migrant and winter visitor.	The five individuals (one male and four females) from late 2016 were still at Saltholme pools on 1st January. Females identified at Greatham Creek on 21st January could be the original birds at Saltholme.
Velvet scoter	Uncommon visitor.	During the summer, a male was reported at North Gare on 24th June.
Common scoter	Common visitor.	2017 was a very poor year for this species, with only two small flocks noted either side of the Tees during the first three months.
Goldeneye	Fairly common migrant and winter visitor.	Counts from areas other than Longnewton Reservoir were low, with Bran Sands lagoon provided the highest single site count, with 23 on 14th February and 16 on 12th December.
Goosander	Rare breeder, common migrant and winter visitor.	A female was observed at Seal Sands / Greatham Creek on four dates (8th to 24th July).
Red-breasted merganser	Fairly common migrant and winter visitor.	During the first winter period the maximum single site counts were 19 at Bran Sands lagoon on 14th February.
Little grebe	Fairly common summer breeder, some resident.	16 were reported on Bran Sands lagoon on 1st February, an d13 were reported on the 12th December.
Shag	Fairly common migrant and winter visitor	Reported in every month, typically favouring Hartlepool Headland, the mouth of the River Tees or Saltburn as feeding areas.
Ringed plover	Uncommon breeder, fairly common migrant and winter visitor	A few breeding pairs were noted, including three between Seaton Snook and North Gare.

Species	Behaviour	Comments
Kittiwake	Abundant breeder and migrant	On the jetties on the River Tees, 171 nests were counted on 27th July on which dates there were at least 168 unfledged chicks present.

11.4.4 Future evolution of the baseline in the absence of the proposed scheme

In the absence of the proposed scheme, the ornithological value of the Tees estuary is unlikely to significantly change from the present day. The ongoing activities along the banks of the Tees estuary would continue, and therefore the levels of direct and indirect disturbance to birds within and adjacent to the Tees would remain.

11.5 Potential impacts during the construction phase

11.5.1 Scope of the assessment

As discussed in Section 6, the proposed capital dredge and reclamation process would cause suspension of sediment into the water column, causing a sediment plume that could potentially affect habitats used by birds and prey that represent a feeding resource for waterbirds and seabirds. The potential adverse impacts arising in the form of reduced feeding resource for birds (both directly due to the proposed reclamation and indirectly due to altered hydrodynamic and sedimentary regime) as well as reduced ability of birds to identify prey species through the water column are discussed here.

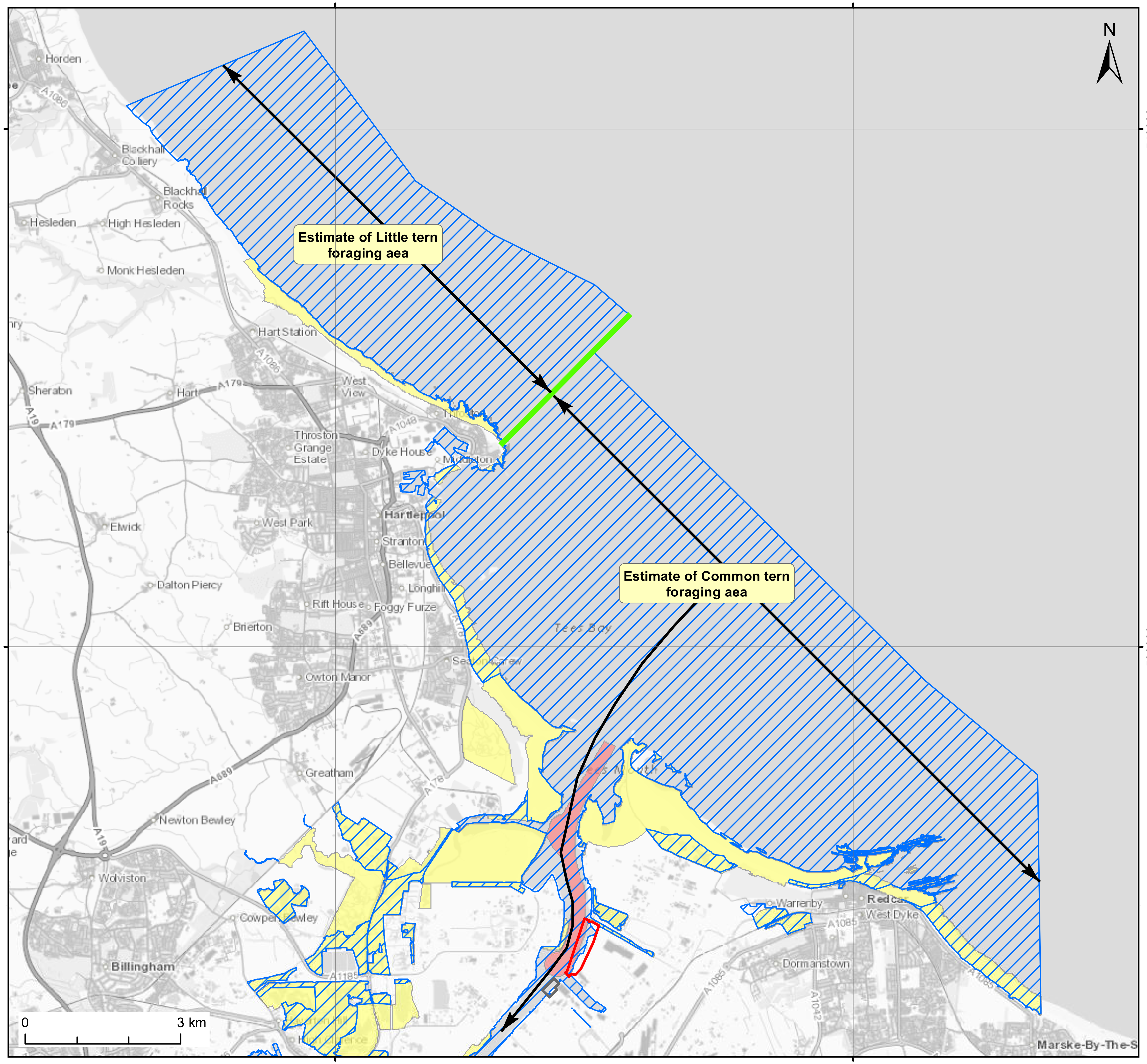
Sediment quality data from within the footprint of the proposed dredge has confirmed that there are no exceedances of Action Level 2. Generally, contaminants were only marginally elevated above Action Level 1, with the exception of PAHs which are elevated throughout the Tees estuary and have been for a significant number of years. Therefore, the assessment presented below relates to the potential impact on prey due to the resuspension of sediment which contains concentrations of contaminants in excess of Action Level 1 only. The predicted increase in SSC resulting from dredging activity is described and assessed in Section 6.

The Tees Bay C offshore disposal site is not located within the boundary of the Teesmouth and Cleveland Coast pSPA, Ramsar site or SSSI, and therefore the assessment presented below focusses on the potential reductions in water quality due to the proposed capital dredging and reclamation activities only.

11.5.2 Impacts to bird feeding resource due to reductions in water quality

The potential effect of dredging using a CSD and TSHD on SSC in the water column is likely to result in a temporary (displacement) impact on small fish that represent prey species for some species of waterbirds. This potential impact is considered below.

It has been demonstrated through survey work (undertaken to inform the boundary for the pSPA and Ramsar site and reported in Natural England, 2018) that the foraging grounds for the little tern colony at Crimdon Dene are contained to the coastal waters north of Hartlepool Headland (approximately 6km north of the mouth of the Tees estuary) (see Figure 11.3). This, in combination with the findings of survey data and WeBS counts reported above, results in a conclusion that little tern do not forage within the Tees estuary. The modelled sediment dispersion plume from the proposed NGCT dredge does not interact with the areas of sea known to support little tern foraging, and therefore it is concluded that there will be no direct impacts to little tern foraging ability as a result of increased suspended sediments during the construction phase.



Legend

- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Limit of deviation for Works No. 2 (no longer proposed as part of NGCT scheme)
- Teesmouth and Cleveland Coast Potential Special Protection Area (pSPA)
- Teesmouth and Cleveland Coast Proposed Ramsar Site
- Proposed dredge footprint

Client:	Project:
PD Teesport	Northern Gateway Container Terminal

Title: Tern foraging areas

Figure: 11.3

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	21/10/2019	TC	SR	A3	1:75,000

Co-ordinate system: British National Grid

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The predicted foraging distribution from the common tern colony at Saltholme illustrated the highest activity in the Tees estuary and at Seal Sands and extending radially offshore across Tees Bay to the 12nm limit. Sandwich tern foraging within the pSPA and Ramsar site is confined to a narrow coastal area within the shallow inshore waters of the estuary. High numbers of sandwich tern and common tern were recorded in the Bran Sands North and North Gare Sands sectors from the most recently available WeBS counts (2013/14 to 2017/18). Of note however, is the absence of common tern, Sandwich tern and little tern in significant numbers in the Bran Sands South WeBS sector (within which the terminal is to be located).

Tern foraging ability may be inhibited by poor visibility above the surface. Terns typically hover several metres above the water surface, before plunging after prey. Vision through clear waters is particularly important for foraging and therefore terns may be sensitive to the turbidity caused by dredging operations and re-suspension of sediment (Cook and Burton, 2010). Common tern have been reported to have a high sensitivity to the potentially longer-term indirect impacts on fish and benthic communities which they feed on (MMO, 2018). However, the occurrence of frequent maintenance dredging activity within and adjacent to the approach channel suggests that exposure to such effects is high and habituation may be likely. Sandwich terns are reported to fly faster, make longer trips, dive deeper from greater heights and catch larger fish than any of the other four British tern species (Cabot and Nisbet, 2013).

As reported in Section 6, for all dredger simulations, the largest rise in peak SSC is predicted in the immediate vicinity of the dredger, centred either at the location of the barge loading pontoon or along the line of the trailing suction dredger track. The hydrodynamic and sedimentary modelling results illustrate that the CSD is predicted to increase SSC by 500mg/l in the immediate vicinity of the barge loading site. Beyond this immediate zone, the increase in concentration is predicted to be in the order of 25mg/l or less.

For spring tide conditions with low freshwater flow, the effect of dredging sandy material with a TSHD in the approach channel and pumping ashore is predicted to result in peak concentrations of between 500mg/l and 1000mg/l along the dredger track and in the vicinity of the run-off from the reclamation. The extent of the predicted increase in SSC associated with both dredging techniques assessed (at the simulated dredge locations shown in Figure 6.1) is illustrated in Figure 6.2 to 6.4.

As shown in Figures 6.2 to 6.4, the capital dredging is predicted to result in an increase in SSC, which has potential to result in adverse effects on small fish that represent the food resource for terns. It is important to note that the common tern foraging area within the pSPA is reported to be approximately 94km^2 (Natural England, 2018).

Figures 6.2 to 6.4 indicate that the magnitude of the effect is likely to extend over a relatively large area of the Teesmouth and Cleveland Coast pSPA boundary within the Tees estuary. However, the increase in SSC is relatively minor in the vast majority of the estuary (in the order of 25mg/l increase outside of the immediate vicinity of the dredger). Therefore, it is predicated that the impacts beyond the immediate vicinity of the dredger would be negligible in terms of reductions in foraging ability, as the predicted increases in SSC are within the natural variability of the system. The predicted impact would be short term, with the SSC returning to background levels relatively quickly following completion of the dredge. Terns are considered likely to be able to continue feeding effectively within the estuary and in the near shore waters of Tees Bay. Given the approximate duration of the proposed dredge (predicted at between four and 11 weeks for granular material and clay and up to 33 weeks for mudstone) and the predicted extent of the sediment plume, the magnitude of the potential effect on feeding birds is predicted to be medium. Based on a receptor sensitivity of very high (i.e. of International / National value), the impact is predicted to be of **moderate adverse** significance.

Mitigation measures and residual impact
To reduce the impact associated with the predicted increase in suspended sediments, the use of a TSHD will be limited to one side of the river at a time. Operations will, therefore, be undertaken in long strips along the axis of the estuary, rather than dredging across the width of the river. This will reduce both the extent and impact of the dredged plume, as any plume generated by operations has been predicted (by HR Wallingford) to remain on the same side of the river as the dredging operation.

This methodology will ensure that a completed strip of the river is clear before the dredger is deployed to the other side. This will allow time for the plume to disperse before operations are moved to a different location. Water quality will, therefore, only be impacted on one side of the river at a time and, should dredging be undertaken during the months when migratory fish are present in the river, one side of the river will remain relatively unaffected. This area will form a passage through which migratory fish will be able to move past the dredging activity (and therefore provide an area within which birds can continue to feed within the estuary).

Mitigation of the plume effects by reducing the size of the dredger, and thus reducing the rate of overflow, is not viable since the size of dredger has to be sufficient to carry a large enough drag head and to have sufficient propulsion power to undertake the required dredging operation.

For the CSD, the most significant impact in terms of producing suspended solids is the overflow from the barge loading equipment. To reduce the potential risk to water quality, and therefore to migratory fish, the barge will be located either on the eastern or western side of the estuary. As with the TSHD, the plume from the barge loading operations will remain on one side of the river, albeit dispersing to a lesser extent and tending to be more confined to the shallower waters. Mitigation of the suspended sediment generated by reducing the size of the dredger, and thus reducing the rate of overflow, will not be possible as a smaller dredger would have insufficient power to be able to cut though the stronger materials and, hence, the smaller equipment would not be able to carry out the work.

With the implementation of the above measures, it is concluded that the residual impact to feeding waterbirds would be **minor adverse**.

11.5.3 Direct loss of intertidal due to reclamation and capital dredging

The construction of the terminal would result in the loss of the intertidal area within the footprint of the terminal as well as Riverside Ro-Ro and the existing jetty upstream. Although this would occur (progressively) during the construction phase, the potential impacts on waterbirds would manifest during the operational phase. Hence, the potential impact is addressed in Section 11.6

11.5.4 Potential effects on intertidal habitats available to feeding waterbirds due to predicted effects on tidal prism

Changes to the cross-sectional area of the Tees estuary as a consequence of capital dredging and reclamation can influence the tidal propagation (tidal prism) within the estuary. This potential effect has been fully examined as part of the hydraulic modelling studies reported in Section 6 of this report. Changes in tidal propagation can affect the level of low and high water and, therefore, result in changes to the area of intertidal habitat that is exposed at low water. The consequence of such changes is that the area of habitat available for feeding birds can be indirectly affected.

The modelling studies conclude that the effect on tidal propagation would be minor, with no change in elevation of either high or low water downstream of the site of the proposed development. This zone of the estuary has the most significant areas of intertidal feeding habitat within the system (e.g. Seal Sands) and **no impact** is predicted on these areas. At the site of and upstream of the proposed container terminal, it is predicted that changes to water level would be small.

The North Tees mudflat (upstream of the development) is the key area of intertidal that has the potential to be impacted by the predicted increase in tidal range (4mm for spring tides). The predicted changes, however, will not affect the intertidal area at high water as the water level will change against the river walls. For low water, the predicted increase on spring tides has the potential to convert up to 40m^2 of intertidal area to very shallow subtidal. However, it should be noted that this area will not be lost; rather the frequency at which it will be submerged will change. This change in low water level would result in a notional shift of the low water line 10cm towards the river edge and a narrow strip of presently drying intertidal area remaining wet. The water depth in this area would be up to 2mm.

In terms of potential knock-on effects on the ability of birds to feed in this area, the impact is considered to be of **negligible** significance given the very small area of intertidal to be affected on certain states of the tide. It is considered that predicted changes to water levels upstream of the North Tees mudflat are not relevant in terms of effect on feeding waterbirds given the lack of intertidal in such areas.

Mitigation measures and residual impact
This predicted effect of the scheme is not possible to mitigate, and there would be **no residual impact** for intertidal areas downstream of the proposed scheme, and a residual impact of **negligible** significance at North Tees mudflat.

11.5.5 Effects of sediment deposition on intertidal food resources due to capital dredging

The deposition of fine sediment within intertidal areas due to capital dredging has the potential to affect benthic communities that represent a feeding resource for waders and wildfowl. For example, high levels of overall deposition or a high rate of deposition could adversely affect components of the benthic community to the detriment of feeding waterfowl.

The nature of the predicted deposition of fine material, in terms of total deposition, rate of deposition and areas affected by the dredging, is presented in Sections 6 and 7. The implications of this for benthic communities are presented in Section 9 where it is concluded that the structure and functioning of the benthic communities of intertidal areas would not be affected by deposition associated with capital dredging.

Given the above, it is concluded that there will be no adverse effect on intertidal food resources as a result of the effects of capital dredging and **no impact** is predicted.

Mitigation measures and residual impact
No mitigation measures are required. However, as set out in Section 9, the studies undertaken to assess the impacts of the scheme on hydraulic parameters indicate that placement of the CSD barge on the eastern side of the estuary will reduce the potential for material to be transported to Seal Sands. The CSD barge will, therefore, be preferentially placed on this side of the estuary for the duration of the capital dredging to reduce the potential for impact on the feeding resource for birds at Seal Sands. There would be **no residual impact**.

11.5.6 Construction phase noise disturbance to waterbirds

Wright *et al* (2010) investigated the effects to waterbirds to impulsive noise and have identified ranges in noise which cause behavioural responses (based on a measured LAeq). These are:

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- no observable behavioural response: 54.9 to 71.5dBA (with a high proportion of extreme outliers);
- non-flight behavioural response: 62.4 to 79.1dBA;
- flight with return: 62.4 to 73.9dBA; and,
- flight with all birds abandoning the site: 67.9 to 81.1dBA.

The above information highlights that, below 55dBA, effects would not be significant, but when noise levels increase (particularly approaching 70dBA) there is a range of bird responses which have the potential to cause adverse effects.

The noise modelling undertaken as part of the NGCT EIA studies predicted construction noise levels at a number of noise sensitive ecological receptors. This data is reproduced within Table 11.13 below.

Table 11.13 Predicted airborne noise levels at ecological receptors

Location	Existing measured background noise	Predicted noise level from piling (dB LAeq)
Vopak foreshore	57	78
Bran Sands lagoon	57	79
Bran Sands	54	55
Seal Sands	56	55
North Gare Sands	56	62

In addition to the above sensitive locations, the change to the boundary of the Teesmouth and Cleveland Coast pSPA and Ramsar site results in the waters of the Tees estuary below the Tees Barrage also representing sensitive feeding habitat for terns. The potential, therefore, exists for noise disturbance to any terns that may be feeding in the estuary as a result of the proposed construction works.

The predicted noise levels shown in Table 11.13 illustrate that there is likely to be no observable behavioural response to waterbirds at Seal Sands or North Gare Sands as a result of the proposed piling. Closer to the noise source (i.e. at Bran Sands lagoon and Vopak foreshore (and the adjacent estuarine waters)), it is expected that waterbirds will exhibit a non-flight behavioural response (e.g. moving away from the source of noise emission), or, birds may exhibit a flight response.

Other research (by Cutts *et al*., 2008) states that sudden, irregular noise above 50dBA should be avoided as this causes the maximum disturbance to birds. The research concludes that no effect would be expected for noise emissions below 50dBA, with head turning, scanning, reduced feeding and movement to other areas close by for noise emissions between 50dBA and 85dBA. The findings of this research support the conclusion drawn above, in that some behavioural response is likely from waterbirds exposed to higher noise levels closer to the noise emission source at Bran Sands lagoon, Vopak foreshore and the adjacent estuarine waters.

The significance of the potential impact of noise disturbance due to the proposed construction works will depend on the timing of the construction works relative to the period when waterbirds numbers are at their highest in the Tees estuary (which is the overwintering period, generally considered to be October to March). For the purposes of the assessment and on a precautionary basis, it has been assumed that the piling works take place over some or all of the winter period. As reported in Section 3, piling for the quay terminal is anticipated to last for approximately 44 weeks for Phase 1 and 24 weeks for Phase 2 respectively. As detailed in Section 3 however, percussive piling would be very much an intermittent activity over this period.

To inform the significance of the potential disturbance impact to birds from construction works, a review of bird monitoring undertaken by INCA in 2004 has been undertaken. Bird behaviour on Seal Sands was monitored during a period of percussive piling at Conoco-Phillips (approximately 270m away) (see Figure 11.4). On all four of the monitoring visits (undertaken at the start and during the piling), there was no evident disturbance to the birds, with birds continuing to feed on Seal Sands (Geoff Barber, pers. comm.). The closest area of sensitive riverine intertidal habitat to the proposed NGCT is at Vopak foreshore, approximately 280m away (although it is recognised that there are topographical differences).

Based on the evidence presented above, the magnitude of the effect will be low and the effect will be temporary. The value of the receptor is very high (Internationally / Nationally important). However, the effect is not predicted to represent a population level impact. Nevertheless, it is anticipated that there will be a temporary disturbance effect over part of Bran Sands lagoon, Dabholm Gut and the waters within the Tees estuary, but that an impact of **minor adverse** significance will arise.

Mitigation measures and residual impact

As mitigation for the potential impact of noise disturbance during the construction phase, it is proposed that noise attenuation barriers (i.e. temporary screens) are positioned along the western boundary of Dabholm Gut. The use of a noise reduction curtain over the hammer piling rig during percussive operations will also be investigated with the contractor prior to starting works; this can provide a minimum of 10dB attenuation to the predicted noise levels reported in Table 11.13.

The use of noise reduction barriers at the above locations (as well as an acoustic barrier on the embankment between the lagoon and the Tees estuary and along the eastern side of Bran Sands lagoon) was modelled during production of the York Potash Harbour Facilities EIA in 2014. The same modelling package was used during production of this EIA Report and the York Potash Harbour Facilities ES (SoundPLAN), and the input parameters for the model were not materially different (i.e. both models used sound power levels from BS5228 and both models assumed percussive piling would be used). The findings from the York Potash Harbour Facilities EIA therefore provide useful context to this report.

The acoustic barriers were found to reduce the pre-mitigation construction noise levels (predicted to arise from the York Potash Harbour Facilities scheme) by approximately 10dB. Given the similarities between the two schemes (in terms of the construction techniques which have been assessed), the modelling package which has been used (both EIAs used the SoundPLAN model) and the proximity of the proposed scheme footprints to each other, it can be concluded that the findings of the York Potash Harbour Facilities EIA (with regard to the effectiveness of acoustic barriers) can be reasonably applied to the proposed NGCT scheme. Assuming a 10dB reduction in noise level as a result of the acoustic barriers, the noise levels over the Bran Sands lagoon and on the Vopak foreshore (and the adjacent Tees estuary) would reduce to a level that will cause no observable response in waterbirds using these areas (based on the ‘thresholds’ from Wright *et al* 2010).

With the implementation of the above mitigation measures, it can be concluded that the potential for construction related noise disturbance to waterbirds will be **negligible**.

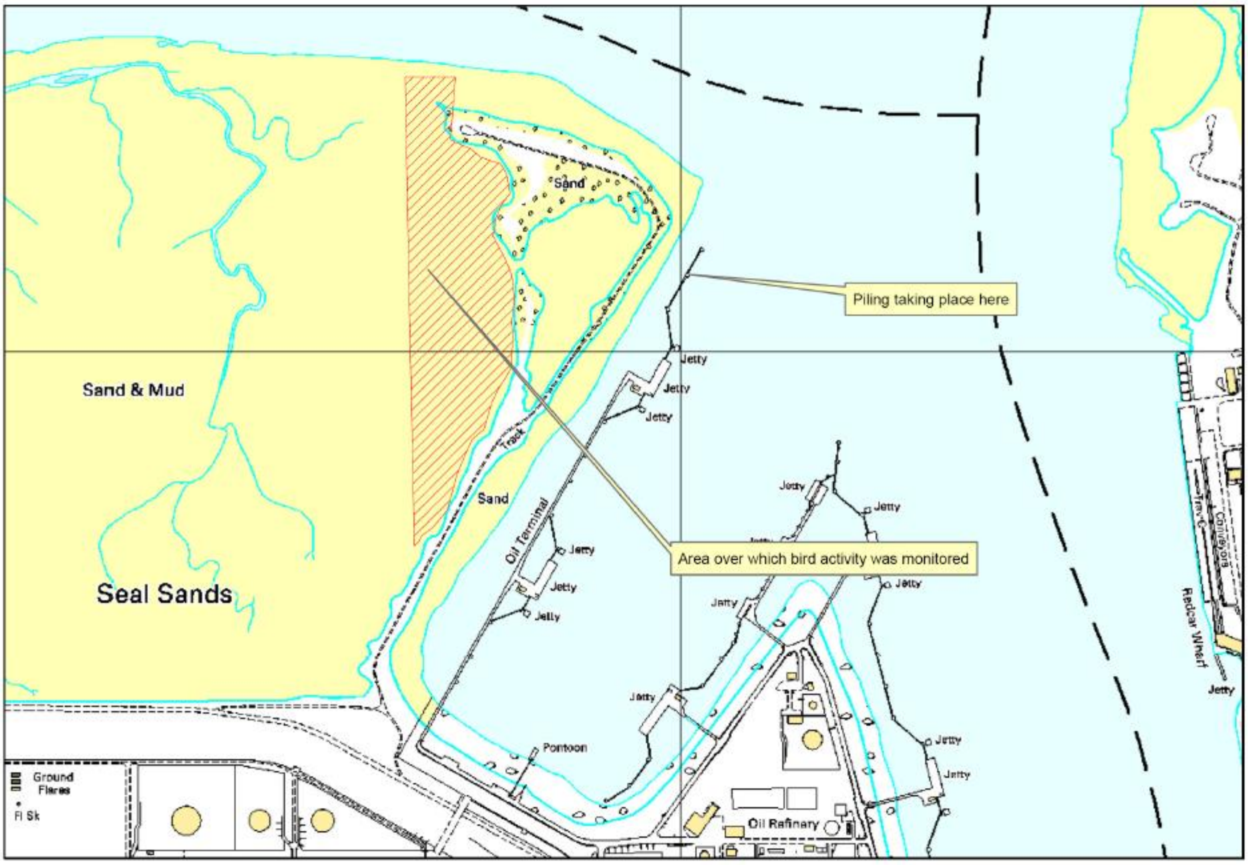

Figure 11.4 Location plan showing 2004 bird monitoring and piling locations

11.5.7 Effect of underwater noise disturbance on the food resource for terns

The Tees estuary (downstream from the Tees Barrage) is included within the boundary of the Teesmouth and Cleveland Coast pSPA and Ramsar site to protect foraging areas for common tern. As detailed above, Natural England has also extended the boundaries of the SSSIs around the Teesmouth and Cleveland Coast into the Tees estuary to protect breeding and wintering birds (through the notification of the Teesmouth and Cleveland Coast SSSI).

The proposed scheme has the potential to indirectly impact on foraging common tern (pSPA and Ramsar site) and other (unspecified) wintering waterbirds (SSSI) by impacting the availability of prey species (i.e. fish). Section 12 of this report considers the potential impact of underwater noise disturbance to fish as a result of the proposed scheme. The underwater noise assessment presented in Section 12 concludes that the overriding consequence of the generation of noise during piling (as well as the dredging and construction activities) will be for fish to move away from the source of disturbance. Therefore, in the worst case, the construction works are expected to result in the localised redistribution of resident fish species and temporary disturbance to migration patterns of fish throughout the Tees estuary. It is, therefore, considered that the temporary disturbance to the feeding resource for waterbirds, within a localised area of the estuary will result in an impact of **negligible** significance to feeding waterbirds.

Mitigation measures and residual impact

No mitigation measures are required. The residual impact would be of **negligible** significance.

11.6 Potential impacts during the operational phase

11.6.1 Potential effect on the morphology of intertidal habitats and implications for waterbird populations

The predicted effects of the proposed scheme on the morphology of intertidal areas throughout the estuary system is summarised in Section 6. This summary integrates the effects of the proposed scheme on tidal currents speeds and directions and wave climate and, therefore, represents an overview of the effects of the proposed scheme on intertidal habitats during the operational phase.

In summary, the predicted effects of the scheme on physical processes (which have the potential to combine to result in an effect on estuarine morphology), are summarised as follows:

- reduced large-scale flows in the main deepened channel;
- increased near bed landward residual flow;
- slightly increased tidal range towards the Tees Barrage;
- increased import of fine sediments resuspended in Tees Bay;
- increased reflection of wind waves within the estuary from the reclamation;
- increased swell wave heights in the deepened channel; and,
- reduced swell wave heights over the intertidal at the mouth of the estuary.

With respect to the third bullet above, the implications for waterbird feeding areas are addressed in Section 11.5.4 above.

When considering potential impact on feeding areas for waterfowl, the key areas of interest are considered to be Seal Sands and North Gare and Bran Sands. These areas are the main areas of intertidal habitat in the estuary that are of importance for feeding waterfowl.

For Seal Sands, it is concluded overall that the morphological effects associated with the proposed scheme are likely to be small. It is predicted that there will be a small (order 10%) increase in the supply of fine material to Seal Sands (via Seaton Channel). It is predicted that fine material would accumulate in the areas of Seal Sands that are currently comprised of muddy sediments, with coarser areas unlikely to experience accumulation of fine material. No changes to tidal flows in this area are predicted and therefore the route for a potential effect on intertidal morphology is the increase in supply of fine sediment described above.

In addition to the increased supply of fine material, it is predicted that the scheme may provide a short-term source of sand to Seal Sands by some slumping of sand into the Seaton Channel turning circle. However, the predicted reduction in storm wave action over North Gare would be expected to counterbalance the significance of this potential source of sand. On balance, the increase in supply of fine material to Seal Sands (described above) is likely to be the dominant process affecting intertidal morphology of this area.

It is concluded that the net effect of the scheme will be to contribute to a raising of the elevation of the intertidal area. This is predicted to be of very low magnitude (predicted to be 0.3mm/year) and indistinguishable from background (considered to be in the order of 3mm/year) (i.e. a change of 10%). Overall, the effect of the scheme on intertidal morphology of Seal Sands with respect to habitats for feeding waterbirds is predicted to be of **negligible** significance.

The proposed scheme is not predicted to have a significant effect on the intertidal areas at North Gare and Bran Sands. No changes to tidal flows are predicted, although decreases in the swell wave heights are predicted over these areas which may result in some localised redistribution of bed material. Overall, **no impact** on waterbird populations is predicted.

Mitigation measures and residual impact
No mitigation measures are possible and it is predicted that there would be a residual impact of **negligible significance** (Seal Sands) and **no residual impact** at North Gare and Bran Sands

11.6.2 Potential effect of increased supply of fine sediment to Seal Sands on feeding resource for waterbirds

The potential impact of the increased supply of fine sediments to Seal Sands on the benthic community structure is described in Section 9.5. In summary, it is concluded that the physical effects arising from the proposed scheme are unlikely to have an impact on benthic community structure of Seal Sands and consequently the potential impact on waterbird populations is considered to be of **negligible** significance.

Mitigation measures and residual impact
No mitigation measures are required and the residual impact would be of **negligible significance**. However, as reported in earlier sections, the barge for the CSD would be located preferentially on the eastern side of the estuary for the duration of the capital dredge, to reduce the potential for sediment transport to Seal Sands during the capital dredge. This would reduce the potential for any construction phase impacts associated with sediment transport to Seal Sands manifesting during the operation phase and impacting on feeding waterbirds in this area.

11.6.3 Disturbance to feeding and roosting waterbirds due to increased shipping activity (shipwash)

Shipwash can be a source of disturbance to feeding waterbirds in that it can propagate across intertidal areas and cause birds to take flight. This disturbance, especially if it is repeated, minimises the time that birds can feed within the tidal cycle and can reduce the overall feeding efficiency. This can be critical during the winter months and during periods of particularly severe weather when maximising available feeding time is of paramount importance. With respect to the proposed scheme, the areas potentially affected which are used by waterbirds are North Gare Sands, Bran Sands, Seal Sands and the Vopak foreshore.

North Gare Sands and Bran Sands are relatively exposed areas of intertidal, although some protection is afforded by the breakwaters. Seal Sands is likely to be less vulnerable to shipwash given its relatively sheltered location and the presence of the training wall fronting Seaton Channel.

The Tees estuary currently experiences high levels of shipping activity, with between 800 and 950 vessel movements per month. The increase in vessel numbers that is predicted to result during the operational phase (approximately 100 per year) is not considered significant in the context of existing overall vessel movements in the estuary. In addition, the Tees currently accommodates vessels of up to 350m in length, including large tankers which berth at the Tees North Sea Oil Terminal and large bulk carriers bringing coal and ore to Redcar Ore Terminal.

The Vopak foreshore is opposite the proposed terminal and could be affected by shipwash through manoeuvring vessels at the terminal. However, the fact that speeds will be low results in a low potential for ship-generated wash to impact significantly on the foreshore.

Overall, the potential additional impact associated with the proposed scheme is assessed to be of **negligible** significance for North Gare Sands, Bran Sands and the Vopak foreshore, given that waterbirds only have the potential to be affected whilst the mudflats are exposed. **No impact** is predicted for Seal Sands for the reasons set out above (i.e. existing sheltering provided by the training wall).

Mitigation measures and residual impact

Other than the normal controls on navigation already exercised by PDT, no other mitigation is possible. The residual impact would be of **negligible** significance for waterbirds at North Gare Sands, Bran Sands and the Vopak foreshore and **no impact** is predicted at Seal Sands.

11.6.4 Potential effect of maintenance dredging on food resources

The hydraulic and sediment transport studies conclude that there would be an increased maintenance dredging requirement during the operational phase but this would not warrant an increased frequency of dredging above that which already occurs (however the campaigns are likely to be longer duration). As the proposed scheme footprint is already subject to maintenance dredging and no increase in maintenance dredge frequency is predicted, an impact of **negligible** significance is predicted to the feeding resource of waterbirds.

Mitigation measures and residual impact

Maintenance dredging of the approach channel (and the associated regular disturbance to the benthic community) is an unavoidable consequence of the proposed scheme. There are no mitigation measures that can be implemented. The residual impact would be of **negligible** significance.

11.6.5 Disturbance to feeding and roosting waterbirds due to noise generated by the container terminal

Airborne noise generated during operation of the container terminal may impact on bird populations that utilise the Tees estuary and the adjacent watercourses (namely Dabholm Gut and Bran Sands lagoon). Noise modelling has been undertaken to predict the operational phase noise levels due to passing and turning of ships at several representative locations within the estuary. This information is presented in Table 11.14.

During the operational phase, there would be no change to the maintenance dredging method or frequency and, therefore, there would be no significant underwater noise effect associated with maintenance dredging for the proposed berth pocket.

As noted below, noise modelling has predicted that the noise level would be below the background level, with the exception of Bran Sands C, where the noise from ship passing is predicted to be 1dB greater than the background. It can be concluded that the birds using Bran Sands C would be expected to experience an increase in noise during the operational phase, but the magnitude of this effect is predicted to be low and would not be expected to result in a behavioural effect on waterbirds. Birds would habituate to the change in noise level of the order and nature that is predicted, and this should be reflected in the assessment of the significance of the potential impact. Hence it is concluded that the impact would be of **negligible** significance.

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Table 11.14 Predicted airborne noise levels at ecological receivers within Teesmouth

Location	Existing measured background noise	Ship passing (dB LAeq)	Ship turning circle noise (dB LAeq)
Vopak foreshore	57*	54	50
Bran Sands lagoon	57*	47	46
Bran Sands A	54*	-	-
Bran Sands B	51*	47	-
Bran Sands C	51	52	-
Seal Sands A	56*	-	33
Seal Sands B	53	46	-
North Gare Sands A	56*	50	-
North Gare Sands B	53	51	-

*Background noise levels derived from nearest background measurement position, namely northern end of Bran Sands or northern end of North Gare Sands, and determined by calculation.

Mitigation measures and residual impact

No mitigation measures are required. The residual impact would be of **negligible** significance.

11.6.6 Loss of intertidal habitat due to reclamation and 'off-site' habitat improvement

The construction of the NGCT would result in the loss of intertidal within the footprint of the proposed reclamation (assuming a closed structure is constructed). However, as noted above, the affected intertidal comprises predominantly rock armouring that does not represent a significant feeding area for waterbirds (and no areas of mudflat were reported to be present following the 2019 intertidal survey). It is therefore concluded that the intertidal that would be directly affected by the proposed scheme is of low sensitivity as a feeding area for waterbirds.

The capital dredging, which involves dredging adjacent to the Vopak foreshore opposite the proposed reclamation area, would not result in a direct impact on the foreshore. Consequently, no loss of intertidal area would arise as a result of the capital dredging.

As a result, it is concluded that there would be an impact of **negligible** significance on feeding waterbirds due to the direct effects of reclamation works or capital dredging.

The proposed habitat improvement measures downstream of Newport Bridge would enhance a degraded area of intertidal habitat and create an area of sedimentary habitat that is expected to provide a more favourable area for feeding waterbirds. Whilst the location of the proposed habitat improvement measures is some distance from the core feeding and roosting areas used by waterbirds in the estuary, the measures would represent an enhanced feeding resource and would add to the diversity of habitat types in the upper estuary, extending the availability of intertidal mudflat within the Tees. This is considered to a potential impact of **minor beneficial** significance

Mitigation measures and residual impact

No mitigation measures are required. The residual impact, taking into account the effect of the habitat improvement measures, would be of **minor beneficial** significance.

12 FISH AND SHELLFISH

12.1 Introduction

This section of the EIA report considers the following potential impacts to fish and shellfish:

- Direct uptake and disturbance of fish during capital dredging.
- Impacts caused by increased suspended sediment during capital dredging and dewatering during reclamation.
- Effects of light on fish populations during construction and operation.
- Restriction of access to potential fishing grounds during construction.
- Underwater noise disturbance during construction and operation.
- Impact on feeding resource for fish during operation.

12.2 Policy and consultation

12.2.1 Policy

Marine Policy Statement

The MPS states that fishing activity is sensitive to changes in other sea uses, with marine developments having the potential to prevent, displace or encourage fishing activities. There are potential social, economic and environmental implications of displacement of fishing activity caused by other sea uses, particularly if from well-established fishing grounds.

The MPS states that the coastal environment is important as a corridor for migrating Atlantic salmon and European eel, as well as providing the marine feeding ground for sea trout. These important species that support coastal and inland commercial fishing and recreational angling could be vulnerable to a wide range of coastal activities. Marine plan authorities should consider the potential social and economic impacts of other developments on fishing activity, as well as potential environmental impacts.

12.2.2 Consultation

Summary of comments received during the HRO scoping phase

Table 12.1 provides a summary of the comments received from the MMO within its Scoping Opinion on the HRO process (specifically comments which the MMO considered should be addressed within a marine licence application). Table 12.1 also includes a reference to the relevant section of this EIA Report where the comment has been addressed.

Table 12.1 Summary of comments in the MMO's Scoping Opinion with regard to fish and fisheries

Scoping comment	Response / section of the EIA Report where comment has been addressed
As piling is expected to be required for the construction of the quay wall, the MMO would expect that underwater noise and vibration arising from the construction works will be reviewed and the potential impacts on sensitive fish receptors assessed.	Section 12.5
The final construction programme should be confirmed. This will help inform if any mitigation is required, e.g. for fish receptors.	Section 3
The works to the watercourse should not be undertaken between the start of October and the end of April in any given year and if works are carried out between March and September, in any given year, a Silt Mitigation Plan must be in	The assessment has been undertaken on a worst-case basis whereby works are undertaken at any time of the year.

Scoping comment	Response / section of the EIA Report where comment has been addressed
place and/or an appropriate water quality monitoring programme must be implemented in accordance with any scheme previously agreed with the Environment Agency.	
The MMO supports the adoption of a 'soft-start' approach to any marine piling which occurs during construction. The highly audible percussive piling, in particular, has the potential to disturb, displace, injure or kill fish.	Noted. PDT has confirmed the adoption of soft-start techniques would be possible and therefore this approach has been proposed as mitigation where appropriate.

Summary of comments received during consultation with the Environment Agency and Natural England

A meeting was held with the Environment Agency and Natural England in November 2018 to discuss the requirement for seasonal restrictions on proposed works in the watercourse. The Environment Agency advised that the seasonal restrictions proposed to manage the risk of injury / disturbance to fish were a starting point, and sufficient justification would need to be provided in order to remove these restrictions.

PDT has confirmed that seasonal restrictions on construction works would result in significant programme implications and are not considered to be appropriate given the daily maintenance dredging which is undertaken. The information presented below has therefore been proposed in order to provide the Environment Agency with comfort that seasonal restrictions are not required in order to manage the potential risks to fish.

12.3 Methodology

12.3.1 Study area

For fish and fisheries, the study area comprises the likely maximum extent over which potentially significant environmental impacts of the proposed scheme may occur. This was informed by hydrodynamic and sediment dispersion modelling and is based on the maximum extent over which effects are predicted to occur (e.g. sediment plumes generated during capital dredging and effects on tidal currents during operation).

12.3.2 Methodology used to describe the existing environment

The description of the existing environment with regard to fish and fisheries has been informed through both desk-based assessment and site-specific survey information (specifically scientific beam trawls).

The benthic ecological survey effort involved 16 scientific benthic trawls within an adjacent to the proposed dredge footprint undertaken during March 2019 by Ocean Ecology Ltd (Figure 9.1). The trawls were evenly distributed across the proposed dredge footprint and tows were undertaken for between seven and nine minutes at a speed over the ground of one to two knots. The trawl sampling was undertaken using a 2m beam trawls with a 5mm cod end. The trawls were undertaken in line with guidelines set out by Ware et al (2011) and further detailed in the Recommended Operating Guidelines (ROG) for MESH trawls and dredges (Curtis and Croggan, 2007, cited in OEL, 2019).

Processing of beam trawl samples was undertaken in line with the guidelines set out by Ware *et al.* (2011) and further detailed in the ROG for MESH trawls and dredges (Curtis & Coggan 2007). A labelled sample photograph was taken, then all fish and epibenthic fauna were sorted, identified and enumerated (presence / absence for colonial / encrusting species) in the field. Length measurements (to the nearest mm) were taken for all commercial fish and shellfish species and photographs were taken of cryptic specimens. When identification required clarification, individuals were transferred to a labelled sample container and fixed in 4-5% buffered formaldehyde solution and identified on return to OEL's NMBAQC scheme participating laboratory. The entire sample was returned to the water once all individuals were identified, enumerated and measured (where required).

The findings from the trawls have been presented in Section 12.3 below. It should be noted that the findings from benthic trawls represent only a snapshot of the fish species (largely demersal species) which are present within the area at the time of the survey. Also, benthic trawls do not effectively survey / sample pelagic species of fish.

In addition to this information, data from the following sources has been reviewed to inform the baseline understanding of fish usage of the area:

- Data from the Fish Atlas of the Celtic Sea, North Sea and Baltic Sea (Heesen *et al.,* 2015).
- OSPAR list of Threatened and/or Declining Species and Habitats.
- UK Biodiversity Action Plan Priority habitat and species.
- Published literature regarding the north-east cod surveys undertaken between 2003 and 2012.
- Fish spawning and nursery grounds of selected fish species in UK waters (Ellis *et al.,* 2012 and Coull *et al.,* 1998).

Published fisheries statistics for the ICES statistical rectangle has also been reviewed alongside vessel monitoring system (VMS) data to aid our understanding of the fisheries use of the area.

A review of the Teesmouth and Cleveland Coast pSPA and Ramsar site Departmental Brief (Natural England, 2018) has been undertaken to determine the species of fish which are most important for foraging terns (which are a key interest feature of the pSPA).

12.3.3 Methodology for assessment of potential impacts

The generic assessment methodology used to determine the potential environmental impacts associated with the proposed scheme is set out within Section 5.

The predicted effects of the proposed scheme on the hydrodynamic and sedimentary regime and potential impacts on marine sediment quality, water quality and marine ecology are relevant to this section of the EIA Report and, therefore, reference has been made to the findings for these topic areas as appropriate.

12.4 Existing environment

12.4.1 Literature review of existing information on resident and migratory species

Tees Bay and the Tees estuary provide important habitats for a number of fish species which feed on benthic invertebrates found in subtidal and intertidal sediments. Intertidal habitats are a key marine habitat and have a high abundance of species; they are also typically highly productive and support large numbers of fish species. Further detail regarding the fish species known to be present within the Tees estuary is provided below.

The lower Tees estuary supports many fish, some of which are estuary dependant (e.g. flounder *Platichthys flesus*) and some temporary residents (e.g. plaice *Pleuronectes platessa*), which use the estuary as a nursery ground (Tansley 2003), with herring (*Clupea harengus*), sprat (*Sprattus sprattus*), cod (*Gadus morhua*), spurdog (*Squalus acanthias*), anglerfish (*Lophius piscatorius*), whiting (*Merlangius merlangus*), lemon sole (*Microstomus kitt*) and nephrops (*Nephrops norvegicus*) also recorded in the general area.

Herring and plaice are identified as BAP species and priority species by the grouped plan for commercial marine fish (UK BAP, 2009). Sandeels are also abundant in the local area and although there is no commercial fishery, they are an important food source for bird populations

Migratory fish species are also present within the Tees estuary, including salmon (*Salmo salar*), sea trout (*S. trutta*), and European eel (*Anguilla anguilla*). Improvements in water quality in recent years have enabled the numbers of salmonids to steadily increase, and the Tees is now recognised as a main salmon river in England and Wales. There are upstream movements of salmon from May onwards through summer to peak movement in September/October, with the downstream smolt run peaking in May.

The river lamprey (*Lampetra fluviatilis*) is found only in western Europe and is widespread in the UK. Whilst not a true 'fish' (as it is jawless), lamprey is a migratory species which grow to maturity in estuaries and then move into fresh water to spawn in clean rivers and streams. River lampreys enter the Tees estuary to spawn and have been observed at the Tees Barrage at Stockton. Sea lampreys have also been recorded within the Tees estuary.

Figure 12.1 shows the number of upstream migrating salmon and sea trout recorded from an electric fish counter at the Tees Barrage, installed during 2011. The data shows that the numbers of migrating salmon and sea trout upstream in the Tees estuary commences from April, generally peaking in July and August.

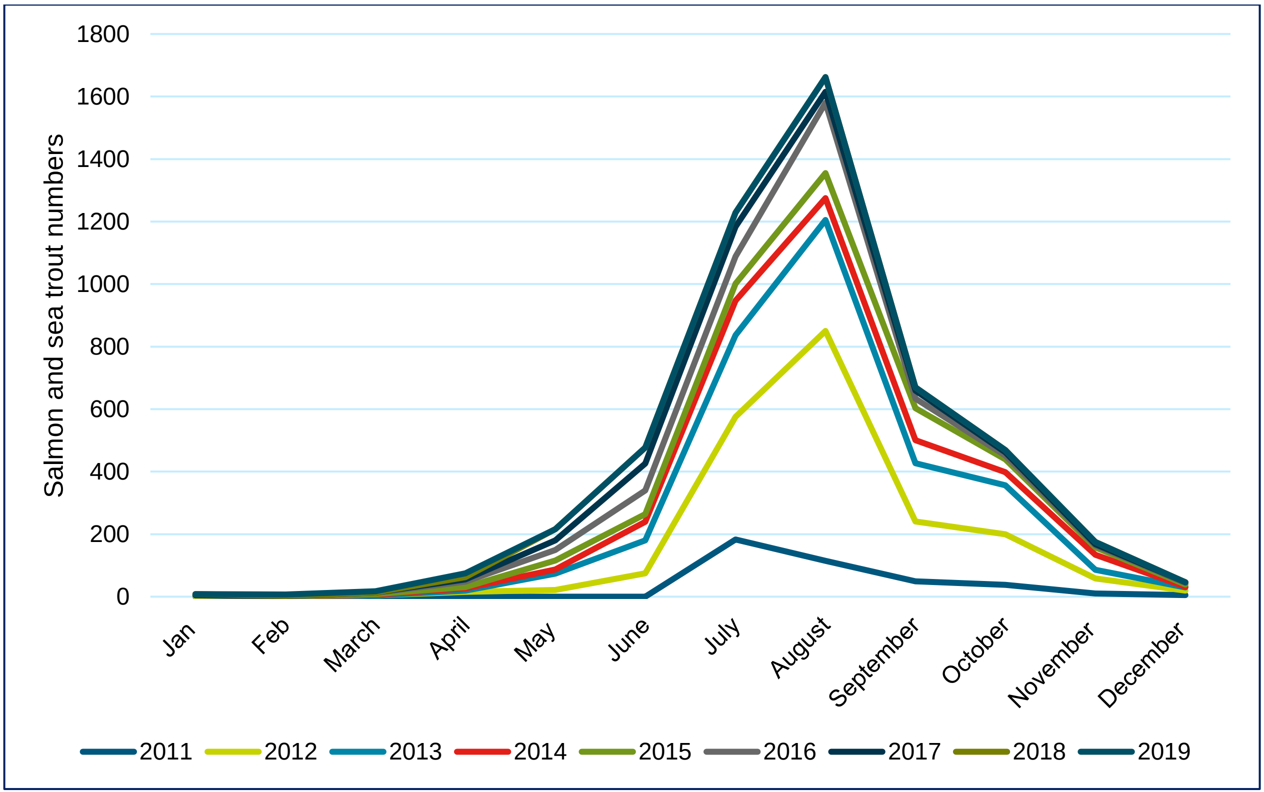

Figure 12.1 Upstream salmon and sea trout numbers measures at the electric fish counter at the Tees Barrage

Figure 12.2 illustrates the rod catch data from the River Tees. This data was sourced from the Environment Agency during October 2017. The data illustrates rod catches of approximately 100 salmon and 50 sea trout per year.

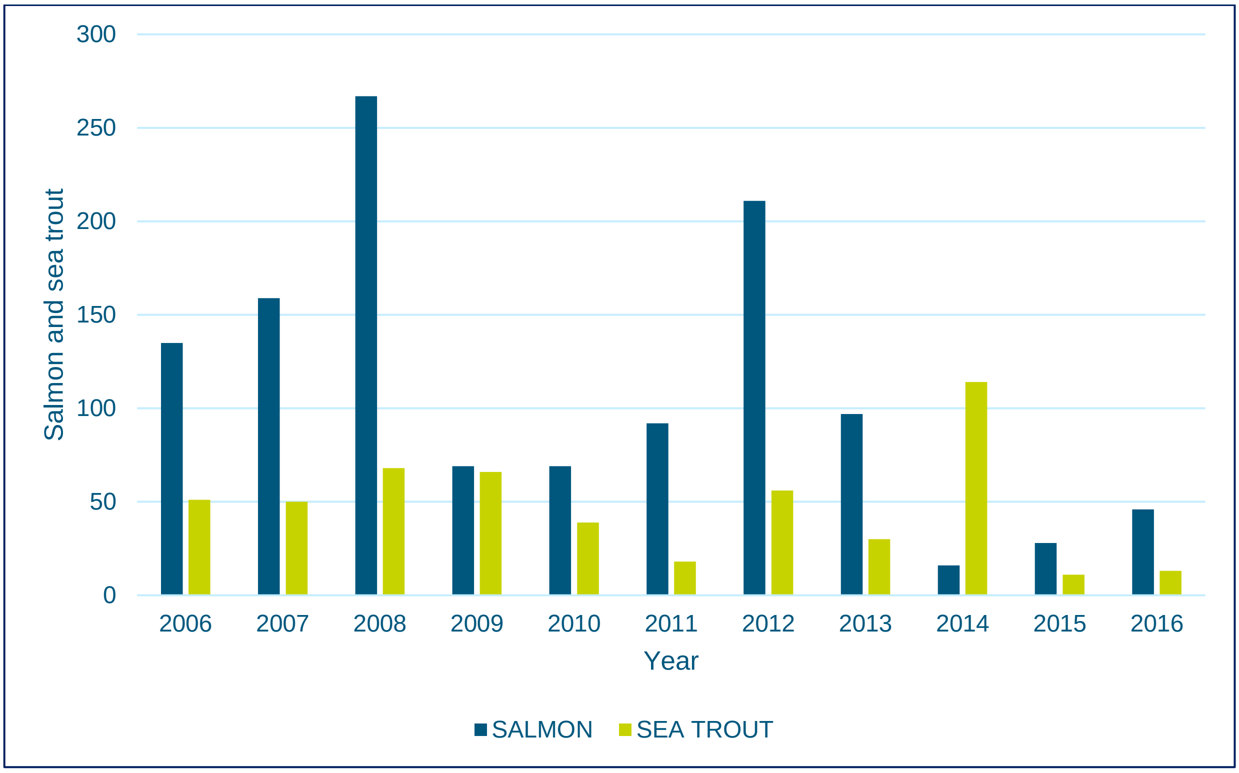

Figure 12.2 Rod catch data sourced from the Environment Agency on the Tees since 2006

12.4.2 Summary of findings from the 2019 site-specific benthic trawls

As part of the benthic ecological survey undertaken in March 2019, 16 benthic trawls were undertaken within and adjacent to the proposed dredge footprint. It is recognised that the benthic trawl data provides only a snapshot of the fisheries use of the proposed dredge footprint and does not effectively survey / sample pelagic species of fish, however, the information has been used to assist with the understanding of the baseline environment of the area. A summary of the data recovered is presented below.

Prior to analysis of the epifaunal data from the 2019 beam trawls, the faunal lists underwent a truncation and standardisation process. All records of infauna (15 taxa) were removed from analysis of epibenthic data.

A relatively diverse epifaunal assemblage was identified with a total of 40 epibenthic taxa recorded with a mean (± SE) of 12.94 ± 0.90 taxa per sample. Mean (± SE) abundance per sample was 1188.63 ± 818.51 individuals. A total of 18 fish taxa were recorded with the most abundant fish taxon being the European Plaice (*Pleuronectes platessa*) (433 individuals in total). The other species of fish recorded within the trawls were:

- Atlantic herring *Clupea harengus* (one individual)
- Lesser weever *Echiichthys vipera* (two individuals)
- Atlantic cod *Gadus morhua* (16 individuals)
- American plaice *Hippoglossoides platessoides* (one individual)
- Pogge *Agonus cataphractus* (27 individuals)
- Common dab *Limanda limanda* (168 individuals)
- Whiting *Merlangius merlangus* (45 individuals)

- Bull rout *Myoxocephalus scorpius* (three individuals)
- Flounder *Platyichthys flesus* (40 individuals)
- Saithe *Pollachius virens* (one individual)
- Sprat *Sprattus sprattus* (one individual)
- Poor cod *Trisopterus minutus* (three individuals)
- Common dragonet *Callionymus lyra* (one individual)
- Fivebeard rockling *Ciliata mustela* (six individuals)
- Gobies Pomatoschistus sp. (96 individuals)
- Rock gunnel *Pholis gunnellus* (one individual)

Anthropods of commercial value recovered during the trawl survey comprised lobster *Homarus gammarus* (one individuals), pink shrimp *Pandalus montagui* (24 individuals), and various species of crab.

Cluster analysis of square-root transformed macrobenthic abundance data was carried out on a resemblance matrix calculated using the Bray-Curtis similarity coefficient in order to graphically represent the similarity of the epibenthic communities recorded in each sample. The resulting dendrogram (Figure 12.3) and SIMPROF test identified two statistically significant faunal groups (shown by point colour) and one outlier (an ungrouped single sample). The corresponding non-metric multidimensional scaling (nMDS) ordination plot (Figure 12.4) graphically displays the similarity between the samples based on the distance between the sample points. The degree of clustering of intra-group sample points demonstrates the level of within group similarity whilst the degree of overlap of inter-group sample points is indicative of the level of similarity of the different faunal groups.

The results of the SIMPER routine enabled the characteristic taxa within each of the faunal groups to be determined by providing a level of percentage contribution (%Contrib) to the group similarity which are discussed for each faunal group in detail below.

- Faunal Group A - this was identified at 13 of the trawl stations (representing 81% of epibenthic trawls) and occurred at locations throughout the survey area (Figure 12.5). These communities were dominated by *C. maenas*, *P. platessa*, and crangonid shrimp (*Crangon* sp.) that contributed 24.10%, 13.93% and 11.90% to the within group similarity respectively.
- Faunal Group B – this occurred at the two outermost trawl stations at the mouth of the estuary and was dominated by *A. rubens* that contributed 53.06% of the within group similarity. Other prevalent species included brittlestars (*Ophiura* sp.) and crangonid shrimp (*Crangon* sp.) which contributed to 19.00% and 13.43% of the within group similarity respectively.
- The outlier group, trawl BT06, was separated from the other faunal groups due to high abundances of brittlestars (*Ophiura* sp.) that were an order of magnitude greater than at other stations.

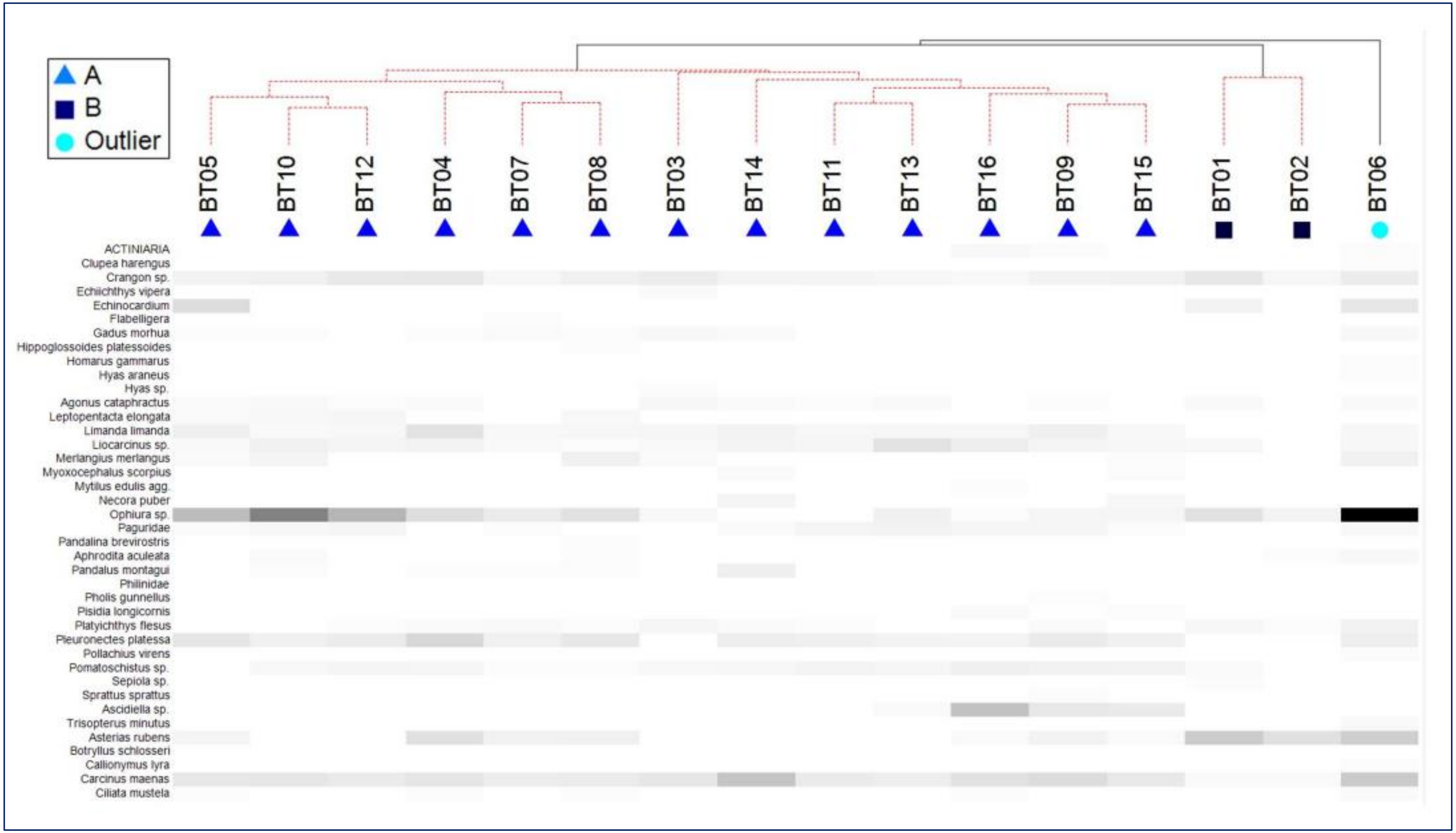

Figure 12.3 Shade plot with dendrogram based on square-root transformed Bray-Curtis similarity epibenthic abundance data

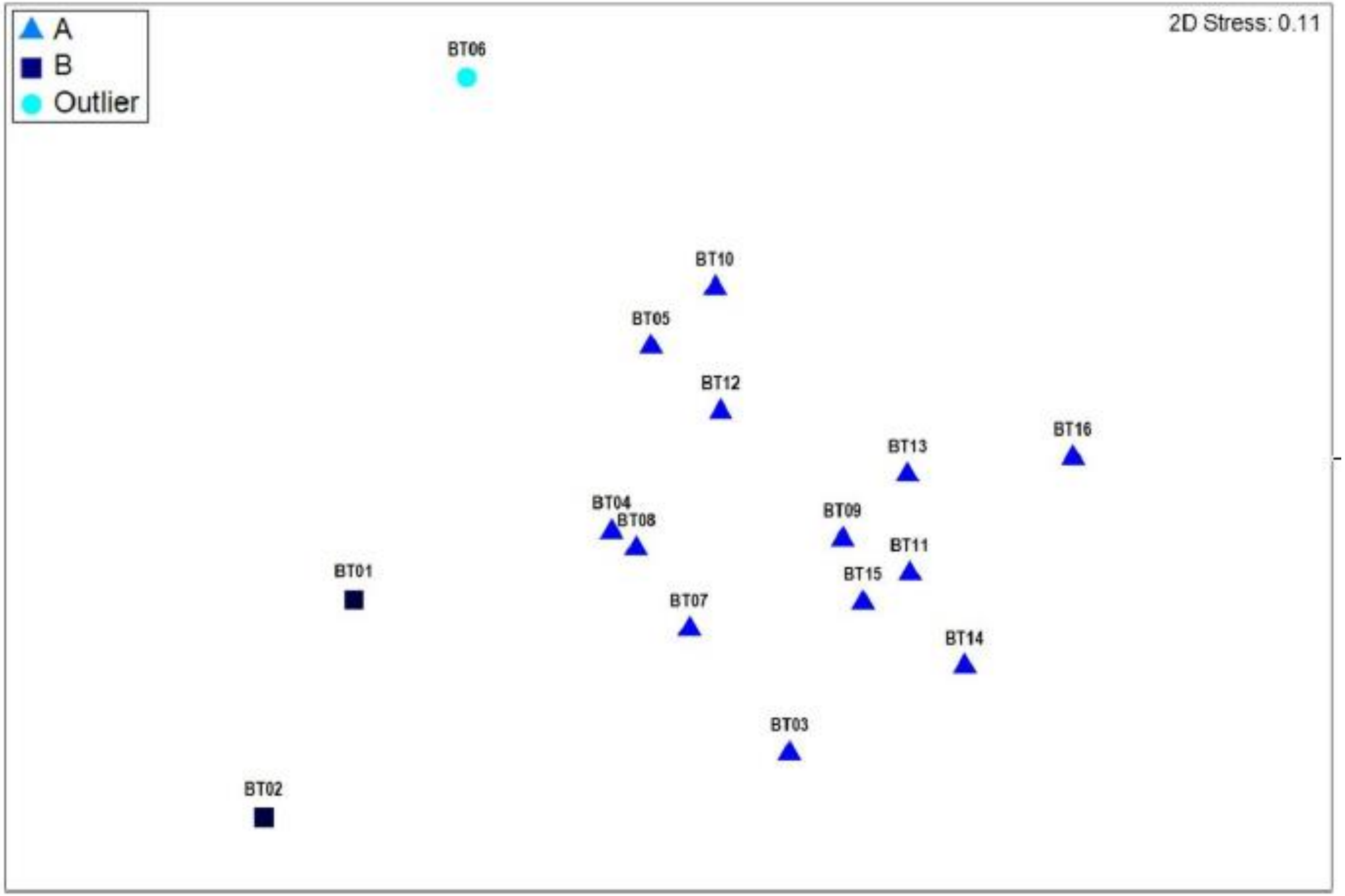

Figure 12.4 Non-metric MDS ordination plot of square root transformed Bray Curtis similarity epibenthic abundance data

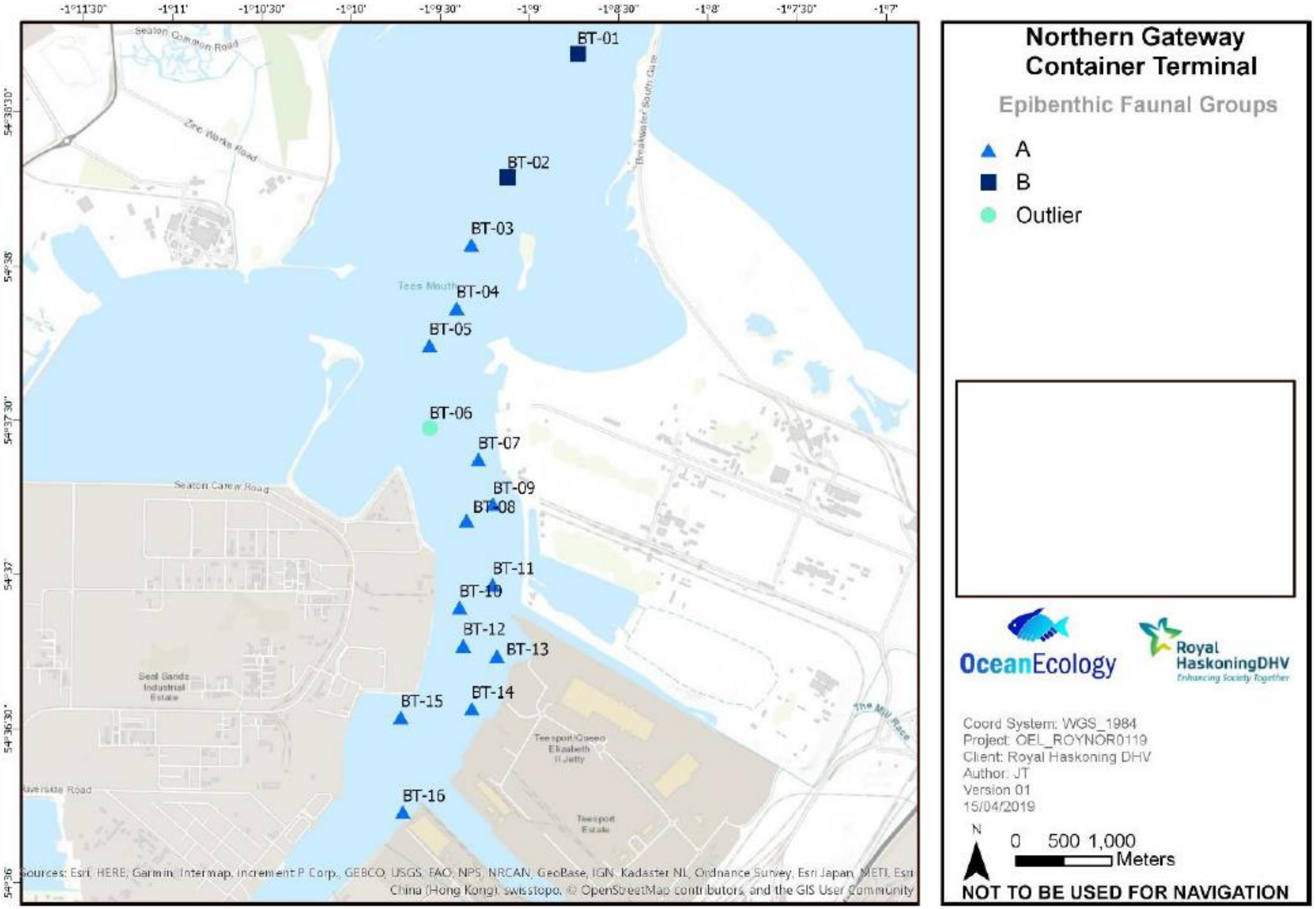

Figure 12.5 Spatial distribution of faunal groups across the 2019 sampling array

12.4.3 Overview of fishing activity

Sea fisheries out to 6nm from the UK territorial baseline between the River Tyne and approximately the southern bank of the Humber estuary fall under the jurisdiction of the NEIFCA. The Environment Agency has responsibility for the management of migratory fisheries for salmon, trout and eels within this area. Further detail regarding the fishing activity within and around the Tees estuary is provided below.

Consultation with NEIFCA during October 2017 has confirmed that most commercial fishing activity takes place outside of the Tees estuary, although there is a small amount of fishing targeted at lobster (*Homarus gammarus*) and velvet swimming crab (*Necora puber*) in the lower estuary during summer. NEIFCA has confirmed that trawling and netting within the estuary itself is prohibited. The digging of lugworms, ragworms and peeler crabs takes place in the intertidal mud and sandflats of the outer estuary and adjacent coast. Ragworm digging takes place throughout the year but peaks in May and September.

The NEIFCA has provided images which show the level of fishing activity (by different methods) within the coastal waters beyond the mouth of the Tees estuary. These figures are shown in Appendix 16.

The NEIFCA has confirmed that the trawl sightings to the east and south of the Tees estuary mouth will be for whitefish, whilst the aggregation of sightings to the north is linked to the *Nephrops* fishery where the seabed is muddy (Tim Smith*, pers. comm.* 2017). Some limited netting does take place in Tees Bay, however, the NEIFCA's byelaws restrict the nets from coming close to the shore (within the 5 or 10m depth contour depending on time of year). As shown below, the main fishing activity in the coastal waters is potting (for crab and lobster).

The International Council for the Exploration of the Seas (ICES) standardise the division of sea areas for statistical analysis. Each ICES rectangle is approximately 30 nautical miles squared. Approximately 100 to 150 tonnes of edible crab and 80 tonnes of lobster is landed from the ICES rectangle which 38E8 (which extends from South Shields down to Redcar, see Figure 12.6) (Tim Smith, NEIFCA*, pers. comm.* 2017). The NEIFCA has also confirmed that most fishing vessels operating in Tees Bay will sail from Hartlepool, South Gare (Paddy's Hole) and Redcar.

A review of the UK Sea Fisheries Statistics Report 2015 has been undertaken in an attempt to source additional data regarding fishing activity and fish landings within the Tees estuary. The report contains a summary of landings into major ports in England by UK vessels. The Tees estuary is not, however, listed as one of the major ports within the report, and therefore there is no landing data of direct relevance to the Tees estuary. The closest port with landing data to the Tees estuary is Whitby harbour, located approximately 40km to the south of Teesport. The landing data from Whitby harbour is not considered to be relevant to this assessment and, therefore, has not been included herein. In addition to the above, the report provides data on the UK fishing fleet by administration port (divided by 10m and under and over 10m vessels); as with the landings data, there is no fishing fleet information available for the Tees estuary. The closest port / harbour to the Tees estuary where such data exists is Scarborough, approximately 65km to the south. Given the separation distance between Scarborough and the Tees estuary, the fleet information from Scarborough is similarly not considered to be relevant to this assessment.

The UK Sea Fisheries Statistics 2015 report (MMO, 2016) provides summary images showing the landings of demersal, pelagic and shellfish by the UK fleet in 2015 by ICES rectangle of capture. These images are repeated below in Figures 12.7, 12.8 and 12.9. The images indicate that the coastal waters at Teesport have not provided significant quantities of demersal, pelagic and shellfish species, in comparison with the coastal waters around the wider UK. The most significant landings were of pelagic species within the coastal waters beyond the mouth of the Tees estuary.

Based on the information presented above, it is concluded that the Tees estuary is not considered to be an important area for commercial fishing activity.

A request for landings data for vessels of less than 10m as well as surveillance data showing the location of fishing vessels (to supplement those presented above) was submitted to the MMO in December 2017. The MMO confirmed that the data is not readily available and was not able to provide such data to inform this report.

Figure 12.6 ICES rectangle 38E8

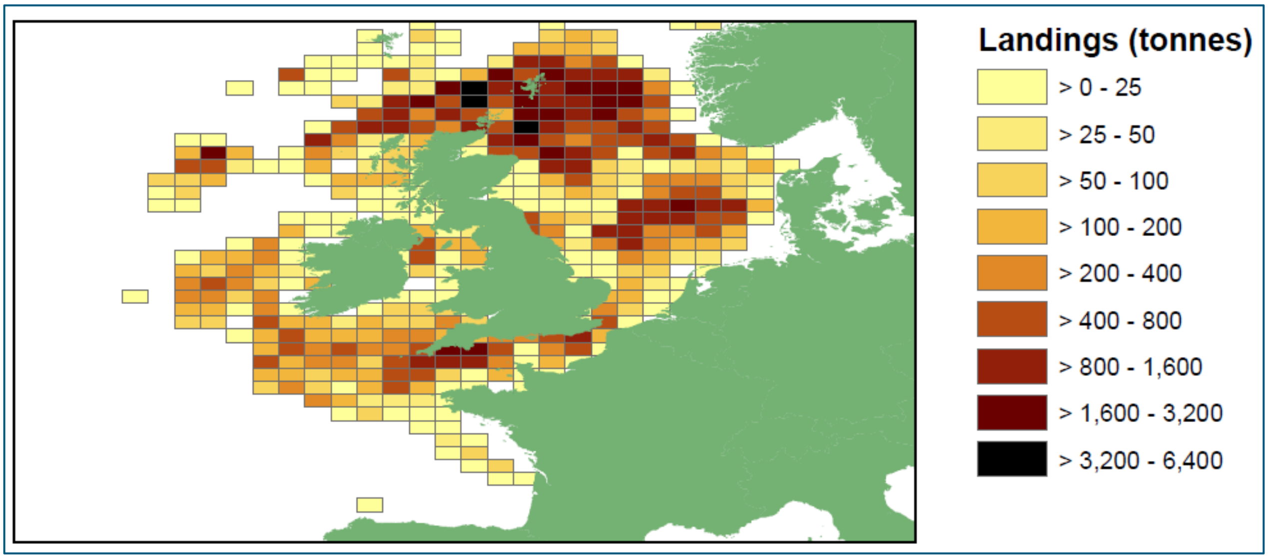

Figure 12.7 Demersal landings by UK vessels by ICES rectangle: 2015

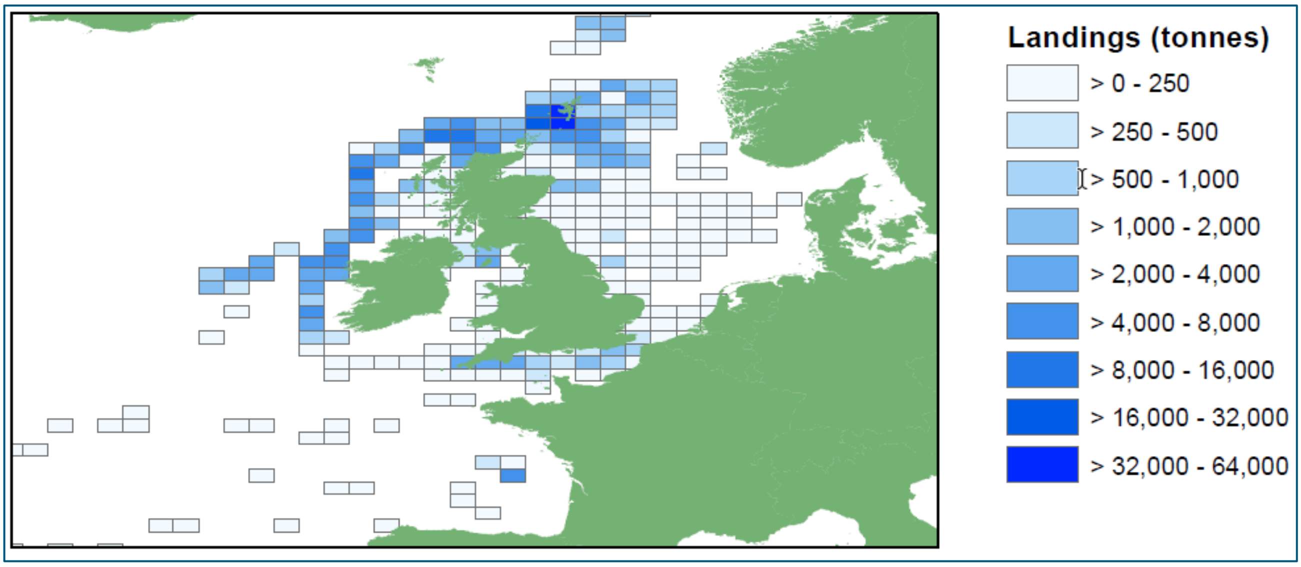

Figure 12.8 Pelagic landings by UK vessels by ICES rectangle: 2015

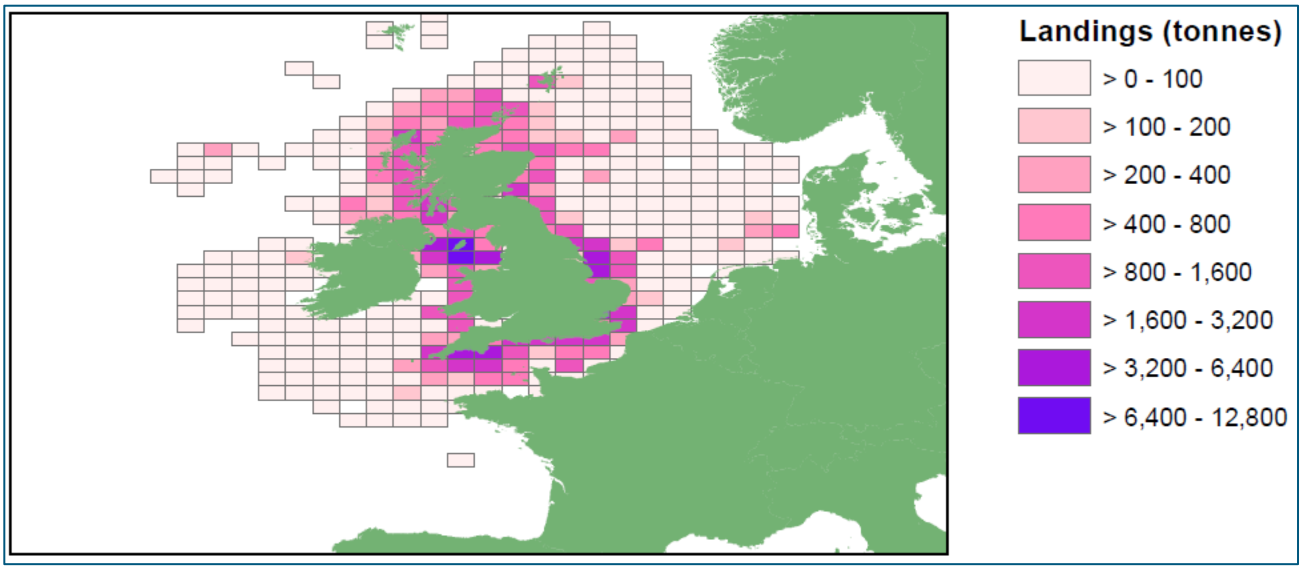

Figure 12.9 Shellfish landings by UK vessels by ICES rectangle: 2015

12.4.4 Commercially important spawning and nursery grounds

Lee & Ramster (1981) compiled an atlas of the seas around the British Isles, illustrating the spawning grounds of several commercial fish species. Subsequently, a collaborative project between numerous parties aimed to provide broad scale maps of the sensitive habitats of marine fish in UK waters (Coull *et al.,* 1998). Since production of the broad scale maps, further survey and study has been undertaken, which has led to some of the maps produced by Coull et al., 1998 being updated by Ellis *et al.*, 2012. A review of the latest information on spawning and nursery grounds of selected fish species in UK waters (provided by Ellis *et al*., 2012) has therefore been undertaken to inform the sensitivity of the study area for such activities. A summary of relevant data is provided in Table 12.3. As shown below, the coastal waters at Teesside are reported to support low intensity nursery grounds for spurdog, anglerfish and plaice (Ellis *et al,* 2012). High intensity nursery grounds are also reported for herring, cod and whiting (Ellis *et al,* 2012). It should be noted that all of these species have extensive nursery grounds which encompass most of the North Sea (Natural

Power, 2014). The coastal waters are not reported to represent spawning grounds for any species listed by Ellis *et al*, 2012.

Table 12.3 Summary of fish spawning and nursery ground data for the Tees estuary region (from Coull et al 1998 and Ellis et al 2012)

<table>
<tr><th rowspan="2">Species</th><th rowspan="2">General description of the presence of the species in estuarine and coastal waters</th><th colspan="2">Coull et al 1998</th><th colspan="2">Ellis et al 2012</th></tr>
<tr><th>Spawning grounds in the Tees</th><th>Nursery grounds in the Tees</th><th>Spawning grounds at the Tees ICES rectangle</th><th>Nursery grounds at the Tees ICES rectangle</th></tr>
<tr><td>Spurdog</td><td>This is a fully marine species that is recorded occasionally in estuaries. It does not typically occur in waters >10m deep.</td><td colspan="2" rowspan="6">No information reported on these species by Coull et al.,1998</td><td rowspan="2">Not well established</td><td>Yes (low intensity)</td></tr>
<tr><td>Tope shark</td><td>This is a marine species that may utilise the outer reaches of some estuaries and coastal waters as a parturition ground and nursery ground</td><td>No</td></tr>
<tr><td>Common skate</td><td>Common skate is a fully marine species that is recorded occasionally in estuaries. It does not typically occur in waters <30 m deep</td><td>No</td><td>No</td></tr>
<tr><td>Thornback ray</td><td>Thornback ray is a fully marine species that is recorded occasionally in estuaries. Juveniles may occur in coastal waters, but are mostly found in waters >10 m deep.</td><td>No</td><td>No</td></tr>
<tr><td>Spotted ray</td><td>Spotted ray is a fully marine species that is recorded occasionally in estuaries. Juveniles occur in coastal waters, although adults are usually found further offshore</td><td>No</td><td>No</td></tr>
<tr><td>Undulate ray</td><td>Undulate ray is a coastal, marine species that utilises the outer reaches of some estuaries as a nursery ground.</td><td>No</td><td>No</td></tr>
<tr><td>Herring</td><td>Herring is a marine species that utilises estuarine habitats as nursery grounds. Certain stocks also spawn in estuarine areas (e.g. Milford Haven)</td><td>No (although a large spawning ground is reported to the immediate south of the estuary)</td><td>Yes</td><td>No</td><td>Yes (high intensity)</td></tr>
<tr><td>Cod</td><td>Cod is a marine species that utilises estuarine habitats and other coastal waters as nursery grounds.</td><td>No</td><td>Yes</td><td>No</td><td>Yes (high intensity)</td></tr>
<tr><td>Whiting</td><td>Whiting is a marine species that utilises estuarine habitats and other coastal waters as nursery grounds.</td><td>No</td><td>Yes</td><td>No</td><td>Yes (high intensity)</td></tr>
</table>

<table>
<tr><th rowspan="2">Species</th><th rowspan="2">General description of the presence of the species in estuarine and coastal waters</th><th colspan="2">Coull et al 1998</th><th colspan="2">Ellis et al 2012</th></tr>
<tr><th>Spawning grounds in the Tees</th><th>Nursery grounds in the Tees</th><th>Spawning grounds at the Tees ICES rectangle</th><th>Nursery grounds at the Tees ICES rectangle</th></tr>
<tr><td>Blue whiting</td><td>Blue whiting is a fully marine species that is recorded only very occasionally in estuaries. Typically occurs further offshore, in waters >50 m deep.</td><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>Blue ling</td><td>Blue ling occurs offshore, usually in waters >150 m deep.</td><td colspan="2" rowspan="6">No information reported on these species by Coull et al.,1998</td><td>No</td><td>No</td></tr>
<tr><td>Ling</td><td>Ling is a fully marine species that is only recorded very occasionally in estuaries. It typically occurs further offshore, in waters >50 m deep.</td><td>No</td><td>No</td></tr>
<tr><td>European hake</td><td>Hake is a fully marine species that is recorded only very occasionally in estuaries. It typically occurs further offshore, in waters >50 m deep.</td><td>No</td><td>No</td></tr>
<tr><td>Anglerfish</td><td>Anglerfish is a fully marine species that is recorded only very occasionally in estuaries. Juveniles may occur in coastal waters, although adults tend to occur further offshore.</td><td>No</td><td>Yes (low intensity)</td></tr>
<tr><td>Horse mackerel</td><td>Horse mackerel is a fully marine species that is common in coastal waters, but only recorded occasionally in estuaries.</td><td>No</td><td>No</td></tr>
<tr><td>Sandeels</td><td>One species, Ammodytes tobianus, is often found in estuaries, with this and other species occurring in coastal waters.</td><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>Mackerel</td><td>Mackerel is a fully marine species that is common in coastal waters, and is only recorded occasionally in estuaries.</td><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>Plaice</td><td>Plaice is a marine species that utilises estuarine habitats and coastal zones as nursery grounds</td><td>No</td><td>Yes</td><td>No</td><td>Yes (low intensity)</td></tr>
<tr><td>Sole</td><td>Sole is a marine species that utilises estuarine habitats and coastal zones as nursery grounds</td><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>Haddock</td><td rowspan="3">No information provided by Coull et al.,1998</td><td>No</td><td>No</td><td colspan="2" rowspan="3">Not reported by Ellis et al.,2012</td></tr>
<tr><td>Saithe</td><td>No</td><td>No</td></tr>
<tr><td>Lemon sole</td><td>Yes (reported as spawning across the entire east</td><td>Yes (reported across the entire east</td></tr>
</table>

Species	General description of the presence of the species in estuarine and coastal waters	Coull *et al* 1998		Ellis *et al* 2012	
		Spawning grounds in the Tees	Nursery grounds in the Tees	Spawning grounds at the Tees ICES rectangle	Nursery grounds at the Tees ICES rectangle
		and north coast of UK)	and north coast of UK)		
Norway pout		No	No		
Sprat		No	Yes		
Nephrops		Yes	Yes		

With regard to the presence of these species in estuaries, Ellis *et al* (2012) confirms that spurdog is a fully marine species that is occasionally found in estuaries. It does not typically occur in waters less than 10m deep (Wheeler, 1978, cited in Ellis *et al.,* 2012). This species is therefore unlikely to be found in the upper reaches of the Tees estuary. Anglerfish is recorded only very occasionally in estuaries (Ellis *et al,* 2012).

Herring, cod, whiting and plaice are marine species that use estuarine habitats as nursery grounds. Certain stocks of herring are also reported to spawn in estuarine areas (Ellis *et al,* 2012).

12.4.5 Summary of information within the Fish Atlas of the Celtic Sea, North Sea and Baltic Sea

A review of information contained within the Fish Atlas of the Celtic Sea, North Sea and the Baltic Sea (Heesen *et al.,* 2015) has been undertaken. The information in the Fish Atlas has been informed by survey data downloaded from the DATRAS survey database at the ICES; the area covered by the surveys comprises the entire north-western European shelf from 47ºS to 62ºN and from 16ºW to 24ºE.

The Fish Atlas reports on over 200 different taxa, and therefore it is not considered practicable to provide a summary of all species within this EIA Report. Rather, the information provided in Table 12.4 is focussed on the key species of fish recovered within the targeted fish surveys undertaken within the Tees estuary (the findings of which are reported above).

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Table 12.4 Summary of information on the key species of fish (i.e. those encountered in greatest numbers during the 2019 site specific benthic trawls and those identified within literature reviews) from the Fish Atlas of the Celtic Sea, North Sea and Baltic Sea (all information below has been sourced from Heesen et al., 2015)

Species	Average catch number per hour around Hartlepool	Spatial distribution	Depth distribution	Habitat	Reproduction	Movements and migrations	Prey species
Dab	10 to 100 individuals reported per hour around the mouth of the Tees. Numbers increase with distance offshore.	Most abundant in inner shelf waters, with the highest two catch rates following the 50m and 100m isobaths closely.	The reported depth range extends to nearly 400m, but catch rates below 120m are negligible.	May be found on sandy and soft substrates at depths of 2 to 150m. This species ranked third in terms of fish biomass in the North Sea after sprat and sandeels.	The spawning season lasts from April to June in the North Sea.	Dab spend a relatively short time in the coastal nurseries, moving offshore as soon as the temperature drops in autumn. Larger fish are typically found offshore.	Larvae feed on copepods and other planktonic crustaceans. The main food of juveniles and adults includes polychaetes, small crustaceans, molluscs, brittle-stars, small sea urchins and fish.
Whiting	1,000 to 10,000 generally reported along the length of the east coast of England.	Amongst the most widely distributed and most abundant gadoid species in the atlas area. Found in high numbers throughout the North Sea.	The depth distribution ranges from shallow inshore waters (<10m) to a maximum of 550m, but by far the greatest numbers occur in the range 30-150m.	The first two or three months of life are spent near the surface, adopting a mainly demersal way of life thereafter. Older juveniles are often abundant in coastal waters and estuaries, with adults generally in deeper waters.	The prolonged spawning season commences in January in the English Channel and continues until June or early July in the North Sea. Whiting spawn mostly in water <100m deep.	Whiting are not known to make long distance migrations. Spatial interchange appears to be limited between the northern and southern North Sea.	Whiting is an active predator that feeds on and near the seabed as well as in mid water. Larvae feeds mainly on juvenile copepods. Pelagic juveniles feed on copepods, euphausiids, appendicularians and larval fish. Older whiting eat mainly crustaceans and fish, although polychaete worms and squid can also be important prey.
Plaice	1 to 10 in the coastal waters with numbers increasing to 10 to 1000 further offshore.	Highest intensities are reported in the south-eastern North Sea and the waters around the British Isles. Distributions for different size classes show huge differences, with plaice <25cm virtually restricted to south and east of Dogger Bank.	Catch rates below 100m are negligible in the North Sea.	Each life stage requires a different habitat. Juveniles show a clear preference for fine sandy sediment which allow them to bury themselves and hide from predators. The preference for sandy sediment remains during the lifespan, although older fish may be found on even coarser sediments.	The spawning period lasts for about three months, ranging from December to April depending on spawning location.	Spawning-feeding migrations follow a north-south axis in the North Sea. Tag experiments have revealed several sub-populations that mix during summer feeding and split up again for the next spawning event.	Larvae eat mostly appendicularians, but several stages of copepods, algae and bivalve postlarvae are also eaten. In nursery areas, juveniles feed on regenerating parts of invertebrates such as tail tips of the lugworm and siphons of bivalves. Larger individuals feed on invertebrates such as sessile polychaetes, bivalves and crustaceans (amphipods, mysids and small shrimp). Fully grown plaice feed on molluscs and sandeels.
Lemon sole	No individuals reported per hour at Teesside. 10 to 100 per hour in the coastal waters of Tees Bay.	Regularly caught throughout most of the North Sea.	Reported from depths ranging from 1m to 1,105m, but catch rates in the North Sea are largest on the inner shelf from 50-125m.	Most often found on coarser sediments such as gravel or shell beds.	Across their distribution range, this species may spawn from January to November.	Tagged individuals are generally recaptured close to the release location.	The diet of lemon sole comprises predominantly of errant and sessile polychaetes, but a range of other invertebrates (including small crustaceans and brittle-stars) is also consumed. Feeding activity is thought to decrease during winter months.
Atlantic salmon	No information available.	Most catches have been reported from the Baltic Sea, with other records from the southern North Sea.	Catches in the North Sea were generally from waters at depth of 10 to 70m.	Atlantic salmon start their life in fresh water, remaining in lower reaches of rivers until they are ready to live in the ocean where they spend most of their immature life, until returning to their home rivers to spawn.	Spawn in late autumn, usually in November or December.	The seaward migration of smolts occurs in spring. Most salmon spend one to four years at sea.	Atlantic salmon are opportunistic feeders. In fresh water, parr start feeding on fish larvae at lengths of 15-25cm, whilst smolts of 15cm or less prey on fish larvae close to the surface after entering the sea. Larger Atlantic salmon in the open sea varies, but includes various fish species and crustaceans including euphausiids and amphipods.
Sea trout	No information available.	The catches in the Baltic Sea are concentrated in the west, with scattered reports available from central and southern North Sea.	Sea trout appear to most abundant in the 10 to 80m depth zone.	Sea trout occupy very small brooks to the largest rivers and coastal waters. They seldom use waters far offshore in the open sea and largely avoid oceanic waters.	Spawning takes place in autumn or winter.	Sea trout may migrate to sea a few times during their life. The time spent at sea is highly variable, ranging from one month to three years. Sea trout do not usually disperse far from the outflow of their natal river.	Sea trout may feed on marine crustaceans, polychaetes and fish, as well as on surface insects in brackish waters.

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Species	Average catch number per hour around Hartlepool	Spatial distribution	Depth distribution	Habitat	Reproduction	Movements and migrations	Prey species
European eel	No information available.	Highest densities of this species were recorded in coastal waters of the North Sea (along the Dutch, German and Danish coastlines and the Thames estuary).	Usually encountered in coastal waters of less than 50m depth.	May be found in a great variety of freshwater, estuarine and marine habitats.	Spawning has only been observed in artificially matured captive specimens. The spawning season is thought to peak in spring.	Glass eels cross the shelf seas to freshwater using selective tidal transport.	Studies performed in estuaries have reported polychaetes, bivalve molluscs, mysids, amphipods, brachyuran crabs, shrimp and fish in the diet.
River lamprey	No information available.	Occur in the coastal waters and rivers of the European Atlantic coast from Scotland southward.	Almost exclusively caught in areas adjacent to the coast, being mainly found in water less than 10m deep in the North Sea.	Tend to remain in estuaries and coastal areas where they feed on smaller fish.	River lamprey enter rivers during autumn to overwinter in freshwater habitat before migrating further upstream to spawn between April and June.		Mainly feed on smaller fish such as sprat, herring or flounder.
Sea lamprey	No information available.		Generally found in the same areas of river lamprey but roam further offshore.	The marine distribution of sea lamprey is not well documented.	Enter rivers to spawn in June / July. Migrate farther offshore than river lamprey.		No information provided in the Fish Atlas.
Sandeel	0 to 0.0001 per hour. Greater numbers located further offshore.	High catch rates are generally reported on the inner shelf, with the distribution of sandeels linked to the presence of sandy sediments.	The depth distribution ranges from shallow water (locally common sandeel can be collected in the intertidal by digging during the ebb tide) to about 250m depth.	The distribution of sandeel is closely linked to the availability of medium to coarse sands (0.25mm to 2.00m grain size) in well oxygenated water, which represent their preferred habitat. Grounds containing fine sediment are avoided being absent where the silt / clay content >10%.	Sandeels deposit their eggs on the seafloor. The different species of sandeels spawn at different times of the year. Spawning grounds are presumed to occur throughout much of the adult range where habitat is suitable.	Sandeels have a distinct diel behaviour, with the *A. marinus* species reported to emerge from the sand in the morning, feed in the pelagic system during daylight and then bury themselves during the darkness. On cloudy dark summer days they may spend all day in the sand. *A. marinus* spawn during winter, spending most of that season underground in a state of hibernation.	Sandeels are visual feeders. Ammodytes spp. forage in schools on a range of zooplankton, including copepods, crangonids, gammarid amphipods, their pelagic larvae, polychaetes and fish (including gobies and other sandeels).
Cod	10 to 100 per hour	On average, the highest catch rates are observed in the Baltic Sea, the Kattegat / Skagerrak and the German Bight. Catch rates in the North Sea are somewhat lower.	Newly settled demersal juveniles may be found close inshore even in depths of <5m. The adults occur down to 500m but the bulk of the catches in the Fish Atlas area were within depths <200m.	Cod generally aggregate in loose shoals roaming both over the seabed and in mid-water. They do not show clear preference for specific sediments.	The spawning season extends from January in the south to April in the north of the Fish Atlas area. A 2004 ichthyoplankton survey showed that the importance of a spawning area off the north-east coast of England had declined considerably.	Movements of cod in the Fish Atlas area are relatively limited, with the majority of spawning groups reported as being sedentary. In the southern North Sea, immature cod are reported to aggregate in shallow water during winter moving to deeper water in the summer. Mature cod appear in the commercial catches in autumn and disappear completely the following May. In the southern North Sea, cod make use of tidal streams to migrate northwards and eastwards in spring, whereas tidal stream transport was rarely exhibited by cod released in the eastern English Channel	Larval cod feed mainly on the nauplii and copepodite stages of copepods. The diet changes rapidly and at lengths of 5cm they feed predominantly on fish. The diet of juveniles is dominated by crustaceans (including crabs and shrimps), but as they grow fish become increasing important in the diet.
Flounder	0 to 0.0001 per hour	Most abundant in the Baltic Sea. Small numbers are reported along coastal margins.	Most abundant in the 0 to 5m depth zone in the North Sea region with abundance dropping steadily at greater depths becoming negligible beyond 70m depth.	This species usually visits marine, brackish and freshwater habitat across its lifespan. Individuals can be found in the lower stretches of rivers because juveniles enter estuaries and move upstream.	In the southern North Sea, spawning starts in January and continues to April, extending to July further north.	Immature flounder spend most of their first 2 to 3 years of life in littoral and coastal areas before joining the mature stock. Adults perform an annual spawning migration in late autumn or early winter to offshore spawning grounds and return to coastal areas to feed during summer.	Flounder are visual predators that bury themselves deep into sediment keeping their eyes above the bed. They feed mainly on a variety on invertebrates, mainly polychaetes, bivalves and crustaceans, but the diet may also include small fish like smelt and gobies.

Species	Average catch number per hour around Hartlepool	Spatial distribution	Depth distribution	Habitat	Reproduction	Movements and migrations	Prey species
Herring	0 to 0.0001 per hour. 1000 to 10,000 per hour in the coastal waters north of the estuary.	Caught in large numbers over most of the Fish Atlas area.	High catch rates are restricted to depths between 20m and 100m in the North Sea.	Found across estuarine, euryhaline, coastal and continental shelf areas, with some populations roaming off-shelf waters to feed.	Populations are often characterised as summer, autumn, winter or spring spawners. Herring deposit their eggs in thick layers on coarse or solid substrate.	Herring is a migratory species exhibiting recurring migrations associated with feeding, overwintering and spawning.	The food consists mostly of zooplankton.
Sprat	0 to 0.0001 per hour. 100 to 1000 per hour in the coastal waters around Teesside.	Most abundant in relatively shallow waters and can be found in areas of low salinity. Sprat is distributed in the shelf waters of Europe and North Africa. It reaches its north-eastern limit of distribution in the Baltic Sea.			No information available.		
Spurdog	0 to 0.001 per hour. Low numbers (up to 10 per hour) caught further offshore.	Reported throughout most of the Fish Atlas area. Highest catch rates were obtained off northern Scotland and to the west of Ireland.	Most common in waters of 60 to 200m depth.	Feed near the bottom as well as mid water. Little is known about specific habitat requirements.	This is an aplacental viviparous species, giving birth to live young that are reliant on yolk reserves during embryonic development.	Spurdog are active fish, swimming at speeds of 1.4 to 2.5km/h. Tagging studies indicate little mixing of species between northern and southern areas.	Spurdog are opportunistic feeders that take a wide range of predominantly pelagic prey. Important fish prey including herring, sprat, small gadoids, sandeel and mackerel but crustaceans, squid and ctenophores are also frequently found in stomachs.
Anglerfish	0 to 0.0001 per hour. 1 to 10 per hour in the coastal waters off Teesside.	Occur throughout much of the survey area, from the western English Channel and Celtic Sea to the northern and central North Sea. Only captured infrequently in the eastern English Channel and southern North Sea.	This species is mainly encountered at depths greater than 50m in the North Sea region.	Widely distributed on a variety of substrates on the continental shelf and slope. In general, younger fish are reported to occupy shallower water, while larger fish inhabit broader areas, including deeper waters. Although often viewed as demersal fish and sluggish swimmers, they can plane in mid water with their pectoral fins outstretched.	The spawning season is presumably protracted based on the findings of various studies.	In a tagging experiment around the Shetland Islands, 35% of the 80 recaptures were taken within 25km of the release location. The experiment indicated an offshore migration in late autumn.	These are opportunistic ambush predators that feed on a variety of fish, cephalopods and crustaceans. The main prey species include various demersal fish species.

12.4.6 Future evolution of the baseline in the absence of the proposed scheme

In the absence of the proposed scheme, the value of the Tees estuary as a fisheries resource is unlikely to significantly change from the present day. The ongoing activities within the estuary and along its banks would continue, and therefore the levels of direct and indirect disturbance to fish and fisheries within the Tees would remain.

12.5 Potential impacts during the construction phase

12.5.1 Direct uptake and disturbance of fish during capital dredging

During the capital dredging there is the potential for fish eggs, fish, shellfish and the food resources on which they rely to be taken up directly by the dredger. Potential effects are injury, mortality and displacement. The potential for direct uptake is greatest for demersal species (i.e. those which live on the seabed) such as flatfish.

Although it is recognised that beam trawling only represents a snapshot in time of the species present within the area, the 16 trawls undertaken within the proposed dredge footprint during March 2019 confirmed the presence of demersal species, with plaice (a demersal species) dominating the returns from the trawls.

The temporary disturbance to the river (which is already subject to regular disturbance from ongoing maintenance dredging operations) is likely to result in an avoidance reaction, with the presence of the dredge head likely resulting in fish temporarily moving away from the area, thereby avoiding direct uptake.

The results of the benthic survey show that the community within the proposed scheme footprint is relatively diverse and dominated by annelid in terms of both abundance and diversity. The inner estuary community was comprised of a range of species, primarily polychaetes.

Although there is potential for the estuary to represent a feeding ground for fish based on the findings of the 2019 benthic survey, the extensive maintenance dredging undertaken by PDT within the proposed dredge footprint on an all-year-round basis leads to a conclusion that the proposed scheme footprint is unlikely to represent an important spawning or feeding ground for fish species. Research undertaken by Ellis *et al,* 2012 also confirms that the coastal waters at Teesside and the Tees estuary do not represent a fish spawning area, which further reduces the risk of direct uptake of fish eggs.

As assessed in Section 9.5, the effect of the dredging does not represent an irreversible loss of habitat; the benthic community would be expected to recover to one that is similar to that present throughout the existing dredged approach channel.

The proposed scheme is predicted to result in direct disturbance to the subtidal habitat, within an area which is already subject to regular maintenance dredging. It is recognised that there is a risk of demersal fish species being present within the proposed dredge footprint which could be subject to uptake, however, it is considered that such mobile species would locally redistribute themselves to avoid this risk being realised. The disturbance effect is considered to be of local scale only, with no impact on the wider populations of fish in the Tees estuary or across Tees Bay. Consequently, it is not expected that there would be significant uptake of fish during dredging and any effect would be localised. The impact is therefore predicted to be of **negligible** significance.

Mitigation measures and residual impact

No mitigation measures are required and the residual impact would be of **negligible** significance.

12.5.2 Potential impacts on shellfish and fish caused by increases in suspended sediment concentrations due to dredging and dewatering of the reclamation area

The construction phase will result in increased SSC in the water column during capital dredging and during the return of water to the estuary from the reclamation process (if required). The predicted characteristics of the change in SSC are fully described in Section 6.

Such changes have the potential to impact on fish within and traversing the estuary. The effects are most likely to be predominantly physiological, particularly the blocking of gill structures for example, but fish are also less efficient at hunting prey and avoiding predators.

In general, estuarine fish have a degree of tolerance to conditions of high SSC as concentrations can vary significantly in response to tidal conditions and other events such as storms (increased wave action) and high rainfall. Larvae and juvenile fish are more susceptible to adverse physiological effects than mature fish as their sensory systems are less well developed. Consequently, they are less able to detect and avoid adverse conditions.

The presence of migratory salmonids (salmon and sea trout) within the estuary from May onwards through the summer period is of particular note in that there is the potential to disrupt migration routes and to affect fish physiology. The capital dredging and terminal construction could coincide with the timing of salmon migration in the estuary and, therefore, the assessment of potential impact on migrating fish has been undertaken on the assumption that this is the case (as a worst-case scenario).

It is predicted that the increase in SSC arising during capital dredging would be outside the range of natural variation, in the immediate vicinity of the dredger (see Section 6). Sediment plume modelling has however predicted that peak SSC's in the main channel are significantly affected by the location of the dredger. When located in the Tees Dock turning circle or in the area of the proposed quay wall, concentrations of suspended solids are predicted to decrease significantly outside of the immediate vicinity of the dredger (see Section 6). This occurs both laterally and within the streamlining of the vessel. This predicted significant decrease in suspended solids also occurs when the dredger is located in the main channel adjacent to North Gare Sands, however SSCs are predicted to remain above natural variation both laterally and in the streamline of the vessel.

The cross section of the estuary affected by the plume arising from the proposed dredging is particularly relevant if areas remain relatively unaffected, thereby allowing migration to continue. With respect to the proposed dredging, significant elevations in SSC are predicted to occur in the immediate vicinity of the dredger and along the streamline; however, the relatively narrow nature of the Tees means that there is the potential for a significant cross-sectional area of the estuary to be influenced by elevated SSC throughout the course of the capital dredging. It is concluded, therefore, that there could be temporary impacts on migratory and resident fish populations in the estuary, particularly on juvenile stages of fish species.

Overall, it is predicted that there is the potential for an impact of **moderate adverse** significance on fish populations within the estuary, largely due to the presence of migratory salmonids at certain times of the year and the potential for their migration to be disrupted.

Mitigation measures and residual impact

The following mitigation measure is proposed to reduce the potential for behavioural disturbance or injury to migratory fish from water quality reductions:

- Limiting the TSHD to working within one side of the river at a time. Operations will therefore be undertaken in long strips along the axis of the estuary rather than dredging across the width of the river. This is to reduce both the extent and impact of the dredged plume, as any plume generated by operations has been predicted to remain on the same side of the river as the dredging operation.

With the implementation of the above mitigation measure, water quality will only be impacted on one side of the river at a time and, should dredging be undertaken during the months when migratory fish are present in the river, one side of the river will remain relatively unaffected. This area will form a passage through which migratory fish will be able to move past the dredging activity (and for resident species to relocate to largely undisturbed areas).

Mitigation of the plume effects by reducing the size of the TSHD, and thus reducing the rate of overflow, is not viable since the size of dredger has to be sufficient to carry a large enough drag head and to have sufficient propulsion power to undertake the required dredging operation.

For the CSD, the most significant impact in terms of producing suspended solids is the overflow from the barge loading equipment. To reduce the potential risk to water quality (and consequently migratory fish), the barge will be located either on the eastern or western side of the estuary. As with the TSHD, the implementation of this measure will result in the plume from the barge loading operations remaining on one side of the river, albeit dispersing to a lesser extent and tending to be more confined to the shallower waters.

With the implementation of the above measures, the residual impact is considered to be **minor adverse** to resident and migratory fish.

12.5.3 Potential impacts on fish species caused by effects on water quality (contaminants and dissolved oxygen)

As discussed in Section 6, a proportion of the material that would be disturbed during dredging would be re-suspended into the water column. Hence, the construction phase would result in temporary increases in the TSS concentrations of the water column. Sediment quality data from within the footprint of the proposed dredge envelope has confirmed that there are no exceedances of Action Level 2, and therefore the assessment presented below relates to the potential impact on fish due to the resuspension of non-contaminated sediment. The assessment has been grouped into impacts on eggs and larvae, juveniles and adult fish and shellfish.

Impacts on eggs and larvae
In general, fish eggs and larvae are considered to be less tolerant to increased SSC in comparison with later life stages, and larvae are generally considered to be more sensitive than eggs (Appleby and Scarratt, 1989). As reported in Section 12.3, research published by Ellis *et al.* (2012) reports that there are no known spawning grounds within the ICES rectangle which covers the proposed scheme footprint. This, in addition to the findings of the sediment plume modelling reporting in Section 6 (which illustrate that the sediment plume is predicted to remain within the estuary), results in a conclusion of **no impact** to fish spawning grounds (and consequently fish eggs or larvae) as a result of the proposed scheme.

Impacts on adults and juvenile fish
An increase in the TSS concentration in the water column would increase turbidity and reduce the depth of water that light can penetrate and, therefore, the amount of light available for primary production by any phytoplankton and marine algae. Such impacts on phytoplankton and marine algae can impact on food availability for fish species. At high levels and/or for prolonged periods of time, an increase in TSS concentrations can impact fish through clogging of gill lamellae, potentially leading to death, whilst lower concentrations can result in sub-lethal stress or avoidance reactions. Juvenile fish may be more susceptible

to adverse physiological effects than mature fish as their sensory systems are less well developed. Consequently, they are less able to detect and avoid adverse conditions.

The re-suspension of sediment as a consequence of the proposed dredging could also potentially affect dissolved oxygen levels in the water column, particularly during summer months. However, given the findings of a sediment quality survey presented in Section 7, this is considered unlikely.

In general, sediment plumes induced by dredging are considered to pose only a limited risk to water quality (and subsequently fish species) since the affected water usually has the capacity to accommodate an increased oxygen demand, particularly where dredging takes place in open sea or estuaries (CIRIA, 2000). It has also been reported that dredging activities often generate no more increased suspended sediments that commercial shipping operations or that generated during severe storms (Parr *et al.*,1998, cited within the UK Marine SACs Project, 2001). In addition, it has been reported that natural events such as storms, floods and large tides can increase suspended sediments over much larger areas, for longer periods that dredging operations (Environment Canada, 1994, cited within the UK Marine SACs Project, 2001). It is therefore often very difficult to distinguish the environmental effects of dredging from those resulting from natural processes or normal navigation activities (Pennekamp *et al.*,1996, cited within the UK Marine SACs Project, 2001).

An increase in TSS concentrations has the potential to create a barrier to fish migrations through the Tees estuary and result in behavioural effects of both resident and migratory species. It has been reported that concentrations of TSS need to be within the mg/l scale to result in avoidance reactions on juvenile and adult fish (Forewind, 2014). For lethal effects to occur, concentrations of suspended sediment have to be on the scale of grams per litre (g/l) (Engell- Sørensen and Skyt 2001, cited within Forewind, 2014). It is also reported that the impact on fish from TSS is not only linked to the concentration that a fish is exposed to, but also the duration of the exposure (Newcombe and Jensen 1996, cited within Forewind, 2014).

It is predicted that the increase in TSS during capital dredging would be outside the range of natural variation, particularly in the immediate vicinity of the dredger (peaking at up to 500mg/l above background in the immediate vicinity of the dredger) (see Section 6). It is therefore concluded that avoidance reactions could occur to both resident and migratory fish, but the concentrations are not sufficiently great to result in lethal effects (based on the 'thresholds' identified above).

Peak suspended solid concentrations in the main channel are predicted to be significantly affected by the location of the dredger. When located in the Tees Dock turning circle or in the area of the proposed quay wall, concentrations of suspended solids decrease significantly outside of the immediate vicinity of the dredger (see Section 6). This occurs both laterally and within the streamlining of the vessel. This significant decrease in suspended solids also occurs when the dredger is located in the main channel adjacent to North Gare Sands, however suspended solid concentrations are predicted to remain above natural variation both laterally and in the streamline of the vessel.

The cross section of the estuary affected by the plume arising from the proposed dredging is particularly relevant if areas remain relatively unaffected, thereby allowing migration to continue. With respect to the proposed dredging, significant elevations in SSC are predicted to occur in the immediate vicinity of the dredger and along the streamline; however, the relatively narrow nature of the Tees means that there is the potential for a significant cross-sectional area of the estuary to be influenced by elevated SSC throughout the course of the capital dredging. It is concluded, therefore, that there could be temporary impacts on migration and populations living within the estuary, particular on juvenile stages of fish species. Given the high sensitivity of resident and migratory fish in the Tees to increases in suspended sediment, an overall impact of **moderate adverse** significance is predicted.

Shellfish
Anthropods of commercial value recovered during the 2019 scientific beam trawl survey comprised lobster *Homarus gammarus* (1 individuals), pink shrimp *Pandalus montagui* (24 individuals), and various species of crab. It is recognised that the trawls only represent a snapshot of the usage at that point in time, however, from the information available, it is evident that significant populations of shellfish are not present within the estuary. Although these species are mobile, it is considered likely that their ability to avoid areas of high TSS would be reduced in comparison to fish given their slower swimming speed.

A review of MarLIN has been undertaken to determine the sensitivity of the various shellfish present within the Tees to increased suspended sediment. Based on the information available on MarLIN for the dominant shellfish species present within the 2019 beam trawls (*Carcinus maenas*), it is concluded that shellfish are 'tolerant' and 'not sensitive' to increases in suspended sediment.

Given the temporary nature of the disturbance activity (between four and 11 weeks for granular materials and clay, and up to 33 weeks for mudstone), in addition to the relatively localised nature of the plume (in terms of peak TSS in the immediate vicinity of the dredger), the magnitude of the impact is considered to be low. Based on the evidence available from MarLIN, the sensitivity of the key shellfish species present in the Tees is considered to be low. It is concluded that the impact to shellfish from increased TSS is **negligible**.

Mitigation measures and residual impact
The controls outlined in Section 7 with regard to minimising suspended sediment load during dredging are also of relevance to this impact. With the implementation of these measures, the residual impact is predicted to be of **minor adverse** significance at worst to adult and juvenile fish. No impact is predicted to eggs and larvae and shellfish.

12.5.4 Effect of construction light on fish populations

The construction works (with the exception of piling) would take place 24 hours a day and therefore lighting would be required at night during the construction phase. Light spill can be a further source of disturbance to fish in the estuary. Under the present-day scenario (i.e. prior to construction commencing), there will be a degree of light spill into the water column from the existing operations on the quay side and from vessel movements within the river; however, the reclamation (if required) and piling works will require lighting further out into the estuary than at present. Consequently, there is the potential for additional disturbance to fish.

The reaction of many fish to this type of disturbance is attraction to the light sources. Therefore, there is the potential for some attraction of fish to the construction area, although the noise generated during construction will counteract this effect to an extent. Overall, it is concluded that the noise and light during the construction phase will result in some localised redistribution of fish within the area around the proposed scheme. However, this will not affect the fish populations of the estuary as a whole and, therefore, the impact is predicted to be of **negligible** significance.

Mitigation measures and residual impact
No mitigation measures are required and the residual impact would be of **negligible** significance. However, in accordance with best practice, construction lighting would be directed away from the estuary where possible in order to minimise light spill into the water column.

12.5.5 Restriction of access to potential fishing grounds

Most commercial fishing activity takes place outside of the Tees estuary, although there is a small amount of fishing targeted at lobster (*Homarus gammarus*) and velvet swimming crab (*Necora puber*) in the lower estuary during summer. The digging of lugworms, ragworms and peeler crabs takes place in the intertidal mud and sandflats of the outer estuary and adjacent coast. The presence of construction vessels throughout the estuary during the construction phase could therefore result in temporary disturbance to such ongoing fishing activities. As discussed in Section 13.5, there would be an impact of negligible significance of existing navigation practices as a result of the proposed scheme. Based on the above, it is concluded that there would be **no direct impact** on fishing activity.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact.**

12.5.6 Underwater noise disturbance

A detailed underwater noise survey and modelling exercise (Subacoustech, 2014) was used to inform the EIA for the York Potash Harbour Facilities (Royal HaskoningDHV, 2014). As justified in Section 9.5, it is concluded that the findings of the underwater noise assessment carried out to inform the York Potash Harbour Facilities EIA can be used to inform this EIA Report.

The species of fish considered within the 2014 underwater noise assessment were:

- Dab (*Limanda limanda*). Based on current peer reviewed audiogram data (Chapman and Sand, 1974), dab is the most sensitive flatfish to underwater sound. Hence, dab was used as a surrogate species for other flatfish (e.g. flounder and plaice) and where high-quality audiogram data was not available. The dab audiogram was also used as a surrogate for European eel, due to a similar frequency response between these species (Jerko *et al.,* 1989, within Subacoustech, 2014).
- Herring (*Clupea harengus*). Based on peer reviewed audiogram data (Enger and Anderson, 1967), herring is the most sensitive marine fish to underwater sound. Herring was used a surrogate for sprat as they are also a clupeiform fish.
- Salmon (*Salmo salar*). Salmon possess a substantial swim bladder, however as it is not in close proximity to the inner ear, salmon are therefore less sensitive to underwater noise and vibration. In the underwater noise study, audiogram data from Hawkins and Johnstone (1978) have been used.
- Sandeels or sand lances (*Ammodytes tobianus)* lack a swim bladder and generally have poor sensitivity to sound relative to other species considered in the assessment (Suga *et al.,* 2005, with Subacoustech, 2014).
- Sea trout (*Salmo trutta*) are considered to have a low sensitivity to sound (Nedwell *et al.*, 2006).

The results of the assessment are presented below.

Unweighted metrics
The underwater noise assessment predicted that the maximum range within which physical injury to fish can be expected is 10m and 36m, for a 914mm and 2000mm diameter pile respectively. The maximum impact range for a behavioural effect is predicted to be 22m and 84m, for a 914mm and 2000mm diameter pile respectively.

The source levels from dredging operations are below the thresholds which would be anticipated to result in either a behavioural response or physical injury.

Royal HaskoningDHV

The dBht (species) criteria: auditory injury
The dBht (species) perceived level is used to indicate traumatic hearing damage over a very short exposure time. The assessment undertaken in support of the York Potash Harbour Facilities EIA concluded that the maximum traumatic hearing damage impact range from piling is 18m and 56m (with specific regard to herring), for a 914mm and 2000mm diameter pile respectively. For sand lace and sea trout, the maximum impact range is predicted to be less than 2m for both a 914mm and 2000mm diameter pile (this was also the greatest predicted impact range for dab and salmon with regard to the 914mm diameter pile only). The modelled results for a 2000mm diameter pile predicted that the greatest range for auditory injury extends to a maximum distance of 6m for dab and 4m for salmon.

The dBht (species) criteria: behavioural response
The estimated impact ranges from impact piling within which a behavioural response could be anticipated was less than 400m for dab, salmon, sand lace and sea trout (using a 914mm diameter pile). The largest impact range was predicted for herring at 4.89km for a 914mm diameter pile.

The assessment associated with a 2000mm diameter pile resulted in estimated maximum impact ranges of 2.89km for dab and 1.80km for salmon; the maximum impact ranges for sand lace and sea trout were not predicted to exceed 360m. The largest impact ranges were predicted for herring, where the impact extends to 4.89km.

The modelling results predicted that the source noise levels would not have a lethal effect on fish, however, traumatic injury could arise if fish are located within very close proximity to the source of the impact piling noise. The modelling work also predicted that there is greater potential for behavioural response within fish species in comparison with traumatic injury (from impact piling), due to the larger modelled impact range for a behavioural response (particularly in the case of herring).

Piling activities will not present a constant noise source and those periods between pile driving (e.g. when repositioning the piling barge) will provide opportunity for the unimpeded movement of fish species within the estuary; the impact will also be temporary, lasting for the duration of piling works. It should be noted that existing noise generated by shipping and industrial activity on the banks of the Tees estuary are already likely to influence the fish distribution within the estuary.

It is predicted that the overriding consequence of the generation of noise during piling operations (as well as the dredging and construction activities) will be for fish to move away from the source. Therefore, in the worst case, the construction works are expected to result in the localised redistribution of resident fish species and temporary disturbance to migration patterns of fish throughout the Tees estuary. The sensitivity of the various fish species present within the estuary ranges; hence a conservative estimate of high sensitivity has been used in this impact assessment. Based on the information presented above, the magnitude of the effect on fish species as a result of noise and vibration is predicted to be medium. An impact of **moderate adverse** significance is, therefore, anticipated to arise for fish as a result of underwater noise and vibration.

Mitigation measures and residual impact
In order to minimise the risk of traumatic injury or impairment to fish from the proposed impact piling, a soft start approach would be adopted in accordance with the JNCC's guidelines ('statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from impact piling'). Although this guidance is strictly focussed on marine mammals, it is concluded that part of the guidance (specifically the adoption of soft start techniques for piling) would allow any resident species to leave the area of greatest disturbance. This would minimise the risk to fish from underwater noise, as fish would be anticipated to move out of the area (thus avoiding impacts from occurring) prior to the noise from the piling reaching its

peak levels. With the implementation of a soft start approach, it is concluded that the residual impact to resident species would be **minor adverse** as a result of the proposed piling activity.

12.6 Potential impacts during the operational phase

12.6.1 Potential impact on feeding resource for fish populations as a result of maintenance dredging

Fish feed on a wide range of benthic invertebrates which live within and on the surface of the seabed, such as polychaete worms and the siphons of molluscs which protrude above the sediment surface. Therefore, impacts on this invertebrate resource as a result of the scheme can lead to the loss of a potential feeding resource or a reduction in the value of the impacted area as a feeding resource. The potential impacts of the proposed scheme on the subtidal ecological resource is assessed in Section 9.

There would be a requirement for maintenance dredging of the newly deepened approach channel and berth pocket during the operational phase, to maintain the required operating depth. Maintenance dredging represents a repeated disturbance to the benthic community within the dredged area, and limits recovery of the benthic community following the impact that would occur as a result of capital dredging. Although there would be recovery following capital dredging, the community would be likely characterised by a community similar to that observed within the pre-capital dredge approach channel (given that the area is already subject to ongoing disturbance from maintenance dredging).

The recovery in the operational phase is predicted to be of negligible significance for the benthic community, and consequently, an impact of **negligible** significance is predicted on the feeding resource for fish due to maintenance dredging.

In addition to the above, the proposed reclamation of the 8.5ha of subtidal habitat and 1.19ha of intertidal during the construction phase has potential to impact on fish during the operational phase (i.e. the impact would arise during the construction phase but would fully manifest during the operational phase). Given the findings of the ecological survey work undertaken within the footprint of the proposed reclamation (which show that the intertidal is predominantly artificial and species poor, and therefore does not represent a significant feeding resource for fish), as well as the vast extent of available subtidal feeding habitat elsewhere throughout the Tees estuary, an impact of **negligible** significance is predicted.

Mitigation measures and residual impact

Maintenance dredging of the approach channel and berth pocket (and the associated regular disturbance to the benthic community) and the loss of subtidal habitat during reclamation are unavoidable consequences of the proposed scheme. There are no mitigation measures that can be implemented. The residual impact would be of **negligible** significance.

12.6.2 Effect of lighting for the container terminal on fish populations

Lighting that is required for the container terminal has the potential to result in an impact on fish populations in a similar manner to that described in Section 12.5 for construction lighting. At present, the existing quayside within part of the proposed scheme footprint is lit given that there are existing operations at the site (e.g. TCT1 and the Riverside Ro-Ro). However, the lighting required for the proposed scheme will be more significant due to the need to provide a minimum lighting standard to meet statutory requirements (Docks Regulations 1988) and so there is the potential for increased light spill into the water column.

Details of the lighting design for the proposed terminal are provided in Section 3.1. The luminaries that will be incorporated into the lighting scheme are designed to minimise upward light output and obtrusive light into the environment (e.g. sky glow, light spill, glare and light intrusion). Nevertheless, it is likely that there will be some light spill into the estuary given the need to light the quayside during night time operations.

As described in Section 12.5, fish tend to react to light spill. Therefore, light spill into the water column can result in a redistribution of fish. However, the fish populations of the estuary as a whole would not be affected beyond the potential redistribution of individuals in the area affected by light spill and the impact is predicted to be of **negligible** significance.

Mitigation measures and residual impact
Beyond the measures incorporated into the lighting design to minimise light spill and other forms of light pollution, no mitigation measures are required. The residual impact would be of **negligible** significance.

12.6.3 Noise disturbance to fish from operational phase vessels

Based on the predicted vessel movements during operation, in the context of the existing vessel movements in the estuary, it is predicted that the magnitude of effect to fish (considered to be a high sensitivity receptor) due to noise disturbance would be very low; an impact of **negligible** significance is anticipated.

Mitigation measures and residual impact
No mitigation measures are required. The residual impact would be of **negligible** significance.

13 COMMERCIAL NAVIGATION

13.1 Introduction

This section of the EIA Report considers the following potential impacts to commercial navigation:

- Conflict between construction activities and commercial navigation.
- Navigational safety for larger vessels during operation.
- Increased collision risk due to increased vessel traffic during operation.
- Delays to shipping movements due to increased vessel traffic during operation.

13.2 Policy and consultation

13.2.1 Policy

Marine Policy Statement

As outlined within the UK MPS (HM Government, 2011), port development may result in an increase in shipping activity. When considering any potential increase in shipping activity, the MPS states (in Paragraph 3.4.10) that marine plan authorities and decision makers should ensure that the social and economic benefits and environmental impacts are taken into account and that impacts are considered in line with sustainable development principles.

As outlined in the MPS (Paragraph 3.4.6), environmental impacts arising from shipping activity can be through accidental pollution from ships in the course of navigation or lawful operations, pollution caused by unlawful operations or physical damage caused by collisions. Other pressures on the environment from shipping activity relate to noise and airborne emissions. These potential impacts have been assessed within this section of the EIA Report, where they are relevant to the proposed scheme.

The MPS (authorised by Section 44 of the Marine and Coastal Access Act, 2009) states that marine plan authorities and decision makers should take into account and seek to minimise any negative impacts on shipping activity, freedom of navigation and navigational safety and ensure that their decisions are in compliance with international maritime law (Paragraph 3.4.7).

13.2.2 Consultation

Consultation with the MMO was undertaken in 2017 via the request for a formal Scoping Opinion to inform the 2008 HRO extension application process. As noted earlier, the MMO provided comments as part of its Scoping Opinion which it considered were more applicable to the marine licensing process, rather than the HRO extension process. There were no comments received from the MMO during 2017 which are applicable to this section of the EIA Report.

Further consultation was undertaken with the MMO in October 2018 to discuss the scope of environmental assessment required to support a marine licence application. It was proposed that no additional assessment with regard to commercial navigation would be undertaken, beyond that presented within the 2018 SEIR. The MMO raised no objections to this approach and therefore further assessment into this topic has not been undertaken. However, the information presented in the SEIR has been re-formatted into an EIA chapter to minimise the requirement for cross referencing to other supporting documentation.

13.3 Methodology

13.3.1 Study area

The study area for this section of the EIA Report comprises the Tees estuary, extending from the mouth of the estuary at the North and South Gare breakwaters upstream to the Transporter Bridge.

13.3.2 Methodology used to describe the existing environment

This section of the EIA Report has been informed by desk-based review of publicly available documents and consultation with the Harbour Master and PDT.

13.3.3 Methodology for assessment of potential impacts

The assessment methodology used to determine the potential environmental impacts on commercial navigation associated with the proposed scheme is generally as set out in Section 5.

13.4 Existing environment

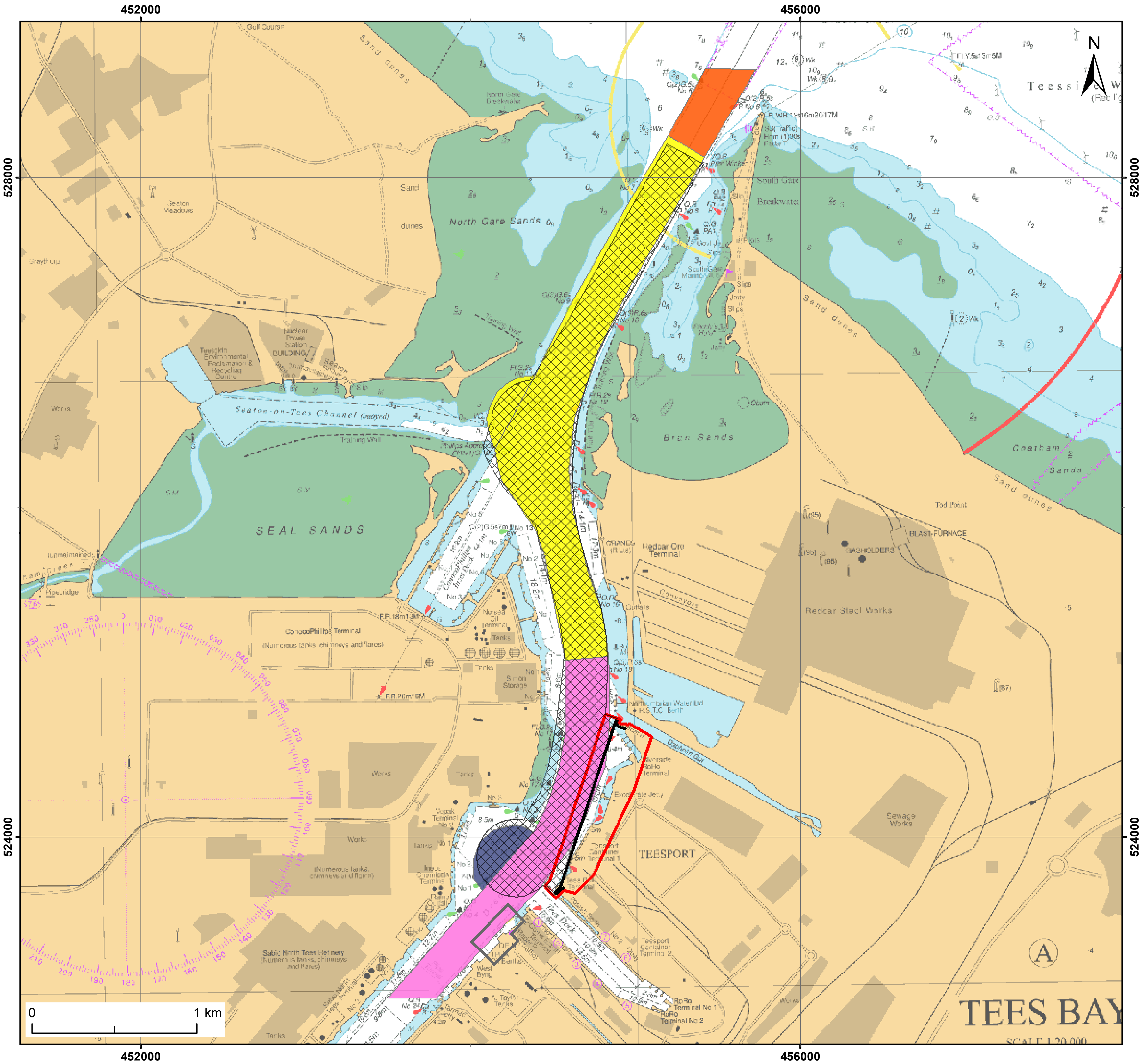
Many of the riverside industrial plants along the 17km stretch of the River Tees have docking and cargo facilities and, therefore, the River Tees experiences significant commercial vessel traffic. PDT has confirmed that on average, there are between 800 and 950 vessel movements per month within the Tees estuary. The 2006 ES identified that on average there are between 950 and 1100 vessel movements per month within the Tees estuary. The average number of vessel movements operating in the Tees estuary has therefore decreased since 2006, however this is not considered to represent a material change to the baseline environment.

The Tees estuary is approached from the north-east through a deep-water channel in Tees Bay. The approach channel has an advertised depth of 15.4m below CD from Tees fairway light buoy to the entrance, where it reduces to 14.1m below CD. Thereafter the maintained depth is progressively reduced to 4.5m below CD, seven nautical miles from the entrance. The current advertised depths of the channel are shown in Figure 13.1 (it should be noted that the Harbour Master has stated that the current channel depths do not match the advertised depths due to sedimentation within the channel).

There are currently two turning areas within the estuary; one within the Seaton Channel area which can accommodate vessels 350m in length and is regularly used for large tankers which berth at the Tees North Sea Oil Terminal and large bulk carriers bringing coal and ore to Redcar Ore Terminal. The second is the Tees Dock turning area which is used to turn vessels which berth at Tees Dock and at the bulk liquid jetties opposite.

Large deep drafted ships bound for Tees North Sea Oil Terminal and the Redcar Ore terminal pick up tug assistance after passing South Gare. Fully laden ships can only enter on the high tide but can leave at any time once their cargo has been discharged. Similarly, any fully laden ships to exit the river must wait for the high tide. Vessels are turned when unloaded either in the Seaton Channel turning area or in the Tees Dock Turning Area depending on which quay or jetty they are destined for.

The channel is maintained by PDT which has a statutory responsibility to maintain the channel for safe navigation. Additionally, traffic in the Tees estuary is controlled by a sophisticated vessel traffic system (VTS).



Legend

- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Limit of deviation for Works No. 2 (no longer proposed as part of NGCT scheme)
- Proposed quay face
- Proposed dredge footprint

Advertised dredge depths

- 15.4m
- 14.1m
- 10.4m
- 8.8m
- 11.7m

Client:	Project:
PD Teesport	Northern Gateway Container Terminal

Title: Advertised dredge depths

Figure: 13.1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	21/10/2019	TC	SR	A3	1:22,971

Co-ordinate system: British National Grid

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Consultation with PDT was undertaken during December 2017 to determine the volume of cargo handled. A comparison of the tonnages handled in 2004 compared to 2016 is provided in Table 13.1.

Table 13.1 Comparison of tonnages handled by Teesport during 2004 and 2016

Material handled	2004 tonnage	2016 tonnage
Liquid bulk	36.2 million tonnes	20 million tonnes
Dry bulk	12.5 million tonnes	2.3 million tonnes
Unitised cargo	3.6 million tonnes	4 million tonnes
Overall	53.8 million tonnes	26.7 million tonnes

The data in Table 13.1 shows that there has been a reduction in the overall tonnages handled by PDT since 2004 (however the volume of unitised cargo has increased). This reduction is largely as a result of the closure of the steel works and reduced exports from the Conoco Philips facility.

13.4.1 Future evolution of the baseline in the absence of the proposed scheme

As detailed in Section 2, the throughput of containers at Teesport is now very close to capacity; in the absence of the NGCT scheme, it is predicted that Teesport would be at full capacity by approximately 2024, preventing the future growth of the port for container cargo. The port may therefore need to look to other markets to allow growth of the port, which could result in a change in the nature of vessels transiting through the river.

13.5 Potential impacts during the construction phase

13.5.1 Potential conflict between construction activities and commercial navigation within the Tees estuary

During the construction phase there is the potential for conflict between the construction activity and navigation within the Tees estuary. This potential arises due to the presence of the dredger within the navigation channel, the need for pipelines to pump dredged material ashore from the dredger and the presence of other construction plant required to construct the terminal itself. Construction activity will be focused on the area in the vicinity of the proposed terminal but the capital dredging will, at certain stages in the construction programme, affect the wider estuary between the proposed terminal location and (approximately) the breakwaters at the mouth of the Tees estuary.

The potential conflict between construction plant and shipping traffic could take a number of forms, including delays to shipping, increased risk collision, obscuring navigational aids and the prevention/interference of activities of other operators that are present in the vicinity of the proposed terminal. This potential conflict exists for the duration of the construction which is predicted to last for a period of 120 weeks overall, divided into two periods associated with Phase 1 (80 weeks) and Phase 2 (40 weeks) (assuming a two phase construction process, for the purposes of this EIA).

PDT would manage any potential conflicts in the same way as routine dredging and other construction activities, through co-ordination via the Harbour Master. Management of dredging operations within a busy port environment is a standard activity for the Harbour Master. It is considered that the use of a VTS would provide a satisfactory mechanism for the effective management of all shipping traffic within the Tees estuary and Tees Bay. The Harbour Master would issue Notices to Mariners to inform other users of the construction works and, in addition, construction vessels would use appropriate signals as required by International Regulations to allow safe navigation.

The Port Maritime Safety Code will be taken into account within the detailed design of the proposed scheme. Liaison with the Harbour Authority will be undertaken to develop a robust Safety Management System, which would be implemented and adhered to during the construction phase for the proposed scheme.

Based on the above, the magnitude of the impact is anticipated to be very low on a medium sensitivity receptor. The proposed scheme is, therefore, predicted to have an impact of **negligible** significance on commercial navigation during the construction phase.

Mitigation measures and residual impact
No mitigation measures are required and the residual impact is predicted to be of **negligible** significance.

13.6 Potential impacts during the operational phase

13.6.1 Navigational safety for larger vessels during operation

The proposed container terminal will result in more frequent movements of larger vessels within the Tees estuary compared with the existing situation. This has potential to impact on navigational within the estuary.

In determining the design for the proposed navigation channel, a series of navigation simulation exercises were undertaken by PDT at South Tyneside College. These exercises were intended to simulate vessel manoeuvring (including turning) within the approach channel and berthing of container vessels at the proposed terminal. The ultimate aim was to inform the design of the channel and turning circles in order to satisfy the Harbour Master that vessels of the type that would use the proposed terminal could navigate to and from the terminal in a safe manner.

The proposed channel design is a consequence of the navigation simulations described above and the Harbour Master has no concerns over the ability of the larger vessels to safely manoeuvre within the estuary. Therefore, **no impact** is predicted.

Mitigation measures and residual impact
No mitigation measures are required and there would be **no residual impact**.

13.6.2 Increased collision risk due to increased vessel traffic during operation

It is difficult to predict the overall increase in vessel traffic that would occur during the operational phase as this is dependent on the nature of the customers that will ultimately use the terminal. However, PDT estimates that an increase in traffic of the order 100 movements per month would arise as a consequence of the construction of the terminal, or an increase of approximately 10% on the average number of existing vessels movements per month.

All vessel traffic in the estuary and Tees Bay is controlled by the VTS and this would, therefore, be applicable to all traffic generated as a consequence of the presence of the container terminal. The Harbour Master has been consulted with respect to this predicted increase in traffic levels and has stated that there are no concerns to an increase in vessel traffic of this order of magnitude and that no changes to the existing VTS are required to accommodate the predicted increase in traffic levels. Consequently, it is predicted that there will be no change in the existing risk of collision as a result of the construction of the terminal and **no impact** is predicted.

Mitigation measures and residual impact
No mitigation measures are required and there would be **no residual impact**.

13.6.3 Potential for delays due to increased shipping activity during operation

PDT commissioned a shipping traffic study to investigate the impact of the proposed scheme and its related shipping on the existing ship movements on the river (Royal Haskoning, 2005b). The assessment was carried out using the Royal Haskoning in-house VTS module of POSPORT, Marine Traffic Model.

The shipping study concludes that the maximum impact to shipping on the river as a consequence of the proposed scheme is to introduce a shipping delay of the order of one hour over the course of one week. The amount of waiting time estimated by the simulation varies between 24 minutes and 62 minutes depending upon the actual sailing schedule for the new container ships. It is further concluded that the estimated weekly waiting time is split between existing shipping and the new container vessels; the maximum waiting time to any category of vessels is 30 minutes. Based on the above, the impact to shipping traffic as a result of the proposed scheme would be **negligible**.

Mitigation measures and residual impact

No mitigation measures are required. The residual impact would be of **negligible** significance.

14 ROAD AND RAIL TRAFFIC

14.1 Introduction

As noted within Section 1, the landside elements of the proposed scheme have commenced (under the planning permission granted by RCBC in 2007).

This section of the EIA Report summarises a review of the transport baseline environment that informed the consents to establish if there has been a material change that would lead to a significant change in the assessed impacts.

To facilitate the review, a Transport Statement has been produced (Royal HaskoningDHV, 2017) (Appendix 17). The scope of the Transport Statement was defined as:

- A review of 'present day' transport policy to establish the compliance of the scheme.
- A review of the Transport Assessment (TA) baseline conditions that informed the impact assessment conclusions for the operational phase of the scheme. Namely:
  - mode share;
  - traffic generation and assignment;
  - highway capacity;
  - road safety; and,
  - cumulative impact.

14.2 Background

As noted in Section 1, PDT secured planning permission from RCBC for the NGCT in October 2007 (Reference: R/2006/0433/OO). The planning application was supported by an EIA, which itself was supported by a series of appendices and accompanying documents. From a transport perspective, the relevant documents produced comprised:

- A TA and subsequent revision – this document established the traffic demand and distribution for the operational phase and considered how this impacted upon junction capacity and road safety. The traffic demand was predicated on an assessment of rail freight capacity.
- The 2006 ES and 2007 Supplement – the 2006 ES was informed by the TA and established the impact of the construction and operational phases of the NGCT.

Mitigation was secured for the NGCT by condition. The transport related conditions specified by RCBC are:

- **Condition 16**: A Business Travel Plan shall be agreed with the Local Planning Authority.
- **Condition 28**: Phase 2 of the terminal development shall not operate until the new rail terminal has been completed.
- **Condition 33**: The development hereby granted consent shall not be brought into use unless and until the highway improvement works have been completed.

The original TA contained the mode share forecasts and baseline conditions that informed the capacity, road safety and 2006 ES assessments.

With regard to the construction phase of the project, the 2006 ES established that the traffic demand (40 HGV/ready-mix truck movements and approximately 225 car movements) will represent an impact of negligible significance. Therefore, the scope of the TS was confined to the operational phase of the development.

14.3 A summary of the transport review

A review of the present-day transport policy framework indicates that the key policy drivers can be summarised as managing demand and assigning trips to sustainable modes. Following full consideration of sustainable modes, infrastructure solutions are to be considered to mitigate residual impacts. These policy directives were secured through the transport conditions applied to the 2007 planning permission.

A comparison of 2007 and 2017 transport baseline conditions shows that there are no material changes to the employee and freight mode share, thus no material change to the traffic demand. It is also considered that the development traffic distribution that informed the original TA has not been subject to material change.

Noting the 'no change' traffic scenario, a review was undertaken of 2017 highway conditions to ascertain if any changes could influence the findings of the original TA.

It has been demonstrated that ten of the 11 links have similar 2017 baseline flows to that of 2005. This indicates that the highway network is stable within the study area and could accommodate the NGCT with the same mitigation strategy proposed within the original TA.

Three of the four conditioned highway improvements have been implemented in advance, effectively 'capturing' much of the additional highway capacity required to accommodate the proposed scheme.

Comparison of the 2006 and 2017 baseline road safety conditions demonstrates a positive reduction in personal injury collision (PICs) within the study area. This positive trend could be partly attributable to the early implementation of conditioned highway improvements.

The NGCT secured the forecast traffic demand and became a material consideration for all subsequent applications. Planning consents post the 2007 consent will have been determined in full consideration of the forecast traffic flows. It follows, therefore, that in demonstrating no material change in traffic demand the requirement to assess the cumulative impact of other projects is satisfied.

14.4 Conclusion

It has been demonstrated that the proposed scheme is policy-compliant and the impacts on the transport network are consistent with those assessed in the 2006 TA.

Noting that the TA informed transport effects in the 2006 ES, it follows that the proposed scheme is consistent with the assessed environmental impacts also.

It is, therefore, concluded that the 2006 transport impact assessments and mitigation remain valid.

15 ARCHAEOLOGY AND HERITAGE

15.1 Introduction

As previously noted, the landside elements of the proposed scheme have commenced (under the planning permission granted by RCBC in 2007). PDT is not seeking new permissions or changes to the development that is already authorised and commenced under the existing planning permission. This section, therefore, addresses only the marine footprint of the works, namely:

- Capital dredging of the approach channel and berth pocket (and maintenance dredging during operation).
- Construction of the quay wall and reclamation (if required).
- Disposal of dredged material.

In November 2015, Royal HaskoningDHV prepared a Written Scheme of Investigation (WSI) (Appendix 18) setting out the archaeological requirements for the scheme in response to planning condition 14, imposed by RCBC on planning permission R/2006/0433/OO:

- *Pre-development - written scheme of archaeological investigation to be approved by LPA. Reason: To enable the identification and recording of archaeological and palaeoecological remains.*

The WSI was approved by RCBC prior to the commencement of works on land in 2015.

The WSI also reviewed the archaeological baseline relevant to both the landside and marine elements and presented an updated summary of the likely impacts. This informed the programme of mitigation presented in the WSI and is summarised below.

15.2 Updated information

The existing environment and impact assessment of the archaeology and cultural heritage resource has been based on an archaeological desk-based assessment (DBA) undertaken by AOC Archaeology Group (AOC, 2005).

The DBA demonstrated that there are no known cultural heritage sites within the proposed development area. It was concluded, however, that the construction of the deep-water berth and quay wall and capital dredging could impact potential archaeology that may be present. This includes the disturbance of previously undisturbed buried sediments within the Tees estuary (comprising peat and alluvial deposits), which have the potential to preserve important information relating to early use of the channel, as well as sea level change and the palaeoenvironment. The documented losses of several ships in the Tees estuary also indicate the potential for remains associated with former maritime use to be present.

As noted earlier in this report, the York Potash Harbour Facilities ES was submitted post production of the 2006 ES and 2007 Supplement. The site of the York Potash Harbour facility is located immediately downstream of the NGCT site. Data from the Redcar and Cleveland Historic Environment Record (HER) acquired for the York Potash Harbour Facilities project include new records of cultural heritage sites, in addition to a DBA produced by AOC archaeology in 2005. Three of these cultural heritage sites are located within the NGCT site and study area. However, these do not relate to extant sites, and comprise three ‘beacons’ relating to a River Tees navigation light shown on historic mapping.

Data from the National Record of the Historic Environment (NRHE) acquired for the York Potash Harbour Facilities project did not demonstrate the presence of further monuments within the NGCT site, with the exception of providing further details on the documented losses of vessels in the vicinity of the development and the potential for maritime archaeological remains to be present. The magnitude of the potential impact of the works remains, however, is considered to be low given that capital dredging required for the NGCT project will take place within an existing dredged channel.

Geoarchaeological assessment was also carried out for the York Potash Harbour Facilities project, comprising the analysis of the marine vibrocore logs and boreholes from the Tees estuary (Cotswold Archaeology, 2014a). Estuarine alluvium and peat of possible mid-Holocene date were seen in boreholes from 16.7m, generally *c.* 2m in extent. However, the peat deposit was comparatively infrequent and slight; none of the vibrocores reached a depth at which these deposits were encountered and no retained borehole samples included material that would be suitable for further analysis. Following consultation with Historic England, Cotswold Archaeology concluded that it was not be guaranteed that further borehole survey would encounter these peat deposits again and no further work was recommended.

Cotswold Archaeology also undertook a settings assessment in relation to a proposed overhead conveyor system linked to the York Potash Harbour Facilities (Cotswold Archaeology, 2014b). The assessment identified an extensive modern industrial landscape, along the southern bank of the Tees estuary and that, in addition to visual considerations, noise, smell and heat also contribute to the experience of the landscape.

15.3 Implications of the updated information on previously reported impacts

Taking account of the DBA carried out by AOC in 2005, and additional work carried out for the York Potash Harbour Facilities ES, potential impacts to the historic environment with respect to the marine elements of NGCT are summarised as follows.

There are no extant cultural heritage assets within the area of the NGCT development. Therefore, there will be **no impact** and no mitigation is required.

The construction of the deep-water berth and quay wall, and capital dredging, may impact as yet undiscovered archaeology which may be present within the footprint of such works. Potential archaeological remains may comprise wrecks or crashed aircraft and other evidence relating to the former maritime use of the River Tees. There is also the possibility of encountering palaeogeographic features and deposits relating to prehistoric activity and the palaeoenvironment.

As set out in the WSI (Royal HaskoningDHV, 2015), maritime, aviation and prehistoric finds encountered during the course of works, other than those discovered through specific archaeological investigation, will be reported through a finds reporting protocol (included as Appendix II to the WSI). In addition, if further ground investigations or geophysical surveys are carried out in advance of capital dredging within the approach channel or the deep-water berth area, or in advance of the construction of the quay wall, then archaeological objectives will be included as part of the survey methodology.

If significant archaeological remains are identified through geoarchaeological assessment of ground investigation data, or archaeological interpretation of the marine geophysical survey data, then ground truthing to establish the nature and extent of these remains may be required. Ground truthing may take place via diver or Remotely Operated Vehicle (ROV) survey. It may also be possible to combine archaeological objectives within any survey undertaken for the purposes of identification of Unexploded Ordnance (UXO).

If diver or ROV survey is required, and the presence of significant archaeological remains is confirmed, then further works may be necessary to record archaeological material prior to removal (i.e. preservation by record) or to establish Archaeological Exclusion Zones (AEZs) to ensure preservation in situ and to prevent damage or destruction to significant archaeological remains during construction and operational works.

Due to the existing industrial character of the area, there will be **no impact** to the setting or historic character of the area or to heritage assets in the wider vicinity as a result of the development.

A draft outline methodology for the mitigation proposed above is included in Section 6 of the WSI. Prior to the commencement of marine works, it is proposed that the WSI should be updated to take account of any marine licence granted for the proposed scheme. At this time Historic England will be consulted (as the statutory advisor to the MMO on the historic environment) to determine the specific methodology for any archaeological works which may be required.

For completeness, a summary of the potential impacts of the marine elements of the proposed scheme on archaeology and heritage are reported in Table 15.1.

Table 15.1 Summary of potential impacts on archaeology and heritage due to the marine elements of the proposed NGCT

Impact	Significance rating	Mitigation	Residual impact
Construction phase			
Potential impact of berth construction, quay wall construction and capital dredging on the potential archaeological resource	Moderate to major adverse	Implementation of the WSI (and the works as outlined above).	Dependent on the outcome of the above investigations
Operational phase			
Effect on the setting of designated structures	No impact	None required	No residual impact.

16 NOISE AND VIBRATION

The landside elements of the proposed scheme have commenced (under the planning permission granted by RCBC in 2007). PDT is not seeking new permissions or changes to the development that is already authorised and commenced under the existing planning permission, and the road and rail traffic assessment (Section 14) has concluded that the 2006 assessment remains valid.

The 2006 planning permission granted by RCBC contained one condition with specific regard to noise and vibration, which had to be discharged prior to the commencement of the works authorised by the planning permission. Details of the planning condition with which PDT has complied, together with an update on the current status, are presented in Table 16.1.

As noted in Table 16.1, the condition imposed by RCBC with regard to noise and vibration was adequately discharged prior to the landside elements of the proposed scheme being implemented. The future development of the wider NGCT (beyond the commencement works) will be subject to the same controls and, therefore, there are measures in place to manage any risks to noise sensitive receptors.

Based on the above, no further assessment works are considered necessary to illustrate that the findings of the 2006 ES (with specific regard to noise and vibration) remain valid.

Table 16.1 Planning conditions imposed on the NGCT by RCBC with regard to noise and vibration

Planning condition	Reason	Status
Condition 15: Prior to the commencement of development, a Construction Method Statement shall be submitted to and approved in writing by the Local Planning Authority. This should ensure compliance with the principles of Best Practicable Means as outlined in BS5228 Part 1 1997 and the Control of Pollution Act and include measures to minimise dust generation and noise from the site. Thereafter all work shall be carried out in strict accordance with the approved construction method statement.	To prevent nuisance from noise and dust and in the interests of the visual amenity of the area.	Royal HaskoningDHV developed a Construction Method in accordance with Condition 15 which was submitted to RCBC in September 2015. Following review of this document, RCBC subsequently confirmed that the commencement works could be undertaken.

The implications of additional knowledge / understanding regarding the potential impacts of noise disturbance to waterbirds and fish (underwater noise) has been included in the respective sections of this EIA Report.

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17 AIR QUALITY

The landside elements of the proposed scheme have commenced (under the planning permission granted by RCBC in 2007). PDT is not seeking new permissions or changes to the development that is already authorised and commenced under the existing planning permission, and the road and rail traffic assessment (Section 14) has concluded that the 2006 assessment remains valid.

The 2006 planning permission granted by RCBC contained one condition with specific regard to air quality which had to be discharged prior to the commencement of the works authorised by the planning permission. Details of the planning condition with which PDT has complied, together with an update on the current status, are presented in Table 17.1.

As noted in Table 17.1, the condition imposed by RCBC was adequately discharged prior to the landside elements of the proposed scheme being implemented. The future development of the wider NGCT (beyond the commencement works) will be subject to the same controls and, therefore, there are measures in place to manage any risks to air quality.

Based on the above, no further assessment works are considered necessary to illustrate that the findings of the 2006 ES (with specific regard to air quality) remain valid.

Table 17.1 Planning conditions imposed on the NGCT by RCBC with regard to air quality

Planning condition	Reason	Status
Condition 15: Prior to the commencement of development, a Construction Method Statement shall be submitted to and approved in writing by the Local Planning Authority. This should ensure compliance with the principles of Best Practicable Means as outlined in BS5228 Part 1 1997 and the Control of Pollution Act and include measures to minimise dust generation and noise from the site. Thereafter all work shall be carried out in strict accordance with the approved construction method statement.	To prevent nuisance from noise and dust and in the interests of the visual amenity of the area.	Royal HaskoningDHV developed a Construction Method in accordance with Condition 15, which was submitted to RCBC in September 2015. RCBC subsequently confirmed that the commencement works could be undertaken.

Within its scoping response, the Environment Agency noted that odours may arise from the storage and re-use of dredged material on land. The material to be re-used within the reclamation (if required) and land-raising activities will be sands and gravels. It is considered that odours will have the potential to be generated if a significant volume of dredged material (containing high levels of organic matter) were to be stockpiled on site for a significant duration of time. In reality, however, the dredged material to be used beneficially will be placed on site and dewatered as part of the construction works.

Sediment samples from the Tees have confirmed percentage organic matter values of between 1.2% and 8.7% within the proposed dredge footprint. The placement of sands and gravels with low percentages of organic matter content is considered unlikely to result in the generation of odours, and therefore no further assessment has been undertaken in this regard.

18 RECREATION AND ACCESS

18.1 Introduction

With regard to landside recreation and access, the landside elements of the proposed scheme have commenced (under the planning permission granted by RCBC in 2007). PDT is not seeking new permissions or changes to the development that is already authorised and commenced under the existing planning permission. In addition, there has been no change to the land ownership rights or addition of recreational assets within the footprint of the proposed container terminal. On this basis, no further assessment regarding landside recreation and access is considered necessary and the findings of the 2006 ES remain valid.

The 2006 planning permission granted by RCBC contained a condition with specific regard to access (see Table 18.1). As this condition was not directly applicable to the landside works which have been undertaken to date, there was no requirement to discharge this condition prior to commencing works. This condition, however, will need to be discharged prior to implementing the full landside development. It can therefore be concluded that relevant controls are in place to manage any potential impacts on access with regard to the landside elements of the NGCT. Based on the above, this section focusses on water-based recreation only.

Table 18.1 Planning conditions imposed on the NGCT by RCBC with regard to access

Planning condition	Reason
Condition 18: Prior to the commencement of development, details of emergency access arrangements shall be submitted to and approved in writing by the Local Planning Authority. The approved scheme has been implemented in full prior to the terminal coming into use.	In the interests of achieving an acceptable form of development.

18.2 Policy and consultation

18.2.1 Consultation

Consultation with the MMO was undertaken in 2017 via the request for a formal Scoping Opinion to inform the 2008 HRO extension application process. As noted earlier, the MMO provided comments as part of its Scoping Opinion which it considered were more applicable to the marine licensing process, rather than the HRO extension process. There were no comments received from the MMO during 2017 which are applicable to this section of the EIA Report.

Further consultation was undertaken with the MMO in October 2018 to discuss the scope of environmental assessment required to support a marine licence application. It was proposed that no additional assessment with regard to recreation and access would be undertaken, beyond that presented within the 2018 SEIR. The MMO raised no objections to this approach and therefore further assessment into this topic has not been undertaken. However, the information presented in the SEIR has been re-formatted and supplemented with information from the 2006 ES to minimise the requirement for cross referencing to other supporting documentation.

18.3 Methodology

18.3.1 Study area

Based on the information presented in Section 18.1, the study area for this section of the EIA Report comprises the Tees estuary, extending from the mouth of the estuary at the North and South Gare breakwaters upstream to the Transporter Bridge.

18.3.2 Methodology used to describe the existing environment

This section of the report has been informed by consultation with the Tees estuary Harbour Master (with specific regard to water-based recreation in the estuary). A review of information within the York Potash Harbour Facilities ES (Royal HaskoningDHV, 2014) has also been undertaken.

18.3.3 Methodology for assessment of potential impacts

The assessment methodology used to determine the potential environmental impacts on commercial navigation associated with the proposed scheme is as set out in Section 5.

18.4 Existing environment

The heavily industrialised nature of the estuary, combined with the history of poor water quality and the busy commercial nature of the port have placed constraints on the estuary for water based recreational activities. Despite this, low intensity water-based recreation is undertaken on the open coast and at the mouth of the estuary in the sheltered waters within the breakwaters. Recreational activities such as paddle sports take place in the upper estuary, beyond the Tees Barrage.

The York Potash Harbour Facilities ES (Royal HaskoningDHV, 2014) concluded that water-based recreational activity generally does not take place in the proposed construction area for the York Potash Harbour Facilities (located immediately downstream of the proposed container terminal for NGCT). Disturbance to water based recreational activities were therefore scoped out of the EIA for the York Potash Harbour Facilities.

18.4.1 Future evolution of the baseline in the absence of the proposed scheme

In the absence of the proposed scheme, the value of the Tees estuary as a water based recreational asset is highly unlikely to change. The ongoing commercial vessel movements within the Tees estuary would continue, which would likely continue to limit the opportunities for water based recreational activity.

18.5 Potential impacts during the construction phase

18.5.1 Potential impact on water-based recreation due to construction activities in the estuary

A variety of plant will be sited in and around the development area during the construction phase, therefore there is the potential for restriction of access by water to the area around the proposed development site, particularly associated with the presence of the dredger in various parts of the channel throughout the course of the construction work.

As described in Section 18.4, use of the estuary around the development site by recreational vessels is low due to the industrialised nature of this section of the estuary. The main potential for conflict with recreational activity is during the dredging that will take place close to the mouth of the estuary where some sailing is undertaken. However, given the limited duration of dredging in this area and particularly the fact that the dredging would take place within an existing navigation channel that is heavily used by commercial shipping, conflict between recreational vessels and the construction activities are predicted to be of **negligible** significance.

Mitigation measures and residual impact
No mitigation measures are required, however, PDT would adopt measures to minimise the risk to water based recreational as far as practicable. The movements of the dredger and other water-based aspects of the construction phase will be within the control of the existing VTS that controls commercial shipping activity and other vessel movements in the estuary and Tees Bay. In addition, Notices to Mariners would be issued for the construction phase of the works. The residual impact would be of **negligible** significance.

18.6 Potential impacts during the operational phase

18.6.1 Potential conflict between water-based recreation due to changes in commercial shipping traffic during operation

As a consequence of the proposed scheme, there will be a change to the patterns of commercial shipping, with an increase in the frequency of movements of larger vessels navigating in the lower estuary and an overall increase in shipping traffic. This change in commercial shipping has the potential to give rise to conflicts with recreational users of the area.

Commercial vessels will be confined to navigating within the dredged channel (as at present) and recreational craft, therefore, avoid this area. Additionally, much of the water-based recreation is undertaken outside of the estuary within Tees Bay and along the coast. Consequently, during the operational phase, the potential for conflict between commercial shipping and recreational activity is the same as at present and as a result **no impact** is predicted.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact**.

19 LANDSCAPE AND VISUAL

The landside elements of the proposed scheme have commenced (under the planning permission granted by RCBC in 2007). PDT is not seeking new permissions or changes to the development that is already authorised and commenced under the existing planning permission.

The 2006 planning permission granted by RCBC contained a number of conditions with specific regard to the landscape and visual environment (see Table 19.1). Following receipt of the outline planning permission, a reserved matters application was submitted to RCBC with specific regard to landscaping within the site and along the access to the site which reflects the form and function of those spaces. RCBC approved the reserved matters application in January 2013 with conditions (which are also presented in Table 19.1).

As noted in Table 19.1, the conditions imposed by RCBC within the planning permission relate to the development of landside infrastructure which has not yet been constructed on site. There was therefore no requirement to discharge the conditions prior to commencement of the landside works. The future development of the wider NGCT (beyond the commencement works) will require all of these conditions to be discharged prior to works commencing. Therefore, it can be concluded that there are measures in place to manage any risks associated to landscape and visual amenity.

Based on the above, no further assessment works are considered necessary to illustrate that the findings of the 2006 ES (with specific regard to landscape and visual amenity) remain valid.

Table 19.1 Planning conditions imposed on the NGCT by RCBC with regard to landscape and visual amenity

Planning condition	Reason
Condition 1: No part of the development hereby permitted shall be commenced until details of siting, design, external appearance, means of access and landscaping (hereinafter called the reserved matters) in respect of that part of the development have been submitted to and approved in writing by the Local Planning Authority, and the development shall not be carried out otherwise than in complete accordance with the details so approved. Application for the approval of the reserved matters for the first phase of development (as shown on drawing 9R0155/PA/1000 Revision 4) shall be made to the Local Planning Authority before the expiration of five years from the date of this permission and application for the approval of the reserved matters for the second phase of development (as shown on drawing 9R0155/PA/1000 Revision 4) shall be made to the Local Planning Authority before the expiration of fifteen years from the date of this permission.	By virtue of the provision of section 92 of the Town and Country Planning Act 1990 (as amended).
Condition 4: Prior to the commencement of development of each part of the development for which reserved matters have been approved, details and samples of all materials to be used in the construction of the external surfaces of the buildings and any external plant and equipment in that part of the development shall be submitted to and approved in writing by the Local Planning Authority and the development shall be implemented using the approved materials.	In the interests of visual amenity to ensure a satisfactory standard of development is achieved.
Condition 13: Prior to the installation of any external lighting on any part of the new terminal, including temporary lighting, details of a scheme of external lighting to be used within that part shall be submitted to and approved in writing by the Local Planning Authority. Such details shall	In the interests of visual amenity and to avoid nuisance or harm to fisheries resources as a result of light spillage.

Planning condition	Reason
include the location, type, angle of direction and wattage of each light which shall be so positioned to prevent any glare or light spillage especially towards the estuary. Thereafter the lighting shall be implemented in accordance with the approved scheme.	
Condition 19: No building on any part of the development hereby permitted shall exceed 14 metres in height.	The development of the site is the subject of an Environmental Impact Assessment and the development of buildings in excess of this height may have an impact which has not been assessed by that process.
Condition 20: Container stacking shall only take place within the areas indicated on parameter plans 9R0155/PA/1001 Revision 3 and 9R0155/PA/1002 Revision 4.	The development of the site is the subject of an Environmental Impact Assessment and the storage of containers in other areas may have an impact which has not been assessed by that process.
Condition 21: Container stacks shall be restricted to the maximum heights set out on parameter plans 9R0155/PA/1001 Revision 3 and 9R0155/PA/1002 Revision 4.	The development of the site is the subject of an Environmental Impact Assessment and the stacking of containers above the agreed heights may have an impact which has not been assessed by that process.
Condition 22: Within the quay and crane back reach area (as identified on parameter plans 9R0155/PA/1001 Revision 3 and 9R0155/PA/1002 Revision 4) the maximum crane height with the jib in the vertical position shall not exceed 100 metres. Elsewhere on the site maximum crane height shall not exceed 25 metres.	The development of the site is the subject of an Environmental Impact Assessment and the use of cranes in excess of the agreed heights may have an impact which has not been assessed by that process.
Conditions of the 2013 reserved matters permission	
Condition 1: The development hereby permitted shall be carried out in accordance with the following approved plans: Drawing No 9T3867/PLN/1017 Revision P5 received by the Local Planning Authority on 05/10/12.	To accord with the terms of the planning application.
Condition 2: Details of materials to be used for all hard surfaces shall be submitted to, and approved in writing by the Local Planning Authority, prior to the commencement of the development and the development shall not be carried out except in accordance with the approved details.	To ensure the use of satisfactory materials.

Royal HaskoningDHV

20 COASTAL PROTECTION AND FLOOD DEFENCE

20.1 Introduction

This section of the report has been informed by a desk-based review to determine whether the proposed scheme is likely to impact coastal protection and flood defence.

The assessment has been informed by both a Flood Risk Assessment (FRA) and the findings of hydraulic, wave and sediment modelling studies undertaken to assess the effects of the proposed scheme on the hydrodynamic and sedimentary regime. Given the findings of those assessments, it has been deemed that the potential effects on coastal protection and flood defence relate to potential changes in tidal flood risk at, or immediately adjacent to, the proposed scheme footprint.

As construction of the landside elements of the proposed scheme has commenced (under the planning permission granted by RCBC), no further assessment is considered necessary with regard to the landside elements. This assessment, therefore, focusses specifically on the proposed marine works.

20.2 Policy

20.2.1 National Planning Policy Framework

Since production of the 2006 ES, Planning Policy Statement 25 (PPS 25): Development and Flood Risk, which previously set out the requirements for FRA, has been revoked and replaced by the National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2019). However, the technical guidance to the NPPF includes flood risk guidance and retains key elements of PPS 25, including the Sequential and Exception Tests, consideration of climate change allowances and development classifications. The information contained in the new technical guidance, together with the NPPF, guidance contained in PPS 25: Development and Flood Risk Practice Guide and the British Standard BS 8533-2011 form the basis of flood risk documentation.

20.2.2 National Policy Statement for Ports

In specific relation to port developments, the NPS for Ports was published by the Department for Transport in 2012. The “minimum requirements for FRAs” as outlined within the NPS for Ports are deemed to have been met, since they are proportionate to the risk and appropriate to the scale, nature and location of the project. They have considered the risk of flooding arising from the project and the risk of flooding to the project, the impacts of climate change and were undertaken by a competent person.

However, there is an additional need for an assessment of the vulnerability to flooding of those using the site during both construction and operation phases, including arrangements for safe access.

20.3 Consultation

20.3.1 Summary of comments received during the HRO extension process

Table 20.1 provides a summary of the comments received from the MMO within its Scoping Opinion on the HRO process (specifically comments which the MMO considered should be addressed within a marine licence application rather than the documentation submitted in support of the application to extend the expiry date of the 2008 HRO). Table 20.1 also includes a reference to the relevant section of this EIA Report where the comment has been addressed.

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Table 20.1 Summary of comments in the MMO's Scoping Opinion with regard to coastal protection and flood defence

Scoping comment	Response / section of the EIA Report where comment has been addressed
A Flood Risk Assessment must be submitted alongside any subsequent planning application in order that flood risk is given due diligence as part of the application process.	The NGCT scheme is authorised by RCBC under planning permission R/2006/0433/00 and therefore no further planning application is required. A further FRA has not been undertaken.
If there is any proposed works on or near a main river, on or near a flood defence structure, in a flood plain or on or near a sea defence, a flood risk activity permit may be required from the Environment Agency.	Consultation with the Environment Agency has been undertaken to determine the requirement for a flood risk activity permit. The Environment Agency confirmed that if a marine licence is being applied for, the Environment Agency would be consulted and will therefore offer comments at that time (and therefore a separate flood risk activity permit would not be required).

20.3.2 Summary of comments received during pre-application discussions with the Environment Agency

Consultation with the Environment Agency during November 2018 confirmed that new climate change tolerances were due to be issued by the Environment Agency; these were subsequently issued by the Environment Agency in late 2018. The Environment Agency recognised that there is no requirement to update any documentation previously issued in support of the planning permission, however, the Environment Agency confirmed that it would be useful to review the data to ensure that the scheme remains robust to the new climate change tolerances. A review of the proposed scheme design against the latest climate change tolerances has therefore been undertaken.

20.4 Methodology

20.4.1 Study area

The study area for this section comprises the area which has the potential to be directly impacted (i.e. the proposed scheme footprint) and adjacent areas that could be indirectly impacted. The EIA, therefore, addresses flood risk at the site itself and the effect of the proposed scheme on flood risk in adjacent areas.

20.4.2 Existing environment

The existing environment information presented in this section has been based on desk-based review of existing information, including the Environment Agency's Tees Tidal Flood Risk Management Strategy (Environment Agency 2009) and the Tees Tidal Integrated Flood Risk Modelling Study (JBA, 2011). A review of FRAs undertaken for other consented schemes within the Tees estuary has also been undertaken.

20.4.3 Methodology for assessment of potential impacts

The assessment methodology used for determining the potential environmental impacts on coastal protection and flood defence associated with the proposed scheme is provided within Section 5.

20.5 Existing environment

The majority of the proposed scheme site is currently undeveloped land. Along the water front, however, there are some existing facilities that will be replaced due to the proposed scheme: the Riverside Ro-Ro facility to the north, and the existing Teesport Container Terminal No.1 (TCT1) to the south. Between these two facilities is the redundant Shell Oil jetty.

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The present dredged approach channel in the Tees estuary is at a depth of 10.4m below CD (-13.25mOD) adjacent to the proposed terminal, increasing to 14.1m below CD (-16.95mOD) to the North Gare and South Gare breakwaters and 15.4m below CD (-18.25mOD) beyond the breakwaters.

20.5.1 Climate change guidance

UK guidance on climate change has been updated through the publication of UK Climate Projections in 2018 (known hereafter as UKCP18). The UKCP18 website includes a User Interface which can be interrogated to extract relevant data for a specific location relating to various climate projections. The UKCP18 have replaced the UKCP09, which were published in 2009.

The principal climate change which could affect flood risk at, or adjacent to, the site relates to sea level rise. Changes in rainfall and fluvial flows are less critical because the Tees Barrage controls flows into the tidal reaches of the estuary. Also, there is limited wave propagation up-estuary towards the development site.

UKCP18 adopts three Representative Concentration Pathways (RCPs) (Met Office, 2018) to determine likely changes in sea level over the next century. These three RCPs are:

- RCP2.6 (under this RCP greenhouse gas emissions are stabilised to a flat line by 2050)
- RCP4.5 (approximately equivalent to the 'Low' greenhouse gas emissions scenario in UKCP09)
- RCP8.5 (approximately equivalent to the 'High' greenhouse gas emissions scenario in UKCP09)

Table 20.2 presents the projections of change in sea level rise from 2007 to 2056 for the nearest coastal model grid cell to the Tees from UKCP18.

Table 20.2 Sea level rise projections for the Tees under three RCPs with 5th, 50th and 95th percentile confidence (Met Office, 2018)

Representative Concentration Pathway (RCP)	Year	UKCP18 projected increase in sea level (m relative to 2007 baseline)		
		5th percentile	50th percentile	95th percentile
RCP 2.6	2056	0.118	0.187	0.282
RCP 4.5	2056	0.136	0.208	0.309
RCP 8.5	2056	0.172	0.259	0.372

The UKCP18 outputs are not directly comparable with the UKCP09 outputs for the reasons previously described and the Environment Agency currently has no published guidance relating to use of the UKCP18 outputs for purposes of flood risk assessment. However, for context it can be seen that the 95th percentile value of change for RCP4.5 (approximately equivalent to the 'Low' emissions under UKCP09) is marginally greater (24mm) than the 'change factor' derived from the UKCP09 outputs, whilst the value of change for RCP4.5 (approximately equivalent to the 'High' emissions under UKCP09) is around 87mm greater than the 'change factor' derived from the UKCP09 outputs. It may reasonably be expected that if new Environment Agency guidance becomes published based upon UKCP18 outputs, then a revised 'change factor' may be slightly higher than 285mm. However, this is based on the 95th percentile value and if instead the 'most likely' value in the probability distribution curve from UKCP18 outputs (i.e. the 50th percentile value) is instead used, then even under RCP8.5 (the greatest of the RCPs under UKCP18) sea level change is less than the previously adopted 'change factor' from UKCP09 outputs.

20.5.2 Flood risk studies

The Tees Tidal Flood Risk Management (FRM) Strategy (published by the Environment Agency in 2009) identified the need for improvements or raising of existing flood defences within the Tees estuary, up to the

Tees Barrage. This report also highlighted areas which may be at risk of flooding, either at present or in the future. Areas identified as being at risk are referred to as 'flood cells', and are located where ground levels are less than 5.0m above OD. This level carries a 0.1% (1 in 1,000) probability of a flood event occurring in any one year. The highest recorded flood event along the Tees occurred in 1953 and reached a level of 4.0m above OD. A water level with a 0.5% (1 in 200) probability of occurrence in any one year is classified in the Tees Tidal FRM Strategy as being 4.19m above OD (Environment Agency, 2009). The existing cope level at the proposed scheme footprint is in excess of this level, providing suitable protection against the 0.5% (1 in 200) annual exceedance probability event.

The Tidal Tees Integrated Flood Risk Modelling Study (published by the Environment Agency in 2011) has expanded on the Tees Tidal FRM Strategy through development and application of an ESTRY-TUFLOW model that covers the Tees estuary from Teesmouth at the coast upstream to the Tees Barrage. The report concludes that some differences exist in the definition of Flood Zones between the studies, but that under the 'undefended scenario' a reduction in extent in Flood Zones 2 and 3 is recommended following the more detailed assessments and modelling, particularly towards the coast. However, the footprint of the proposed port terminal is identified as still being at Flood Zone 3, the 1 in 200-year return period tidal flood risk.

The MMO's Scoping Opinion provided as part of the HRO extension process (Appendix 4) confirmed that "*the Environment Agency has flood modelling information in this area from 2011 to 2015 providing data for the 1 in 200 and 1 in 1000-year events which may be of use.*" This information was provided by the Environment Agency in December 2017, and is summarised below.

The data provided by the Environment Agency in December 2017 was taken from the 2011 Tidal Tees Integrated Flood Risk Modelling Study and the 2015 Tidal Tees Integrated Flood Risk Modelling Study. Figure 20.1 illustrates the locations of the modelled 'nodes points' within the Tees estuary; node point 330 is the closest modelled location to the NGCT footprint. The modelled flood levels for this location are provided in Table 20.3.

Table 20.3 Data taken from the 2011 Tidal Tees Integrated Flood Risk Modelling Study and the 2015 Tidal Tees Integrated Flood Risk Modelling

Study node point name	Return period (years)	Level value (metres above OD)
300 (undefended scenario)	200	4.11
	1000	4.37
	1000 plus climate change	5.27
330 (defended scenario)	200	4.12
	1000	4.38
	1000 plus climate change	5.26

The existing site levels at the current TCT1 quay and terminal and the Riverside Ro-Ro terminal are both above the predicted 1 in 1,000-year level presented in Table 20.2.

In terms of flood risk and vulnerability, Table 2 of the NPPF Technical Guidance classifies the proposed port terminal as 'water compatible'. Table 3 of the NPPF Technical Guidance indicates that developments of this classification are considered appropriate in all Flood Zones.

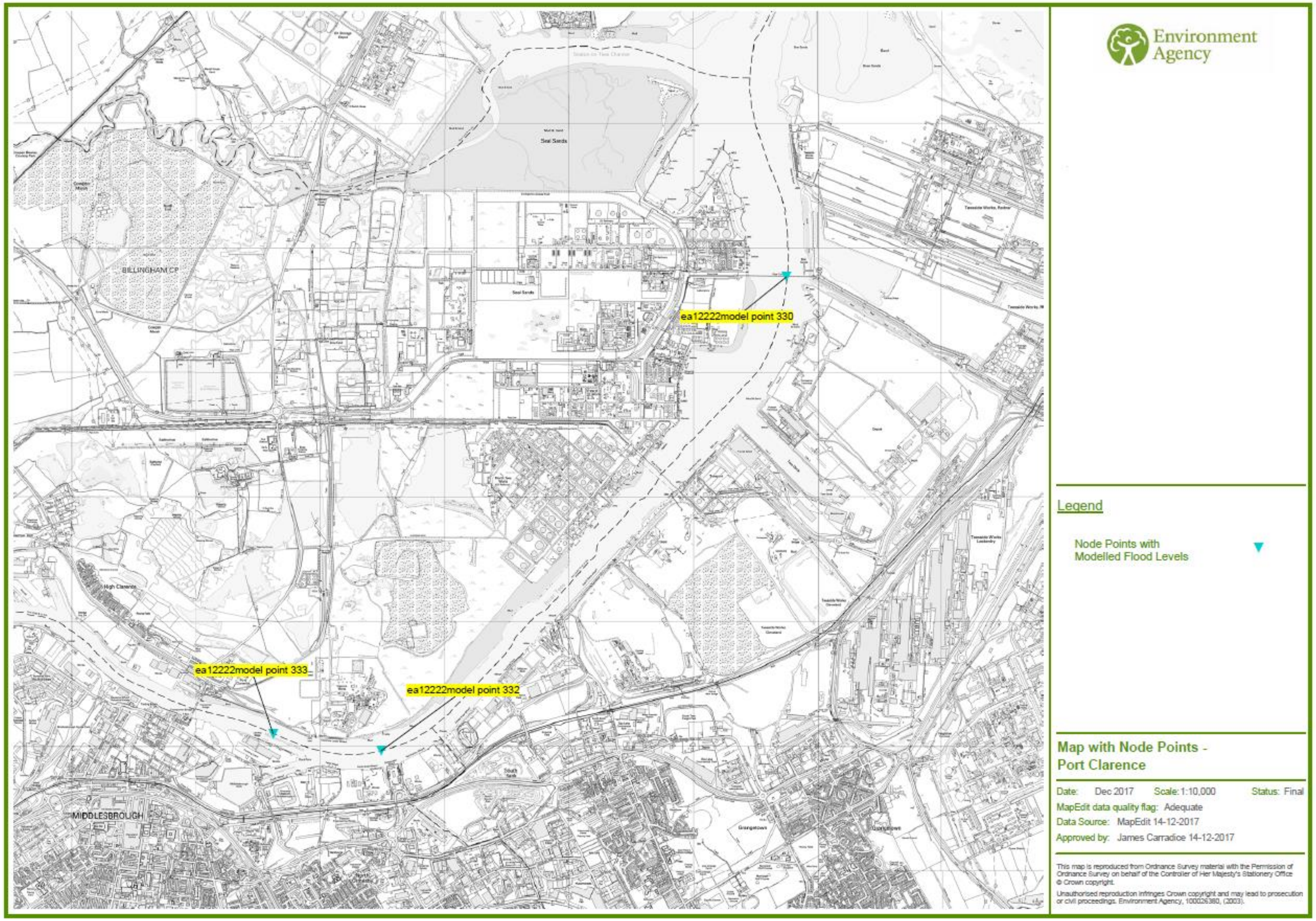


Figure 20.1 Node points with modelled flood levels in the Tees estuary (source: Environment Agency)

20.5.3 Future evolution of the baseline in the absence of the proposed scheme

As detailed above, predicted sea level rise is likely to result in a greater degree of flood risk to the site in the future. There is therefore the potential for more regular flood events of the land within the proposed NGCT footprint.

20.6 Potential impacts during the construction phase

20.6.1 Potential effect on the integrity of flood defences during the construction works

The construction works do not have the potential to directly impact on any flood defences as no defences will be removed or altered during the construction phase. As such, **no impact** is predicted.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact**.

20.6.2 Vulnerability to flooding of those using the site

To ensure compliance with the NPS for Ports, there is need for an assessment of the vulnerability to flooding of those using the site during construction, including arrangements for safe access. This is presented below.

The location of the NGCT (within and immediately adjacent to the Tees estuary) inherently presents risks to construction workers associated with drowning or accidents during flood or storm events within the estuary. As it is difficult to quantify the level of severity of any flood events / storms in the estuary, it is not possible to predict the significance of potential impacts to construction workers. However, the risk of a flood event occurring and its impact on human health can be controlled through the implementation of the measures outlined below.

Prior to works commencing, all construction workers will undergo site induction training prior to being allowed access to the Teesport Estate. This will include actions required in the event of a number of emergency incidents, including flood risk; such as warning sirens and escape routes in the event of a site evacuation. No workers would be allowed on site unless they have undergone such an induction. These measures will minimise the potential risk to human health as far as possible.

20.7 Potential impacts during the operational phase

20.7.1 Potential for effect on risk of tidal flooding at and immediately adjacent to the proposed scheme footprint

Similar to the construction phase effects, there is a need for an assessment of the vulnerability to flooding of those using the site during its operation phase, including arrangements for safe access, to ensure compliance with the NPS for Ports.

The principal change in baseline information which could have implications for the previously reported operation phase impacts relates to the updated climate change science and associated guidance. In the 2006 ES, the operation phase assessment considered that sea level rise would increase by 200mm over the 50 years between 2006 and 2056 (4mm per year linear average), in accordance with the guidance that was current at that time. Subsequent guidance published by the Environment Agency on Adapting to Climate Change, which was based on UKCP09 outputs, yields a ‘change factor’ of 285mm between 2006 and 2056 for the site, based on the 95th percentile projection for the project location based on the 'medium' greenhouse gas emissions scenario.

Whilst the Environment Agency is in the process of updating its guidance based on UKCP18 outputs, the User Interface from UKCP18 indicates that at the 50th percentile value (the 'most likely' value from the probability distribution curve), the projected sea level rise is lower than the 'change factor' derived from UKCP09. However, considering the 95th percentile values under RCP4.5 and RCP8.5, a revised 'change factor' may be slightly higher than the 285mm considered. Notwithstanding this, the new proposed quay level and container terminal site will be at or greater than +6.15mOD. This presents a freeboard allowance at the proposed new quay of +1.76m above the required extreme water levels. Other development site levels behind the quay are currently in excess of +5.0mOD.

This small difference in predicted sea level rise compared to earlier (2006) guidance over these timescales does not have a material bearing on the conclusions of the impact assessment for the operational phase effect. It is therefore concluded that the proposed scheme will result in an increased standard of flood defence at the proposed terminal site itself, representing a potential impact of **moderate beneficial** significance. The presence of the proposed scheme would not give rise to an adverse effect in terms of changes to existing risk of flooding to immediately adjacent areas to the north and south of the proposed scheme.

Mitigation measures and residual impact
No mitigation measures are required and the residual impact would be of **moderate beneficial** significance. No adverse residual impact would arise for areas immediately adjacent to the proposed scheme to the north and south.

20.7.2 Potential for effect on risk of tidal flooding elsewhere in the estuary system

The predicted effect of the proposed scheme on flows and water levels has been assessed as part of the hydraulic modelling studies (reported in Section 6). The results indicate a very small effect on high water level of up to +2mm near the Tees Barrage, and less than +4mm overall increase on the tidal range. For the mean spring tidal range of 4.6m this represents less than a 0.1% effect on the total tidal range. A lower magnitude of effect on tidal range is predicted in the region of the estuary adjacent to the proposed scheme, with no effect on water levels predicted in the lower estuary.

In summary, it can be concluded that the predicted impact of the scheme on tidal water levels throughout the estuary is of low magnitude. The important result with respect to potential for tidal flooding is the predicted change in the level of high water on spring tides; the maximum predicted change is up to 2mm increase in the level of high water at the Tees Barrage. Such predicted effects are considered to be of **negligible** significance and would not affect the integrity of any flood defences at this location or throughout the estuary system.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact**.

20.7.3 Consideration of the effect of fluvial flows on flood risk throughout the estuary

Given the location of the proposed scheme close to the mouth of the Tees estuary, flows are tidally dominated and flood risk from extreme water levels at the site is principally dictated by the surge tides. The Environment Agency stated (in 2006) that they do not consider the impact of fluvial flows at this location to be an issue, and results from HR Wallingford's modelling assessment corroborate this view. Water levels are only very marginally affected by the input of river flows and show a similar negligible effect on water levels with the proposed scheme arrangement as the tidal only case.

Fluvial flows are regulated by the Tees Barrage which is operated to maintain upstream water levels and prevent the upstream penetration of saline water. Flows downstream of the barrage are, therefore, not continuous and are unlike natural river flows.

HR Wallingford undertook the hydraulic studies by including a constant river flow input into their hydrodynamic tidal model in combination with mean spring and neap tidal variations. A river flow input of 60 cumecs was included at the upstream extent of the model, at the Tees Barrage.

It has been determined that including the river flow input of 60 cumecs to the model has no effect on the maximum water levels adjacent to the proposed new quay. The inclusion of the river input with the proposed scheme produced a very small effect on resulting water levels at the proposed quay. Resulting water levels at the Barrage show a slight increase with the inclusion of the river flow input compared with the tidal water level case (3mm as opposed to 2mm).

Given the above, it is considered that the incorporation of fluvial flows into the assessment of flood risk does not change the conclusions drawn above and, therefore, an effect of **negligible** significance is predicted on flood risk throughout the estuary system.

Mitigation measures and residual impact
No mitigation measures are required. The residual impact would be of **negligible** significance.

20.7.4 Potential effect on frequency of overtopping

The potential for increased overtopping frequency has been informed by the studies into the effects of the proposed scheme on the wave climate throughout the estuary system (see Section 6). The modelling predicts the effects of the proposed scheme on both swell waves and wind-generated waves.

The changes in alignment and reflective properties of the new proposed quay structure are predicted to increase the wind-generated wave effects towards the mouth of the Tees estuary; however, increases are small (less than 10cm) and dissipate across the Tees estuary.

The maximum locally generated wind waves adjacent to the quay are estimated from the northerly winds. Results from a northerly 20m/s wind produce generated waves at the quay of up to 0.70m, with an estimated exceedance of 0.4%. Assessment of the potential for overtopping of the quay wall has shown only nominal overtopping (<0.1 litres per second per metre (l/s/m length)) for extreme 0.7m wave in combination with the 200-year water level.

Swell entering the estuary is limited in direction by the North Gare and South Gare Breakwaters. Although not reaching through to the new terminal location, approaching swell waves are predicted to be affected by the deepened approach channel. Results taken adjacent to the quay indicate no change in wave height for even the 50-year offshore conditions.

The wave modelling results show that deepening of the approach channel does increase significant wave height in the quay area of ConocoPhillips Dock adjacent to the ConocoPhillips Oil Terminal, during extreme events. For the 50- year return period, wave conditions are increased by a maximum of 0.5m, and for the 1-year return period event conditions a maximum increase of 0.3m is obtained. These results, however, are based on modelling of the actual (i.e. shallower) depth (as opposed to currently declared depth) and so the results overestimate the effect of the proposed deepening of the declared depth from 14.1m to 14.5m below CD by up to 50%.

The top of the embankment at the ConocoPhillips Oil Terminal is at +5.50mOD, with the loading arm deck at +6.00mOD and a suspended roadway between at +8.00mOD. The slag embankment has a slope of 1 in 4.

Assessment of the potential for waves overtopping the embankment at the oil terminal has been undertaken. Generally, the results show that the scheme produces approximately a two-fold increase on the existing rates of wave overtopping at the ConocoPhillips Oil Terminal. Again, it should be reiterated that the effects of dredging the channel to the present declared depth account for approximately half of this impact.

In addition, the 50-year swell wave results show that there is some small increase of wave heights along the Tees estuary. At the Corus Steel quay, just to the north of the proposed scheme site, the figure indicates an increase of up to 0.1m, with the 50-year swell producing a wave height of 0.4m with the scheme in place.

The quay at the Corus Steel site is at 5.5mOD and is a vertical quay face construction. Assessment has shown that no overtopping will occur with the 50-year swell conditions in combination with the 200-year water level.

Other than the locations mentioned above, the proposed scheme is predicted to have no impact on the frequency of overtopping of any seawalls or flood defences structures in the Tees estuary.

It is concluded, therefore, that there is an increased risk of wave overtopping in the ConocoPhillips Oil Terminal/ConocoPhillips Dock area, particularly under extreme swell conditions. When compared with the conditions that would prevail at this location under extreme events at the present time, the effects of the capital dredging represent a minor change. Overall, a potential impact of **minor adverse** significance is predicted.

No adverse effect is predicted at any other flood defence structures throughout the estuary.

Mitigation measures and residual impact

This potential impact is not possible to mitigate and a residual impact of **minor adverse** significance would arise.

21 INFRASTRUCTURE AND LAND DRAINAGE

21.1 Introduction

With regard to infrastructure and land drainage, the landside elements of the proposed scheme have commenced (under the planning permission granted by RCBC in 2007). PDT is not seeking new permissions or changes to the development that is already authorised and commenced under the existing planning permission. On this basis, no further assessment regarding landside infrastructure or land drainage is considered necessary and the findings of the 2006 ES (which concluded no impact) remain valid. This section of the EIA Report is therefore focussed on potential impacts to infrastructure within the marine environment only. impacts to flood and coastal defences are excluded from this assessment as such impacts are addressed in Section 20.

21.2 Policy and consultation

21.2.1 Consultation

Consultation with the MMO was undertaken in 2017 via the request for a Scoping Opinion to inform the 2008 HRO extension application process. As noted earlier, the MMO provided comments as part of its Scoping Opinion which it considered were more applicable to the marine licensing process, rather than the HRO extension process. There were no comments received from the MMO during 2017 which are applicable to this section of the EIA Report.

21.3 Methodology

21.3.1 Study area

The study area for this section of the EIA Report comprises the area which has the potential to be directly and indirectly impacted by the marine elements of the proposed scheme. This therefore comprises the Tees estuary, extending from the Tees Barrage downstream to the mouth of the Tees estuary.

21.3.2 Methodology used to describe the existing environment

The description of the existing environment with regard to infrastructure has been informed by desk-based assessment and site visits. A number of documents have been reviewed as part of the desk-based assessment, including the ESs produced for the NGCT, the QEII Berth Development, the Tees Dock No.1 Quay and the York Potash Harbour Facilities. A review of Ordnance Survey mapping and aerial photography publicly available online (Google Earth) has also been undertaken.

Consultation with the Environment Agency has also been undertaken with regard to surface water abstractions within the Tees estuary.

21.3.3 Methodology for assessment of potential impacts

The assessment methodology used to determine the potential environmental impacts on infrastructure associated with the proposed scheme is as provided within Section 5. However, for a number of potential environmental impacts on infrastructure (presented in Sections 21.5 and 21.6), a risk-based approach to the assessment has been adopted, as this was considered more appropriate than the methodology presented in Section 5.

21.4 Existing environment

21.4.1 Overview of industrial developments bordering the Tees estuary

The Tees estuary is bordered by industrial developments, including chemical, petrochemical and steel works, sites of former industry and open areas of ground originally intended for industrial use. There is a concentration of oil-related industry near the river mouth, including a large petrochemical works and an oil refinery at Seal Sands, together with two large storage terminals and two gas producing facilities. There is a large titanium pigment plant south of Seaton Carew on the north side of Teesmouth and a second oil refinery and chemicals processing plant is located next to Teesport on the south side of the estuary at Wilton. The Redcar steelworks, formerly located on the south side of the river at the mouth of the estuary, closed in 2015.

Hartlepool nuclear power station is located on the east side of Seaton Channel. Further upstream in the Tees estuary, there is a former ICI agrochemical plant at Billingham which was a sister to the former ICI chemical plant at Wilton (now owned by SembCorp). There are also several ship repair yards and large port facilities, including Tees Dock, on the south shore (Royal HaskoningDHV, 2014).

The Northumbrian Water Limited (NWL) Sewage Treatment Works (STW) is located immediately adjacent to the Bran Sands landfill site, which itself is located immediately adjacent to the Bran Sands lagoon and Dabholm Gut on the southern side of the estuary. This is the largest STW (Ofwat size band 5) in the Northumbria area of NWL's activities. It is understood that the STW discharges into Dabholm Gut through an outfall.

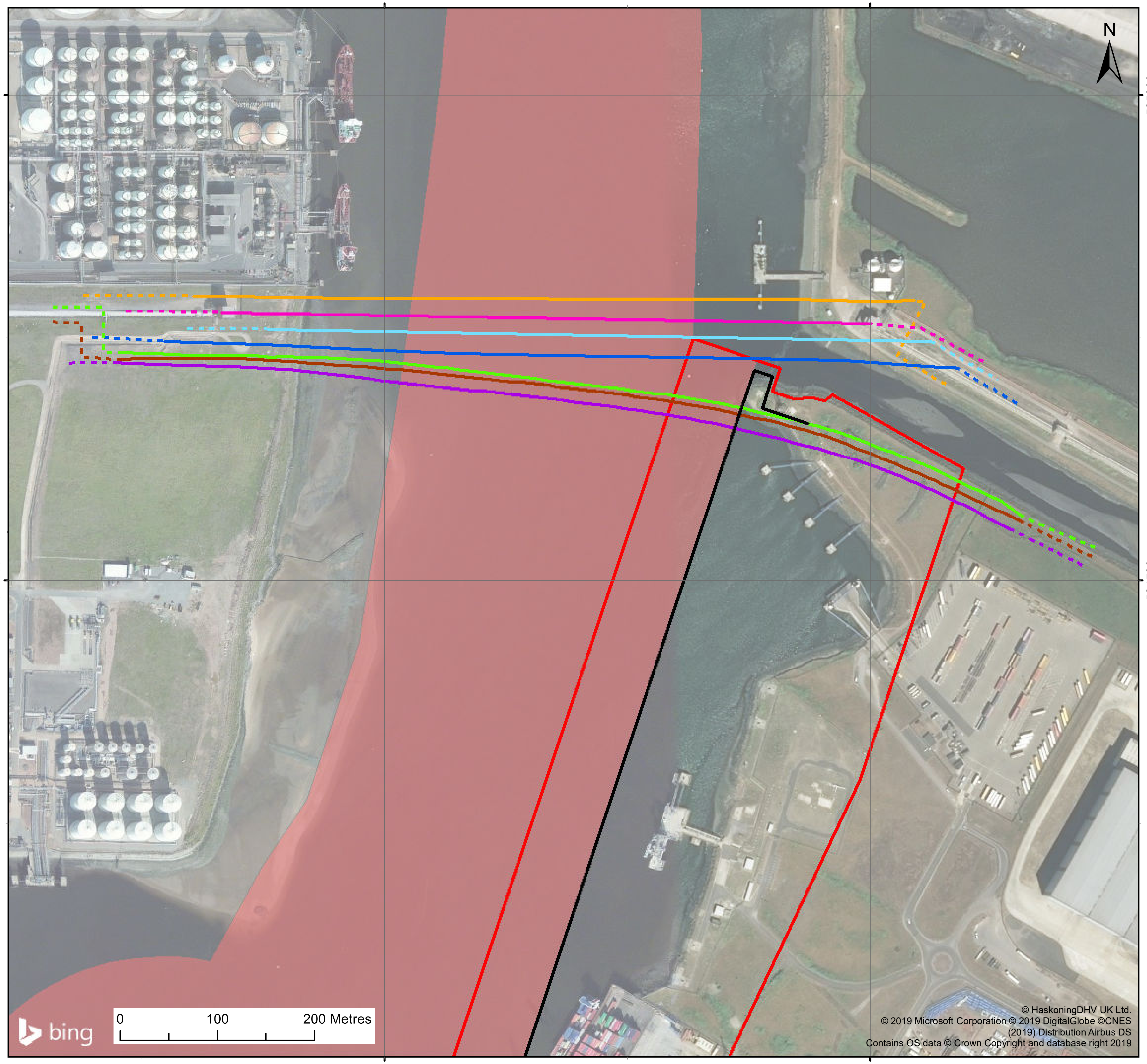
A small jetty and pumping station are located at the confluence of Dabholm Gut and the Tees estuary. This infrastructure is owned by NWL and was historically used for the import of sludge to its sewage treatment works.

Along its western side, Bran Sands lagoon is separated from the estuary by a slag bund formed behind a training wall towards the edge of the main estuary channel. The foreshore between the bund and the training wall is exposed on spring tides and comprises sediments accumulating over rip-rap of road planings (similar in nature to crushed tarmac). The masonry remains of a navigation marker are visible which delineates the line of the training wall (Royal HaskoningDHV, 2014).

21.4.2 Pipelines / tunnels

Pipelines and tunnels which are known to cross underneath the Tees estuary in the vicinity of the proposed scheme comprise (see Figure 21.1):

- Pipe Tunnel No.1.
- ICI Tunnel No. 2 (Pipe Tunnel No. 2), containing numerous pipelines (now owned and operated by SembCorp) (this is a traditional tunnel with plate sections lining the inside of the tunnel).
- BP AMOCO CATS pipeline (the pipeline is contained within a tunnel formed under the Tees estuary using traditional tunnel construction; the tunnel is known to be flooded (Sean Gleeson Px pers. comm. 2014))
- Former Enron (now GDF Suez) 1.0m diameter crossing (installed using horizontal directional drilling).
- BOC 1m diameter thrust bore crossing (installed using horizontal directional drilling).
- BOC 0.15m diameter thrust bore crossing (installed using horizontal directional drilling).
- RWE Breagh Onshore Gas crossing (installed using horizontal directional drilling).



Legend

- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Limit of deviation for Works No. 2 (no longer proposed as part of NGCT scheme)
- Proposed quay face
- Proposed dredge footprint

Pipelines under the Tees

- Breagh Onshore Pipeline
- ICI No.2 Tunnel
- BP Amoco Cats Tunnel
- Former 1.0m Ø Enron pipeline
- B.O.C. 1m Ø thrust bore
- B.O.C. 0.15m Ø thrust bore
- Excelerate Energy 0.6m thrust bore

Client:	Project:
PD Teesport	Northern Gateway Container Terminal

Title: Pipelines under the Tees

Figure: 21.1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	21/10/2019	TC	SR	A3	1:4,000

Co-ordinate system: British National Grid

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Pipe Tunnel No. 2 is thought to consist of a 3.85m internal diameter, 4.08m outside diameter, cast iron segmental tunnel. The crown level of the tunnel dips from approximately -27.8mCD on the western (Seal Sands) side of the river, to approximately -31.5mCD on the eastern (Bran Sands) side of the river. The crown level of the tunnel in mid-channel is approximately -26.6mCD. The vertical shafts at either end of the tunnel are thought to be 5.75m internal diameter, 6.11m outer diameter cast iron segmental shafts, encased in concrete to a diameter of 7.11m. These shafts rise to ground level, where they are protected by brick-built head houses. The RWE Breagh Onshore Gas Crossing, Pipe tunnel No.2, the BP AMOCO CATS pipeline and the GDF Suez pipelines are within the proposed dredge footprint, but outside of the construction footprint for the container terminal. Pipe Tunnel No.1 is located upstream of the proposed dredge footprint. The above infrastructure is imperative to on-going practices on the banks of the Tees and is therefore considered to be of high sensitivity.

21.4.3 Surface water abstractions from the Tees estuary

Two surface water abstractions are located within the vicinity of the proposed scheme. The first is located in Tees Dock (NZ 546 235) and is held by Tees Bulk Handling Ltd. The second is located within the main navigable channel (NZ 547 259) and is held by Corus UK Ltd. A third abstraction licence located further outside of the vicinity of the scheme is held by Hartlepool nuclear power station. The nuclear power station is licensed to abstract 35.5 $m^3 s^{-1}$ of surface water from Seaton Channel for cooling water.

The receptor which could be impacted as a result of a reduction in water quality within the Tees estuary (with regard to this section of the EIA Report), is the infrastructure which is reliant on the abstracted water (i.e. third-party users). It is considered that such infrastructure has a limited capacity to accommodate chemical changes to water quality, and as such, is considered to be of high sensitivity.

21.4.4 Future evolution of the baseline in the absence of the proposed scheme

In the absence of the proposed scheme, the infrastructure and land drainage assets within and adjacent to the Tees estuary would likely remain in place, in order to support the ongoing activities at Teesside (which are predicted to still be operational in the future).

21.5 Potential impacts during the construction phase

21.5.1 Potential impact on tunnels, pipelines and other infrastructure due to the construction works

The capital dredging, terminal construction and disposal of dredged material to land have the potential to directly impact on various infrastructure assets within the vicinity of the works. As noted above, impacts to flood and coastal defences are excluded from this assessment as such impacts are addressed in Section 20.

With respect to the capital dredging, the potential direct effect is limited to impacts on pipelines and cables that cross the Tees estuary. There are several groups of cables, pipelines and tunnels that cross the estuary. Pipe Tunnel No.1 is located outside of the footprint of the capital dredging (upstream), and therefore **no impact** on this infrastructure is predicted.

The second group of pipelines (Pipe Tunnel No.2) crosses the estuary in the Dabholm Gut area. These are outside of the footprint of the proposed quay wall and reclamation (the terminal was designed to avoid this infrastructure) and therefore no direct impact is predicted from this activity. Additionally, piles for the quay construction at the downstream end will be socketed into bored holes in the rock to avoid indirect impacts on the infrastructure (i.e. vibration) during installation.

The capital dredging for the berthing pocket and approach channel would, however, pass over Pipe Tunnel No.2. These pipelines are located at a minimum depth of 22.45m below CD; the maximum depth of dredging is 16m below CD for the berthing pocket, and therefore, the dredge would have no direct impact on Pipe Tunnel No.2.

In addition to the above pipelines, there is a set of BOC pipes that cross the estuary just upstream of the radar tower adjacent to Dabholm Gut. These pipelines are at approximately 53m below CD in the centre of the estuary and are, therefore, too deep to be affected by capital dredging.

Given the above, **no impact** is expected to arise on pipelines, cables and tunnels crossing the estuary as a consequence of the terminal construction and capital dredging.

Mitigation measures and residual impact
No mitigation measures are required and there would be **no residual impact.**

21.5.2 Potential impact on surface water abstractions due to the construction works

The proposed dredging, reclamation and piling activities have the potential to impact water quality by temporarily increasing total SSC within the water column. This has potential to impact third parties as an increase in total suspended solid concentrations could impact upon the processes for which the water is used. As noted above, the third-party users of abstracted water are considered to represent a highly sensitive receptor.

For the Hartlepool nuclear power station, the main concern relates to increases in concentrations of gross solids around the area of the intake. Fines are not considered to be an issue due to the high velocity of the intake flow through the plant and therefore there is minimal risk associated with settlement. There is however the potential for gross solids to block screens and, therefore, interrupt the process (British Energy, *pers. comm*.).

Sediment plume modelling predicts that SSC would not increase above background concentrations by more than 5mg/l in the vicinity of the power station intake. In addition, since the proposed dredging is to occur some distance from the intake location in Seaton Channel (approximately 1km away), gross solids will have settled out of suspension in the immediate vicinity of the dredger (see Section 6 for further detail). **No impact** on the Hartlepool power station abstraction is therefore predicted.

In the vicinity of the Corus abstraction and the Tees Bulk Handling abstraction, suspended solid concentrations are not predicted to increase above background concentrations by more than 25mg/l and 5mg/l respectively. This is a minor elevation above background levels, and any minor reduction in water quality in the vicinity of the abstraction point due to increased suspended sediment would be temporary in nature. Based on the above, the magnitude of the effect is considered to be very low and an impact of **negligible** significance is predicted to both abstractions.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact** to the Hartlepool power station intake and a residual impact of **negligible** significance at the Corus and Tees Bulk Handling abstractions. The controls outlined in Section 7 (with regard to minimising sediment plume dispersion during dredging) would be implemented in line with best practice.

21.5.3 Potential impact on Dabholm Gut and other discharges due to construction works

In addition to Dabholm Gut, there are two consented discharges which relate to the existing Riverside Ro-Ro facility. No aspect of the construction works will have an effect on the operation of Dabholm Gut and no run-off from the reclamation area will discharge to Dabholm Gut. With regard to the consented discharges from the Ro-Ro facility, these will become redundant as the Ro-Ro is to be removed as part of the proposed scheme. Based on the above, it is concluded that there would be **no impact** on discharges as a result of the proposed scheme.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact**.

21.6 Potential impacts during the operational phase

21.6.1 Potential impact on infrastructure due to maintenance dredging

The hydraulic and sedimentary studies indicate that there is no requirement to change the current maintenance dredging strategy and, therefore, **no impact** is predicted on infrastructure as a result of the proposed maintenance dredging.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact**.

21.6.2 Potential impact on outfalls and abstractions

Outfalls and abstractions have the potential to be impacted as a consequence of changes to the flow regime and sediment transport pathways. The potential effects of the proposed scheme on these aspects are described in Section 6.

The most significant abstraction that has the potential to be affected by the proposed scheme is the intake for the Hartlepool power station, which extracts water from the Seaton Channel. Assuming that the intake flow is the same following the proposed channel dredging as at present, the prediction of no change in the hydraulic regime in the Seaton Channel as a consequence of the proposed scheme is unchanged.

Since there is no requirement to change the existing maintenance dredging strategy following completion of the dredge, **no impact** relating to increases in gross solids or fines, is predicted to occur on these abstraction licences.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact**.

22 SOCIO-ECONOMICS

22.1 Introduction

An assessment of the socio-economic impact of the NGCT development was undertaken by Steer Davies Gleave as part of the 2006 ES. This section provides an overview of the existing socio-economic state of the region and discusses issues such as population and labour force, skills, unemployment and the economic context.

22.2 Policy and consultation

22.2.1 Policy

Marine Policy Statement

As outlined in the MPS (HM Government, 2011), developments in the marine area can provide environmental and social benefits as well as drive economic development, provide opportunities for investment and generate export and tax revenues. The marine planning system will help to promote these benefits in contributing to the achievement of sustainable development. There will therefore be a presumption in favour of sustainable development in the marine planning system (HM Government, 2011).

The MPS goes on to state that marine based activities can provide opportunities for employment in long established industries such as fishing, marine transport, port related storage and processing. This employment provides wide and long-term benefits for both national and local economies (HM Government, 2011).

National Policy Statement for Ports

The NPS for Ports (Department for Transport, 2012) outlines the potential socio-economic impacts which can arise as a result of construction and operation of port infrastructure and provides guidance on the scope of assessment required in support of a marine licence application.

In summary, the NPS for Ports states that where the project is likely to have socio-economic impacts at the local or regional levels, the applicant should undertake and include in their application an assessment of these impacts as part of the EIA Report. The NPS states that applicants should describe the existing socio-economic conditions in the areas surrounding the proposed development and should also refer to how the development's socio-economic impacts correlate with local planning policies. The relevant guidance from the NPS for Ports has been used within this socio-economic impact assessment.

22.2.2 Consultation

Consultation with the MMO was undertaken in 2017 via the request for a Scoping Opinion to inform the 2008 HRO extension application process. As noted earlier, the MMO provided comments as part of its Scoping Opinion which it considered were more applicable to the marine licensing process, rather than the HRO extension process. There were no comments received from the MMO during 2017 which are applicable to this section of the EIA Report.

Further consultation was undertaken with the MMO in October 2018 to discuss the scope of environmental assessment required to support a marine licence application. It was proposed that no additional assessment with regard to socio-economics would be undertaken, beyond that presented within the 2018 SEIR (and the 2006 ES and 2007 Supplement). The MMO raised no objections to this approach and therefore further assessment into this topic has not been undertaken. However, the information presented in the SEIR has

Royal HaskoningDHV

been re-formatted and supplemented with information from the 2006 ES to provide the evidence that potential socio-economics impacts have been appropriately assessed.

22.3 Methodology

22.3.1 Study area

The study area used for this section of the EIA Report comprises the north-east region of the UK. This wide-ranging study area covers that which could be directly and indirect impacted to the greatest extent as a result of the proposed scheme.

22.3.2 Methodology used to describe the existing environment

The description of the existing environment has been informed by desk-based assessment only. No surveys or studies have been used to inform the understanding of the existing environment.

22.3.3 Methodology for assessment of potential impacts

The assessment methodology used for determining the potential environmental impacts on coastal protection and flood defence associated with the proposed scheme is provided within Section 5.

22.4 Existing environment

22.4.1 Regional context

The North East is the smallest of England's nine administrative regions in terms of population and, with the exception of London, is the smallest geographically.

Over the last decade, the North East has remained one of the slowest growing regions of the United Kingdom, and this is reflected in the poor performance relative to the rest of the UK in terms of lower rates of productivity, participation, skills, wages, investment and business start-ups. There remains however a significant geographic variation within the region in terms of economic activity, with concentrations of areas of severe deprivation, poor health, and high rates of unemployment and economic inactivity (NELEP/NECA, 2016).

The North East is a net exporter of goods and services, with 58% of its total international trade made up of exports. A comparable figure for the UK as a whole is 44%. The North East accounts for 4% of the UK's exports and receiving 2.8% of the country's imports (NELEP/NECA, 2016). The automotive, chemicals and pharmaceuticals industry contributes 70% of the exports of the North East and the chemicals industry is the most productive in the UK with a productivity index of 187 against the UK average of 100 (NELEP/NECA, 2016).

The North East remains in a weak position in terms of both of the key factors of gross value added (GVA) growth (productivity and participation). The North East has the lowest GVA per head (£18,927 ~ 74.7) of any region in the UK, with the exception of Northern Ireland (£18,584 ~ 73.3) and Wales (£18,002 ~ 71.0) (NELEP/NECA, 2016). The North East retains the lowest share (3.0%) of UK GVA of any region with the exception of Northern Ireland (2.1%), though growth recently (2015 was 2.8%) has been higher than other regions (such as East Midlands (1.0%) (NELEP/NECA, 2016).

However, there have been improvements. Between 2014 and 2015 information and communication was the strongest growing industry in the UK by GVA (6.9%) with growth being highest in the North East (14.9%); agriculture, mining and the utilities (electricity, gas and water) decreased in the region.

22.4.2 Sub-regional Context

The Tees Valley comprises five unitary authority areas: Hartlepool, Darlington, Stockton-on-Tees, Middlesbrough, and Redcar & Cleveland.

Since the 2006 ES was written, employment in industries such as mining and manufacturing have reduced significantly, though both sectors are higher employers as a percentage of workforce compared to the UK (see Table 22.1 for current employment by industry). Similarly public administration and defence, along with human health and social work and education activities, are represented in higher numbers compared to the GB average.

Table 22.1 Employment by Industry in the Tees Valley, North East, and Great Britain (2016)

Employee jobs (2016)	Tees Valley (Employee jobs)	Tees Valley (%)	North East (%)	Great Britain (%)
Total employee jobs	257,000	-	-	-
Full time	168,000	65.4	66.1	67.8
Part time	89,000	34.6	34.0	32.2
Employee jobs by industry				
B: Mining and quarrying	1,000	0.4	0.2	0.2
C: Manufacturing	25,000	9.7	10.8	8.1
D: Electricity, Gas, Steam and Air Conditioning Supply	1,000	0.4	0.4	0.4
E: Water Supply: Sewerage, Waste Management and Remediation Activities	1,250	0.5	0.6	0.7
F: Construction	12,000	4.7	4.0	4.6
G: Wholesale and retail trade: Repair of motor vehicles and motor cycles	39,000	15.2	14.7	15.3
H: Transportation and storage	12,000	4.7	4.2	4.9
I: Accommodation and food service activities	17,000	6.6	7.8	7.5
J: Information and communication	6,000	2.3	2.7	4.2
K: Financial and insurance activities	6,000	2.3	2.1	3.6
L: Real estate activities	4,000	1.6	1.6	1.6
M: Professional, scientific and technical activities	18,000	7.0	5.8	8.6
N: Administrative and support service activities	17,000	6.6	7.7	9.0
O: Public administration and defence; compulsory social security	14,000	5.4	6.5	4.3
P: Education	27,000	10.5	9.7	8.9
Q: Human health and social work activities	47,000	18.3	16.5	13.3
R: Arts, entertainment and recreation	7,000	2.7	2.8	2.5
S: Other service activities	4,000	1.6	1.9	2.1

The Tees Valley share of information and communication, and financial and insurance activities, are significantly smaller employers of the population compared to the GB average.

The GVA per head in the Tees Valley in 2002 was £11,777 compared to the UK figure of £15,614 (75% of the UK figure). In 2014 this was £18,525 in the Tees Valley compared to the regional rate of £18,216 and UK rate of £24,616 (75% of the UK figure) (Tees Valley Unlimited, 2015).

In 2015, GVA per head was £15,475 for Durham CC[2], £18,815 per head in Hartlepool and Stockton-on-Tees[1], and £16,890 per head in South Teesside[1].

22.4.3 Population and labour force

Since 2004, the regional population has been increasing (see Figure 22.1), increasing by 3.8% between 2004 (2,540,500) and 2016 (2,636,800).

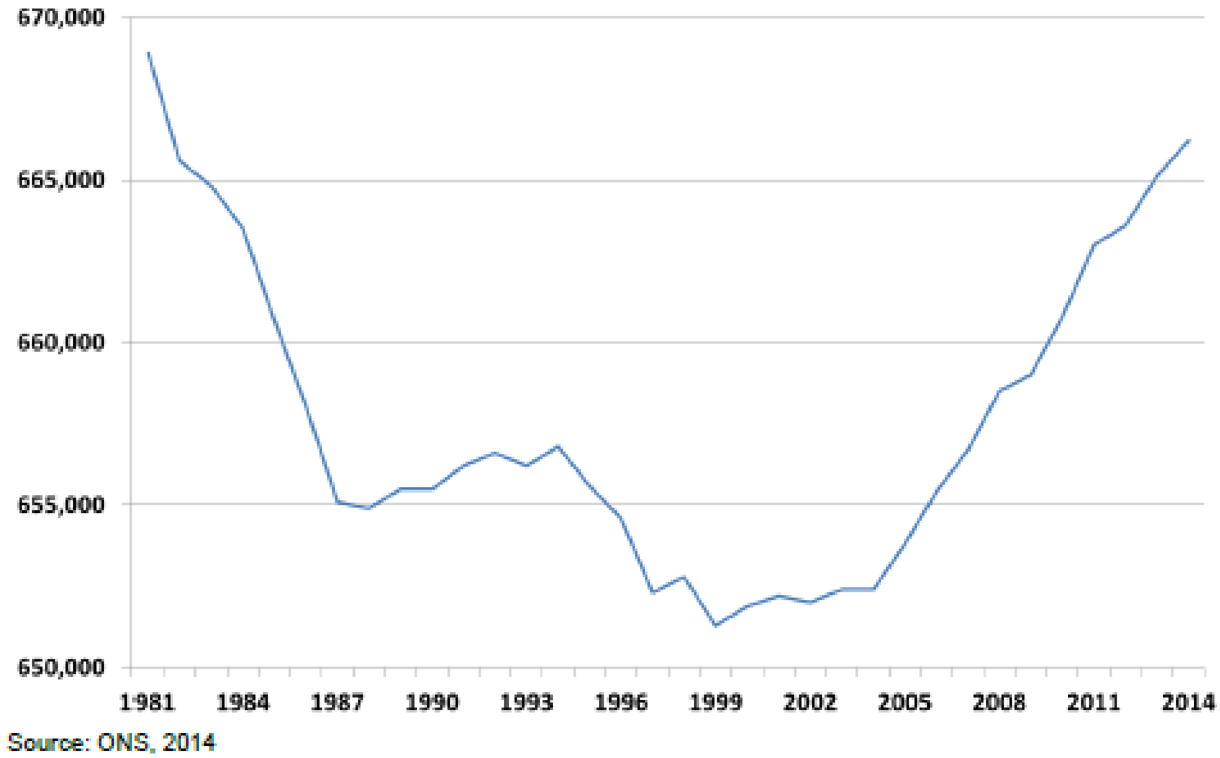

Figure 22.1 Total Resident Population in the Tees Valley from 1981 to 2014 (Source: ONS)

The latest population figures for the region and Tees Valley are shown in Table 22.2. This trend is opposite to the predictions made in 2006 by ONS. The working age (16 - 64) population has also increased over that timescale, albeit by 1.7% only. The working age population has however experienced recent declines, from a high of 1,681,000 in 2011, though 2016 has been the first recorded year of increase since then.

[2] *https://www.ons.gov.uk/file?uri=/economy/grossvalueaddedgva/datasets/regionalgvaibylocalauthorityintheuk/1997to2015/regionalgvaibylainuk.xls*

Table 22.2 Total Population in the Tees Valley and North East Region in 2016 (Source: ONS)

Total population (2016)			
	Tees Valley (Numbers)	North East (Numbers)	Great Britain (Numbers)
All people	669,900	2,636,800	63,785,900
Males	327,800	1,294,400	31,462,500
Females	342,100	1,342,500	32,323,500

As of the middle of 2016, ONS estimated the population in the Tees Valley as around 670,000, of which 416,000 (62%) are between the ages of 16 to 64 (see Table 22.3); 19% of the population is below 16 years of age and 19% is 65 and above.

Table 22.3 Population Aged 16-64 in the Tees Valley and North East Region in 2016 (Source: ONS)

Population aged 16-64 (2016)				
	Tees Valley (Numbers)	Tees Valley (%)	North East (%)	Great Britain (%)
All people aged 16-64	416,100	62.1	63.0	63.1
Males aged 16-64	204,800	62.5	63.6	63.8
Females aged 16-64	211,300	61.8	62.4	62.4

Employment

The number of jobs in Tees Valley has increased from around 257,000 in 2001 to 292,000 in 2016. Of the economically active population in the Tees Valley, in 2016 – 2017, the number in employment is 69.1% (compared to 70.2% for the North East region and 74.4% for GB). Unemployment is around 6.8% (c. 21,400), being at a higher rate for males (7.9%) than females (5.7%), as shown in Table 22.4.

Table 22.4 Economically Active Population in Employment or Unemployed in 2016/17 in the Tees Valley and North East Region in 2016 (Source: Nomisweb)

Employment and unemployment (July 2016 – June 2017)				
	Tees Valley (numbers)	Tees Valley (%)	North East (%)	Great Britain (%)
All people				
Economically active	313,600	74.3	75.2	78.0
In employment	292,100	69.1	70.2	74.4
Employees	256,900	61.1	62.5	63.4
Self employed	33,100	7.6	7.4	10.6
Unemployment	21,400	6.8	6.5	4.6
Males				
Economically active	164,100	78.8	79.7	83.2
In employment	151,100	72.4	73.9	79.2
Employees	127,400	61.4	63.7	64.7

Employment and unemployment (July 2016 – June 2017)				
Self employed	22,300	10.4	9.8	14.2
Unemployment	13,000	7.9	7.1	4.7
Females				
Economically active	149,500	69.9	70.9	72.9
In employment	141,000	65.9	66.6	69.6
Employees	129,500	60.8	61.4	62.1
Self employed	10,800	4.9	5.0	7.1
Unemployment	8,500	5.7	5.9	4.4

Around 106,000 of the Tees Valley population were classified as economically inactive in 2016 – 2017, 22% of these are studying, whilst 23.6% want a job against 76.4% who do not want employment, see Table 22.5.

Table 22.5 Economically Inactive Population in the Tees Valley and North East Region in 2016-2017 (Source: Nomisweb)

Economic inactivity (July 2016 to June 2017)				
	Tees Valley (level)	**Tees Valley (%)**	**North East (%)**	**Great Britain (%)**
All people				
Total	106,000	25.7	24.8	22.0
Student	23,800	22.5	24.3	26.8
Looking after family / home	27,700	26.2	22.4	24.5
Temporarily sick	2,800	2.6	2.5	1.9
Long term sick	26,700	25.2	28.5	22.0
Discouraged	-	-	0.3	0.4
Retired	14,400	13.6	14.4	13.5
Other	10,000	76.4	76.1	76.5
Wants a job	25,000	23.6	23.9	23.5
Does not want a job	81,000	76.4	76.1	76.5

Employment within the Tees Valley in the service industries (skilled trades, caring, leisure and other service occupations, sales and customer services, process plant and machine operators, and elementary occupations) is higher than the average across the country, as shown on Table 22.6.

Table 22.6 Employment by Occupation in the Tees Valley and North East Region in 2016-2017 (Source: Nomisweb)

Employment by occupation (July 2016 to June 2017)				
	Tees Valley (numbers)	Tees Valley (%)	North East (%)	Great Britain (%)
Soc 2010 Major Group 1-3	112,000	38.6	39.0	45.4
1 Managers, Directors and Senior Officials	24,600	8.4	8.6	10.7
2 Professional occupations	51,600	17.7	18.0	20.3
3 Associate, Professional and Technical	35,800	12.3	12.2	14.3
Soc 2010 Major Group 4-5	62,800	21.6	21.4	20.7
4 Administrative and secretarial	30,200	10.3	10.3	10.3
5 Skilled trades occupations	32,600	11.2	10.9	10.3
Soc 2010 Major Group 6-7	56,700	19.5	19.8	16.8
6 Caring, leisure and other service occupations	33,900	11.6	9.9	9.2
7 Sales and customer service occupations	22,800	7.8	9.7	7.5
Soc 2010 Major Group 8-9	58,700	20.2	19.8	17.0
8 Process plant and machine operatives	22,200	7.6	7.7	6.3
9 Elementary occupations	36,500	12.5	11.9	10.6

The largest sector in Tees Valley for employment is the other services sector (encompassing retail, leisure and other sectors), with over 97,500 employees, accounting for 39% of all employment. There is a similar picture nationally.

Unemployment

Economic inactivity in Tees Valley has decreased to 25.7% in 2017 (it is 24.6% for the North East region and 22.0% for the country), down from 32% in 2005.

Unemployment increased from 5.9% in 2005 to a high of 12.8% in 2012, though it has since decreased to 6.4% in 2016. The unemployment claimant rate in September 2017 as a percentage of the population in the Tees Valley LEP area is presented in Table 22.7. Both adult and youth unemployment is twice the national average.

Table 22.7 Claimant Count (September 2017) (source: Nomisweb)

Claimant count by sex – not seasonally adjusted (September 2017)				
	Tees Valley (numbers)	Tees Valley (%)	North East (%)	Great Britain (%)
All people	16,635	4.0	3.2	1.9
Males	10,920	5.3	4.1	2.3
Females	5,720	2.7	2.3	1.5
Note: % is the number of claimants as a proportion of resident population of area aged 16-64 and gender				

22.4.4 Skills

Regional context

Overall, the numbers of employed persons with no qualifications has decreased since 2006 across the country, region, and in the Tees Valley.

Local context

Table 22.8 presents the numbers and percentages of relevant levels of qualifications for the economically active. However, the highest skilled rates in the Tees Valley are still notably lower than the UK as a whole, though this gap is decreasing.

Table 22.8 Qualifications of the Economically Active Population in the Tees Valley and Region in 2016-2017 (Source: Nomisweb)

Qualifications (January 2016 to December 2016)				
	Tees Valley (level)	Tees Valley (%)	North East (%)	Great Britain (%)
Individual levels				
NVQ4 and above	126,100	30.8	31.4	38.2
NVQ3 and above	215,100	52.5	52.3	56.9
NVQ2 and above	300,100	73.2	73.7	74.3
NVQ1 and above	343,400	83.8	85.3	85.3
Other qualifications	27,600	6.7	5.4	6.6
No qualifications	38,800	9.5	9.4	8.0
Note: Numbers are % are for those of aged 16-64. % is a proportion of resident population of area aged 16-64				

22.4.5 Local Economic Context (Port of Tees and Hartlepool)

The River Tees is at the heart of an area strongly associated with petrochemicals, manufacturing and engineering. The area is home to many companies serving these industries as well as offshore and other river related activities.

Teesport offers a deep-water facility with no obstructed access, and handles around 5,000 vessels and 40 million tonnes of cargo per annum (PD Ports, 2013). Regional steel, petrochemical, agri-bulks, manufacturing, engineering and high street commerce operations are all supported through Teesport (PD Ports, 2013). In addition, the Port supports a burgeoning renewable energy sector – in both production and assembly facilities (PD Ports, 2013).

Overall exports through Teesport have increased driven by chemicals and containers; whilst activity in steel has reduced their remains good opportunities for the energy and other engineering sectors (PD Ports, 2013). PDT provides almost 2,000 core and directly related jobs and contributes around £250m annually to the region's economy (PD Ports, 2013). The Port provides vital transport infrastructure for major industry sectors that export to Europe and Scandinavia and enhances the prospects for future investment within the region.

22.4.6 Future evolution of the baseline in the absence of the proposed scheme

As detailed in Section 2, the throughput of containers at Teesport is now very close to capacity; in the absence of the NGCT scheme, it is predicted that Teesport would be at full capacity by approximately 2024, preventing the future growth of the port for container cargo (which could impact on the socio-economic value of the area). The port may therefore need to look to other markets to allow growth of the port. Fundamentally however, Teesport (and the numerous industrial facilities along its banks) would remain in the absence of the proposed scheme, which would continue to provide socio-economic benefits to Teesside and the wider area.

22.5 Implications on previously reported impact assessment

A summary of the socio-economic impact assessment presented in the 2006 ES in presented in Table 22.9.

Table 22.9 Summary of potential socio-economic impacts due to the proposed NGCT from the 2006 ES

Impact	Significance rating	Mitigation	Residual impact
Construction phase			
Generation of employment during the construction phase	Minor beneficial	None required	Minor beneficial
Operational phase			
Increased direct employment by PDT	Moderate beneficial	None required	Moderate beneficial
Increased direct employment by other operators at the port	Minor beneficial	None required	Minor beneficial
Increase in associated employment	Moderate beneficial	None required	Moderate beneficial
Increased competitive advantage	Moderate beneficial	None required	Moderate beneficial
Multiplier effects	Moderate beneficial	None required	Moderate beneficial

With regard to the previously assessed construction phase impact, the changes to the economic circumstances in the local and regional context presented in Section 22.4 and the likely procurement of works through a contractor do not change the baseline or assessment conclusions relating to this minor beneficial impact.

With regard to the previously assessed operational phase impacts, there have been improvements in the economic baseline for the local (Tees Valley) and regional economy since 2006, in terms of reduced unemployment and increased skills / education. However, these baseline changes do not materially alter the positive nature of the impacts associated with the NGCT across these economic areas (i.e. employment and GDP/income), though they may (to a degree) reduce the scale of the benefits previously assessed.

Overall, the changes to economic circumstances in the local and regional context and the likely procurement of works through a contractor do not change the baseline or assessment conclusions relating to this minor beneficial impact. The scheme still has the potential to support the reduction of deprivation in the Tees Valley.

In terms of the improved competitiveness of the region, the expansion will continue to improve this, to the benefit of the local and regional economy.

Based on the above, it is concluded that the findings of the 2006 ES remain valid and no further assessment is considered necessary beyond that undertaken in 2006.

23 CLIMATE CHANGE

23.1 Introduction

Schedule 3 of The Marine Works (Environmental Impact Assessment) (Amendment) Regulations 2017 states that EIA Reports produced under these Regulations should assess: "*the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change".*

It is recognised that construction and operational activities associated with the NGCT will release greenhouse gases (GHG) and, therefore, a GHG footprint assessment has been carried out using available quantitative information. Where information was unknown, sources of GHG emissions have been estimated. In addition, the vulnerability and adaptability of the project to climate change has been considered.

23.2 Greenhouse gas emissions

23.2.1 Methodology

There are three 'scopes' of GHG emissions, as defined by the GHG Protocol developed by the World Resources Institute and World Business Council on Sustainable Development (2015). These emission scopes are detailed below:

- Scope 1 emissions: "direct" GHG emissions arising from a project, such as those associated with fossil fuel consumption by marine vessels and construction traffic.
- Scope 2 emissions: account for "indirect" GHG emissions from the production of electricity and gas (i.e. off site and usually by third parties) consumed by plant and equipment.
- Scope 3 emissions: are "indirect emissions arising from supporting activities" (e.g. work upstream and/or downstream, the activities of sub-contractors and ancillary travel) associated with a project. The assessment of Scope 3 emissions is voluntary and an organisation can take a decision on the materiality of such activities before deciding to spend effort on calculating them for inclusion in a GHG footprint calculation. This includes third party marine vessel and road traffic vehicles, which are not under the direct control of PDT.

The assessment set out herein has considered Scope 1 and Scope 2 GHG emissions under the 'control' of PDT during the construction and operational phases of the NGCT. Scope 3 GHGs associated with third parties during the operational phase, such as shipping and haulage companies responsible for container vessels and road traffic movements, have not been considered.

The boundary for the GHG footprinting exercise has been defined as the spatial extent of the NGCT, including the onshore infrastructure (which has been partially constructed under the planning permission granted by RCBC), the marine infrastructure (notably the container terminal) and the footprint of the proposed dredge.

In this assessment, GHGs were included from the following sources:

- Scope 1 GHGs associated with the consumption of diesel fuel by construction plant and dredgers during the construction phase;
- Scope 1 GHGs associated with the consumption of diesel fuel by tug boats in the operational phase; and,
- Scope 1 GHGs associated with the consumption of diesel fuel by port cargo handling equipment (CHE), including RTGs, TTUs, Empty Reach Stackers and Railhead Reach Stackers.

With regard to Scope 2 GHGs, sources considered that had to be excluded from the assessment due to a lack of information are set out in Table 23.1.

Table 23.1 Sources of GHGs associated with the NGCT not included in the assessment

Emissions scope	Construction phase	Operational phase
Scope 2	The consumption of purchased electricity used to power construction plant and equipment	The consumption of purchased electricity, used to power electrically powered port infrastructure, such as ship to shore cranes and rail mounted gantry cranes. This is likely to be the most significant source of GHG emissions within the NGCT boundary during the operational phase.

Emission factors used for this assessment were obtained from Defra (Defra, 2017). To provide a conservative assessment, it was assumed that construction plant and CHE will operate using gas oil, and tugs would use Marine Gas Oil (MGO). The emission factors used are provided in Table 23.2.

Table 23.2 Emission factors used in the assessment

Fuel	Emission factor (kg/CO_2 per tonne)	Source
Gas oil	3,470	Defra, 2017
Marine gas oil	3,215	Defra, 2017

23.2.2 Construction phase GHG emissions

The number of plant and their maximum power ratings were used to calculate an average maximum power rating of 78 MW. The hours of operation were assumed to be 12 hours per day, 6 days per week for 50 weeks per year. The average engine load was assumed to be 10% and the engine efficiency 40%. Therefore, annual fuel consumption was predicted to be 2,295 tonnes per year.

GHG emissions from construction plant and dredgers were estimated to be 7,335 tonnes of carbon dioxide equivalent (CO_2e) per year. This equates to less than 0.05% of GHG emissions in the north-east of England, based on a 2015 baseline (BEIS, 2015).

23.2.3 Operational phase GHG emissions

Table 23.3 provides information regarding the number and power rating of plant proposed to be used during the operational phase of the proposed scheme.

Table 23.3 CHE information used in the assessment

Item	Number	Power rating (kW)
Rubber tracked gantry cranes	24	400
Port Tractor Trailer Units	72	130
Empty Reach Stackers	6	172
Railhead Reach Stackers	4	246

The assumptions detailed in Table 23.4 were made to calculate annual fuel consumption by CHE.

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Table 23.4 CHE Calculation Assumptions

Parameter	Value
Energy Content of Fuel	46 MJ/kg
Equipment on-time	350 hours/month
Engine Efficiency	40%
Average Engine Load	10%
Tonnes Fuel Used	401.7

GHG emissions associated with the consumption of fuel from plant anticipated to be required to operate the NGCT are estimated to be 1,394 tonnes of CO_2e per year.

In addition to the above, there will be a requirement for the use of tugs during the operational phase of the proposed scheme. It is predicted that two large and four small tugs would support the operational phase of NGCT, all of which use MGO. Typical fuel consumption figures for tugs are provided in Table 23.5.

Table 23.5 Typical tug fuel use

Vessel size	Fuel consumption (litres per week)
Large	6,530
Small	3,933

Based on the above, annual fuel consumption in the operational phase was estimated to be 28,792 litres, which equates to 24.65 tonnes per year[3]. Therefore, the release of GHG emissions associated with the operation of tugs at the NGCT is estimated to be 79 tonnes of CO_2e per year.

Annual GHG emissions calculated in this assessment are provided in Table 23.6.

Table 23.6 Annual GHG emissions considered in this assessment

Source	CO_{2e} emissions (tonner per year)
CHE	1,394
Tugs	79
Total	1,473

Annual CO_2e emissions associated with the consumption of fuel by CHE and tugs is estimated to be 1,473 tonnes of CO_2e per year. This equates to less than 0.01% of GHG emissions in the north-east of England, based on a 2015 baseline (BEIS, 2015). However, the largest source of GHG emissions is anticipated to be associated with the consumption of purchased electricity within the NGCT boundary.

It is considered that the NGCT terminal will not have a significant impact on regional initiatives to address the causes and impacts of induced climate change. In addition, the provision of the NGCT terminal in the North of England is likely to lead to a reduction in vehicular freight miles nationally and therefore, contribute to a reduction in road-based emissions within the UK.

[3] *Conversion factor of 1,168 litres per tonne for marine gas oil obtained from the Energy Institute, 2012.*

Mitigation and best practice measures recommended in relevant guidance and set out in existing container port action plans that could be adopted by PDT to reduce the GHG footprint include measures that range from achieving efficiencies within the port itself, to offering incentives to operators using low emission technology at NGCT.

23.3 Vulnerability and adaptation to climate change

The principal climate change effect that could affect the proposed scheme is sea level rise, which could affect flood risk at or adjacent to the site. Predicted changes in rainfall and fluvial flows are likely to be less critical because the Tees Barrage controls flows into the tidal reaches of the estuary. The implications of the NGCT in light of climate change guidance and flood risk studies are presented in Section 20.

Royal Haskoning produced a Climate Change Adaptation study for PDT in 2011 (Royal Haskoning, 2011), which was produced as part of Defra's Adapting to Climate Change programme (Defra, 2009). The purpose of the study was to identify the risks to the operations and statutory responsibilities of PDT posed by climate change, and to identify actions to mitigate those risks. The assessment identified that there were three 'very high' risks to the Port, namely:

1. Sea defences adversely impacted or compromised by sea level rise and/or increased storminess.
   - PDT has full or partial maintenance responsibility for a number of sea defences, for which condition assessments are regularly undertaken. The requirements for repair or maintenance works carried out on the sea defences is also under continual review, and long-term strategic planning documents (such as Shoreline Management Plans) are in place which take into account for climate change and sea level rise risk.
2. Road closure/damage to roads from flooding and resulting impact upon movement of cargo/equipment/people from the Port to the surrounding road infrastructure, or vice versa (i.e. closure of the A1053).
   - Changes to the drainage system were made prior to 2014 following a flooding incident which impacted a large area of Teesport and its access roads. The requirements for an enhanced drainage strategy as a result of climate change have been discussed at workshops and considered by PDT.
3. Flooding of quays through overtopping due to rising sea levels/high winds and swell conditions.
   - The port has an ongoing asset protection programme in place - a scheme of works to ensure that infrastructure and sea defences are maintained to the proper standards. It is likely that quays will be replaced for reasons other than climate change by the time sea levels rise to a problematic level. Adopted business continuity measures are designed to limit the adverse impacts of an event such as a major flood by protecting 'business critical' systems, services and infrastructure.

The potential effects on the Port due to these risks include:

- A reduction in port operations and capacity, as vessels may not be able to access the NGCT scheme and port infrastructure performance may be reduced.
- Port closures due to an increase in hazardous weather conditions, affecting commercial results, the import and export of materials and may impact the ports reputation.
- Wider damages to the local area due to increased runoff from the drainage network.

It is of note that the risk assessment undertaken in 2011 did not reveal any risks that could be considered 'new'. Rather the predicted climatic changes are expected to bring about a change in those conditions that the Port is already well used to dealing with; either through an increase or decrease in the frequency or

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extent of an event. Operating within a dynamic environment, PDT (as all port operators) is prepared for conditions including storm surges, high winds, high and low temperature extremes, and coastal erosion. The 2011 study identified a number of adaptation responses that should be implemented (or are already being implemented) to minimise the risks to the operations at the Port due to climate change. These are outlined below.

1. Sea defences adversely impacted or compromised by sea level rise and/or increased storminess.
   - This is an ongoing issue for PDT with regard to its statutory duties as a competent harbour authority. Regular condition assessments are undertaken for defences owned or maintained by PDT. The nature and extent of any repair works is also under continual review and appropriate works are undertaken (guided by co-operation with the local planning authorities and the Environment Agency) in light of information relating to sea level rise.

2. Road closure/damage to roads from flooding and resulting impact on movement of cargo/equipment/people from the Port to surrounding road infrastructure.
   - As set out above, PDT implemented a number of changes to the drainage system following a previous flooding incident which cut of the Port by road when rainwater overwhelmed the capacity of the local drainage system. An ongoing maintenance regime will consider the need to increase drainage capacity to ensure that the infrastructure is able to cope with the predicted increased in rainfall over time.

3. Flooding of quays through overtopping due to rising sea levels/high winds and swell conditions.
   - If realised, this potential climate change risk could have major consequences for the Port. PDT has an ongoing asset protection programme, which ensures that infrastructure and sea defences are maintained to proper standards. Defences will be upgraded or increased where necessary so that they can cope with predicted changes in conditions. Any new quays (such as the NGCT) will be constructed taking into account predicted increases in sea level.

As reported in 2011, PDT employs a comprehensive risk management strategy and the climate change risk assessment is being amalgamated into this. As part of the existing risk management strategy, risks relating to climate change impacts can be identified and climate change adaptation measures introduced to reduce those risks wherever applicable. As the 2011 risk assessment process has demonstrated, risks associated with the expected impacts of climate change are largely extensions of those that are currently faced, although the extent and frequency of events may increase these risks slightly in areas. Therefore, whilst PDT are already familiar with the risks that the 2011 study has identified through its ongoing operations, PDT is in a position to review them in the future from a climate change perspective, taking account of changes in legislation, observed trends in sea level rise and climatic variables, and best practice.

PDT has considered the existing and future risks to the Port’s operations as a result of climate change and has put in place measures to minimise such risks from occurring. The development of the NGCT will not impact on the mitigation strategies that are already in place.

24 USE OF NATURAL RESOURCES

24.1 Introduction

Schedule 3 of The Marine Works (Environmental Impact Assessment) (Amendment) Regulations 2017 states that EIA Reports produced under these Regulations should include a description of the likely significant effects of the development on the environment resulting from (amongst others): *“the use of natural resources, in particular land, soil, water and biodiversity, considering as far as possible the sustainable availability of these resources.”*

Although there will be a requirement for the use of natural resources during construction and operation (i.e. water for drinking/WC use), this is not considered to be significant / unusual for a project of this nature (and no significant natural resource demands are anticipated). The assessment presented below therefore focusses on waste minimisation and the beneficial use of the dredged material.

24.2 Waste minimisation and beneficial use of dredged material

24.2.1 Waste hierarchy

The Waste Framework Directive (2008/98/EC) (WaFD) consolidates earlier legislation and sets out the general rules applying to all categories of waste. A key objective of the WaFD is to provide measures to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste, and by reducing overall impacts of resource use and improving the efficiency of such use.

Article 3(1) of the Directive defines waste as:

“…..any substance or object……which the holder discards or intends or is required to discard”.

More generally, the WaFD Directive provides a general duty to ensure that waste is dealt with in an environmentally friendly way. The key to this is the ‘waste hierarchy’ which emphasises prevention (in the first instance) and then re-use, recycling and recovery of waste (see **Figure 24.1)**. EU Member States must have regard to the waste hierarchy when dealing with waste. Disposal to landfill or at sea is the least favourable option.

As noted in Section 3 of this report, the scheme will generate waste, primarily as a result of capital dredging required during the construction phase. The favoured option of waste prevention under the waste hierarchy, therefore, is not possible to deliver for the scheme. Section 3 considers beneficial uses of the dredged material within the NGCT scheme; however the worst-case assumption is that 3,830,000m^3 of the overall volume of material to be dredged should be disposed offshore. A review of possible beneficial uses for the 3,830,000m^3 of material has been undertaken and presented below.

Figure 24.1 The waste hierarchy

24.3 Beneficial use of dredged material

24.3.1 Summary of disposal options for dredged material

A number of options for the disposal of dredged material that will be generated as a result of the scheme have been considered, namely:

- Disposal at the Teesport Estate (i.e. reclamation behind the solid quay wall option should this be progressed, and locally raising ground levels within the proposed NGCT terminal area).
- Disposal at the Former Leathers chemical works site at North Gare (i.e. using dredged material to cap existing contaminated material). This option has not been progressed further due to concerns raised regarding potential disturbance to waterbirds as a result of this option.
- Disposal at sea at either, or both of, the existing active disposal sites in Tees Bay.
- Beneficial use of sediment as part of habitat enhancement works (discussed further below).

Within its scoping consultation response to the MMO on the Hartlepool channel scheme, HBC recommended that the creation of safe, shorebird roost island(s) (possibly doubling as little tern nesting islands) could be created using the dredged material from Hartlepool channel. In terms of Hartlepool borough and the wider Teesmouth and Cleveland Coast, HBC also advised that the lack of safe shorebird roost islands is a conservation issue of great concern to the Council, particularly as existing ‘slag’ islands have eroded and recreational disturbance is adversely affecting wader roosts.

Further consultation with HBC was undertaken during September 2018 to discuss possible locations for the creation of bird islands. HBC identified four locations at the mouth of the Tees estuary which could be suitable locations for the re-use of dredged sediment; three were located adjacent to the South Gare Breakwater, with one adjacent to the North Gare Breakwater. Consultation with Natural England in October 2018 confirmed that the creation of bird islands as an environmental enhancement measure to the proposed Hartlepool channel scheme by beneficially re-using dredged material would be welcomed.

Within the Hartlepool Channel EIA Report (Royal HaskoningDHV, 2018), it was concluded that the beneficial use of dredged sediment to create / enhance existing roost sites does represent a possible option. The marine licence application submitted to the MMO for the proposed Hartlepool channel scheme assumed the offshore disposal of all dredged material to ensure that the proposed scheme can proceed should the development of bird islands not be possible at the point of undertaking the proposed dredge.

PDT will continue to investigate the option of creating bird islands using dredged material (including that to be generated from the NGCT scheme), possibly linking with the aims and desires of the Tees Estuary Partnership. Such creation of bird islands at the mouth of the Tees (or any beneficial use of dredged material in the marine environment) would require a separate marine licence application to deposit dredged material, or potentially a variation to the marine licence for the proposed scheme (if granted) should it be possible to implement the bird islands in parallel with the proposed scheme.

Although there are no immediately identifiable schemes which could utilise the dredged sediment that would arise from the NGCT (in addition to the fact that there is no immediate source of material, as the marine works may not be progressed for a number of years), PDT will continue to investigate opportunities for beneficial use to minimise the volume of material that would be deposited offshore. Whilst not utilising dredged material arising directly from the proposed NGCT, PDT is proposing to recharge the intertidal area downstream of Newport Bridge with maintenance dredged silt as part of habitat improvement measures being progressed in partnership with the Tees Rivers Trust.

Depending on the timescales, it may be possible to utilise some of the dredged material that will arise from the NGCT dredge within the habitat enhancement works that are required in Bran Sands lagoon for the York Potash Harbour Facilities. This will be reviewed by PDT when the timescales for the full implementation of NGCT are confirmed.

Based on the above, a combination of disposal within the Teesport Estate (i.e. locally raising ground levels and use within the reclamation, should the closed structure be progressed) and disposal at sea have been included within the scheme design (on the basis that there are no feasible beneficial uses of dredged material available). However, beneficial use options will be continually reviewed by PDT (through discussion with the Environment Agency and Natural England) to minimise the requirement for offshore disposal.

25 DISASTER RISK

The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) require consideration of the vulnerability of the proposed scheme to major accidents or disasters that are relevant to that development. It is considered that the main major accident / natural disaster which could affect the proposed scheme is tidal flooding. The findings from the coastal protection / flood defence assessment, therefore, address this risk and no further specific accident / natural disaster assessment is considered to be necessary.

26 OFFSHORE DISPOSAL OF DREDGED MATERIAL

26.1 Introduction

The NGCT is predicted to generate up to 4.8 million m^3 of dredged material. Of this total, 970,000m3 is to be used for land raising. Approximately 3,830,000m^3 is proposed for disposal in a licensed offshore disposal site in Tees Bay (namely Tees Bay C) as a worst-case scenario whereby the open quay structure is progressed by PDT. Should PDT progress with the closed quay structure, the offshore disposal volume would likely reduce to approximately 2.9 million m^3, as material would be utilised within the reclamation for this option.

The 2006 ES considered the potential environmental impacts associated with offshore disposal of 2.9 million m^3. The 2006 ES also considered the environmental impacts associated with the disposal of approximately 2.3 million m^3 of dredged material in Bran Sands lagoon (which would reduce the volume of material required for offshore disposal to 0.6 million m^3). However, the disposal of dredged material in Bran Sands lagoon is no longer an option for the NGCT scheme, as habitat enhancement works in the lagoon are required as part of the York Potash Harbour Facilities scheme.

As detailed in Section 3, a number of alternatives to offshore disposal have been investigated, however, none are considered to be feasible at this stage. The assessment presented below has been undertaken on a worst-case basis whereby approximately 3,830,000m^3 of dredged material would be disposed offshore.

This section of the report has been informed by undertaking a review of relevant publicly available data regarding the Tees Bay C offshore disposal site, as well as the findings of a targeted benthic ecological survey undertaken during 2019. Relevant publicly available data includes that recovered by Cefas during monitoring at disposal sites around the coast of England during 2010 (under the SLAB5 project).

26.2 Baseline environment

26.2.1 History of offshore disposal

The majority of dredged material arising from the NGCT project will be disposed offshore at Tees Bay C (TY150). As well as Tees Bay C, there is also another licenced disposal site in Tees Bay, namely Tees Bay A (TY160). Both sites have historically been used for the disposal of both capital and maintenance dredged material. In general, Tees Bay A is used for the disposal of maintenance dredged material, whilst Tees Bay C is used for capital dredge arisings.

Disposal records received from Cefas during June 2019 indicate that over the period 1989 to 2017, Tees Bay C has been used for the disposal of both capital and maintenance dredged material. The disposal volumes per year are presented in Table 26.1. It is evident that the site is not used every year, with deposits made within 17 of the 30 years between 1989 and 2017. The long-term average disposal volume into Tees Bay C (from 1989 to 2017) was 33,000 wet tonnes per annum.

Table 26.1 Annual disposal volumes at the Tees Bay C site (data sourced from Cefas)

Date	Volume (wet tonnes)	Type	Date	Volume (wet tonnes)	Type
1989	12,600	Maintenance	2004	0	-
1990	4,200	Maintenance	2005	10,692	Capital
1991	33,918	Capital	2006	472	Capital
1992	0	-	2007	0	-
1993	7,172	Capital	2008	0	-
1994	440	Capital	2009	7,950	Capital
1995	19,254	Maintenance	2010	-	
1996	8,121	Capital	2011	60,000	Capital
1997	200,910	Capital	2012	-	
1998	0	-	2013	-	
1999	0	-	2014	7,877	Capital
2000	0	-	2015	409,837	Capital
2001	0	-	2016	108,003	Capital
2002	0	-	2017	108,004	Maintenance
2003	0	-	2018		

26.2.2 Current maintenance disposal practice

PDT currently holds a 10-year licence (L/2015/00427/4) for the disposal of maintenance dredged material from the Tees estuary into the Tees Bay A site. This licence was issued by the MMO in 2015. In accordance with the marine licence conditions, the volume of maintenance dredged material disposed is recorded and provided to the MMO and Cefas.

A zoned disposal plan has been operating since 2006 for the disposal of maintenance dredged material at the disposal sites. This ensures an even bathymetry within the disposal sites.

The annual volume of maintenance dredged material deposited within the Tees Bay offshore disposal sites (both Tees Bay C and Tees Bay A) is approximately 1.14 million m^3 (average from 2001 to 2018).

26.2.3 Modelling the dispersion of capital dredged material

Hydrodynamic and sedimentary modelling has been undertaken to understand the predicted dispersion of capital dredged material arising from the NGCT project. Simulations have been undertaken for disposal activities over an entire spring-neap cycle and the results are provided in Figure 26.1 and 26.2. The figures show the dispersion under calm conditions (no wave conditions) and illustrate that under these conditions most of the fines are predicted to deposit and remain close to the point of disposal. Peak concentrations are predicted to increase by approximately 5mg/l within an area 2km from the boundary of the disposal area at Tees Bay C. No peak deposition depths greater than 1mm were predicted outside the boundary of the disposal areas during the simulation.

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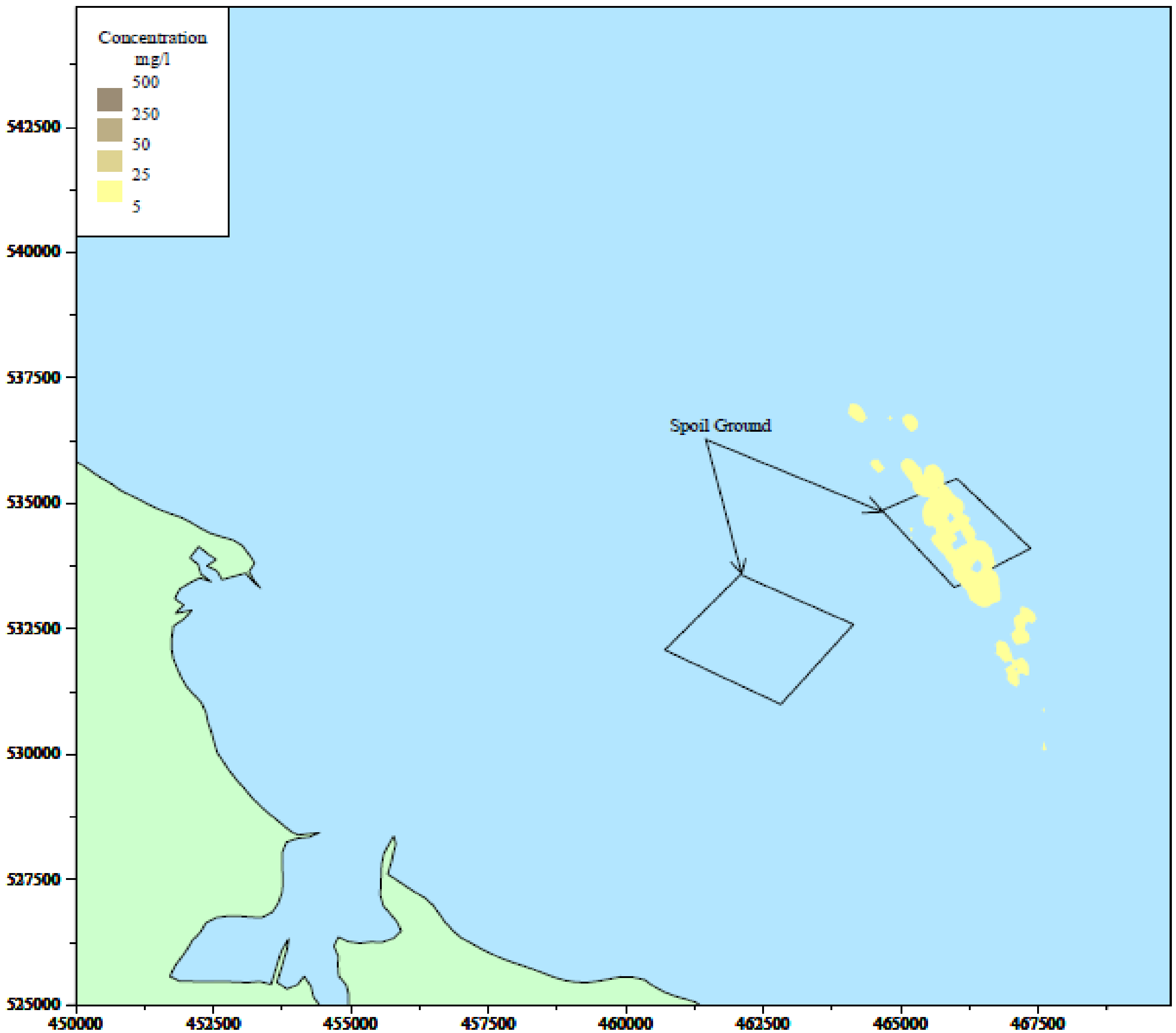


Figure 26.1 Simulated peak concentration for disposal operations at Tees Bay C (Tees Bay A also shown for reference)

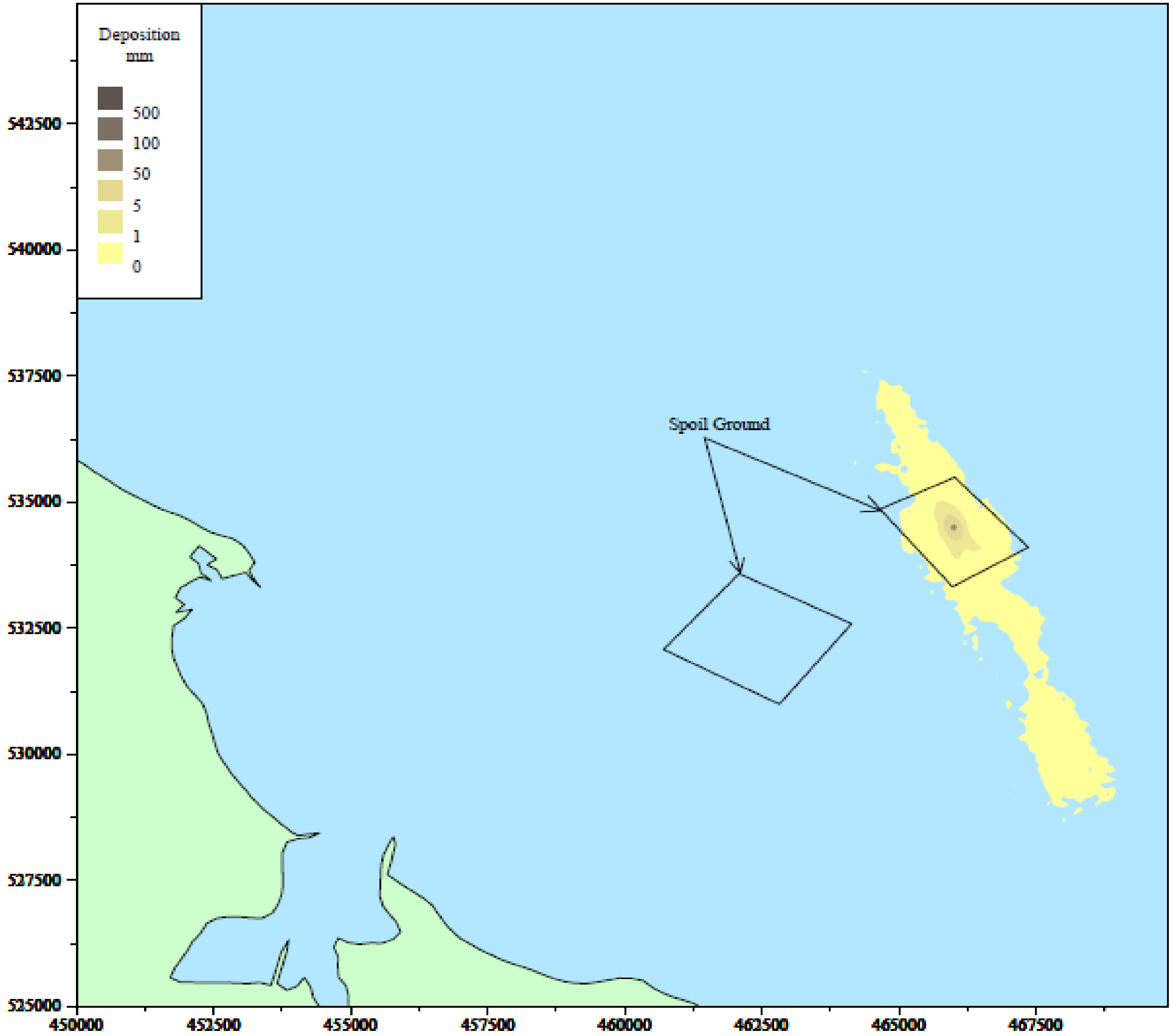


Figure 26.2 Simulated peak deposition for disposal operations at Tees Bay C (Tees Bay A also shown for reference)

The modelling exercise has concluded that, in the context of the existing disposal of maintenance dredged material, the effect of depositing fine material at the Tees Bay C offshore disposal site will be of minor significance.

It is also concluded that the capital dredging will result in far lower rates of the introduction of fines into the system to that which occurs during maintenance dredging and disposal. Therefore, the physical effects of the material disposed at the site during the capital dredging for NGCT will be smaller. There will be some short-term build-up of fine sandy sediment at the disposal site, however, this would be dispersed over time.

26.2.4 Summary of benthic monitoring at offshore disposal sites

2010 Cefas SLAB5 monitoring

In 2010, CEFAS undertook the 'SLAB5' dredged material disposal site sampling survey at a number of disposal grounds around England and Wales, including Tees Bay C and Tees Bay A (Bolam *et al.,* 2011). The study concluded that the macrofaunal communities within the Tees Bay C and Tees Bay A disposal sites appear to be altered (relative to those outside), but that disposal activity has not had significant impacts on either the total number of taxa per grab or the total number of individuals (Bolam *et al*., 2011)

2019 benthic ecological survey

A total of eight Day grab samples ($0.1m^2$) were collected from within and immediately adjacent to the Tees Bay C offshore disposal during March 2019 (Figure 26.3). Macrobenthic and PSD analysis was undertaken on these samples. Eight Day grab samples were also recovered from within and immediately adjacent to the Tees Bay A disposal site.

The PSD results show that the sediments within and adjacent to Tees Bay C comprise gravelly muddy sand, muddy sandy gravel and muddy sand.

The macrobenthic analysis confirmed that the samples recovered from within and adjacent to Tees Bay C were dominated by Annelida in terms of abundance, biomass and diversity. Cluster analysis of square-root transformed macrobenthic abundance data was undertaken to determine the similarity of the epibenthic communities recorded in each sample. The analysis confirmed that all eight samples from within and immediately adjacent to the Tees Bay C site fell within the same faunal group. This faunal group was dominated by the polychaete *Lumbrineris cingulata* which contributed 21% of the within group similarity. Other prevalent species included *S. spinulosa* and Nemertea, which contributed 6% and 5% of the within group similarity respectively.

The Tees Bay C offshore disposal site was found to support populations of two species of conservation interest, namely the Ross worm S*. spinulosa* and the ocean quahog *Arctica islandica*. *A. islandica* is on the OSPAR List of threatened and/or declining species and habitats and is also a FOCI in England and Wales. Dense subtidal aggregations of tubes created by *S. spinulosa* may form biogenic reefs that can stabilise cobble, pebble and gravel habitats and provide a consolidated habitat for epibenthic species (Pearce *et al.* 2011). These reefs form solid, raised structures above the surrounding seabed, thus increasing local habitat complexity and creating a biogenic habitat onto which various other species may become established. *S. spinulosa* is therefore only an Annex I habitat when it is present in reef formation. A summary of the number of individuals recorded at each sample is provided in Table 26.2.

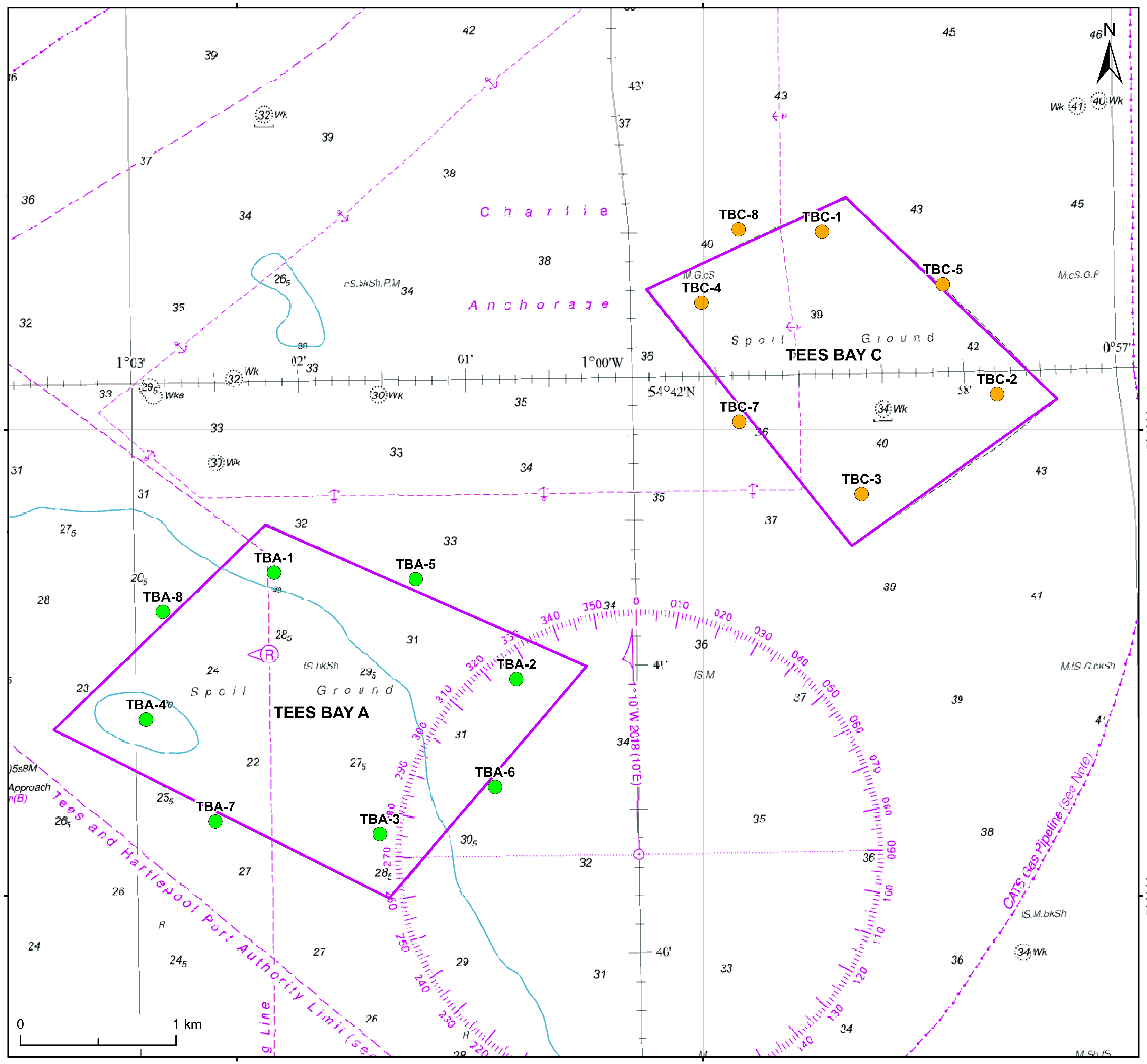
Table 26.2 Summary of species of conservation interest in samples recovered from Tees Bay C

Species	Sample ID	Individuals present
S. spinulosa	C1	15
	C2	725
	C3	1
	C5	66
	C6	262
	C7	1
	C8	10
A. islandica	C3	5
	C4	4
	C6	1

As reported above, there were high densities of *S. spinulosa* found locally within Tees Bay C (particularly from site C2). Despite the high density of individuals at this location, the visual inspection of the grab samples indicated that the tube aggregations were representative of a low-lying veneer formation that was not deemed to meet the Annex I reef qualifying criteria as described by Gubbay (2007) (Ocean Ecology, 2019).

As well as species of conservation interest, two individuals of the invasive species *Yoldiella* were reported at one station within Tees Bay C. Following discussions with expert bivalve taxonomists at the National Museum of Wales, they were assigned to *Yoldiella c.f hyperborea*. The genus *Yoldiella* is in need of further taxonomic study with three species recorded on the east coast of the USA, Norway and Iceland as well as two potential subspecies. Molecular systematics would be required to determine which population or species these specimens belong to with certainty.

As shown on Figure 26.3, the sampling station which contained the invasive species *Yoldiella* was located on the eastern boundary of the disposal site. None of the other seven sampling stations within and adjacent to the Tees Bay C site contained invasive species. It should also be noted however that individuals were recorded within both the Tees estuary and the Tees Bay A site, indicating a potentially widespread population beyond the boundary of the Tees Bay C site.



Legend

Offshore disposal sites

Grab sample locations

- Tees Bay A
- Tees Bay C

Client: PD Teesport

Project: Northern Gateway Container Terminal

Title: Grab sample locations at the Tees Bay A and Tees Bay C offshore disposal sites

Figure: 26.3

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	21/10/2019	TC	SR	A3	1:25,000

Co-ordinate system: British National Grid

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26.2.5 Broadscale habitat mapping

Broadscale habitat mapping from the UKSeaMap (2018) illustrates that the Tees Bay C offshore disposal site is occupied predominantly by low and moderate energy deep circalittoral sand (EUNIS code A5.27) (Figure 26.4). An area of moderate energy deep circalittoral mud (EUNIS code A5.37) is also reported to be present in the south-west corner of the Tees Bay C offshore disposal site, with localised areas of moderate energy circalittoral fine sand or circalittoral muddy sand in the west of the site (EUNIS code A5.25 and A5.26).

26.3 Predicted impacts

The proposed disposal of dredged material within the Tees Bay C offshore disposal site has the potential to have an influence on the following environmental topics:

- Fish populations and fisheries
- Benthic ecology
- Commercial navigation

The potential impacts on the above environmental topics are discussed below.

26.3.1 Impacts on fisheries interests

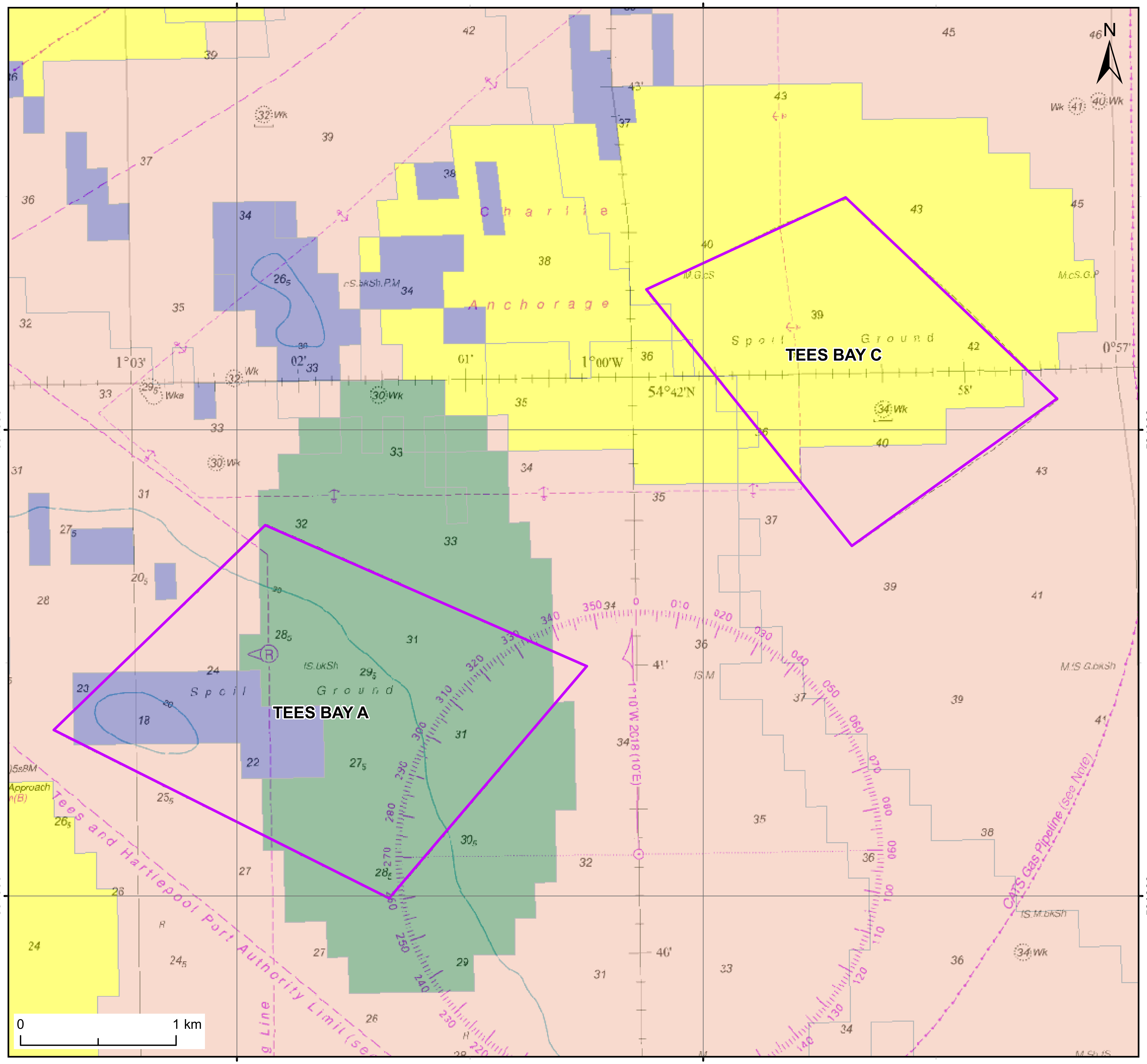
Based on the predicted dispersion of fine sediment from Tees Bay C described above, it is concluded that there is little potential for an impact on water quality and, therefore, fisheries interests beyond the boundary of the Tees Bay C site due to disposal of dredged material. It has been demonstrated that the rate of introduction of fine material to the disposal site will be less than which currently occurs during the disposal of maintenance dredged material and there will be a negligible effect on SSC outside of the boundary of the disposal site.

It is predicted that there will be a short-term accumulation of sand on the seabed at the disposal site, with a longer-term accumulation of coarser sediments. It is predicted that the sand would, over time, disperse away from the site and would be worked into the seabed. Given the long-term history of Tees Bay C as a licensed disposal site, it is considered highly unlikely that the area would be utilised by fish species for feeding, spawning or as a nursery ground. It is also concluded that the site would not represent important fishing grounds for the same reason. It is therefore concluded that there would be **no impact** on fish or fisheries due to the proposed deposition of dredged material at Tees Bay C.

Overall, it is concluded that the effects of disposal will be localised to the disposal sites and **no impact** is predicted on fish or fisheries interests.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact.**

Figure 26.4 Broadscale habitat mapping offshore disposal site



Legend

Offshore disposal sites

Broadscale Habitat Mapping (EUSeaMap2016)

Substrate

- Mixed sediment
- Rock or other hard substrata
- Sand
- Sandy mud to muddy sand

Client: PD Teesport

Project: Northern Gateway Container Terminal

Title: Broadscale habitat mapping at Tees Bay A and Tees Bay C offshore disposal sites

Figure: 26.4

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	21/10/2019	TC	SR	A3	1:25,000

Co-ordinate system: British National Grid

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26.3.2 Impacts on subtidal benthic ecology

Smothering of existing habitats

The proposed disposal of dredged material at the Tees Bay C offshore disposal site would be significantly greater than the rate of input of material to this site over recent years. It is therefore concluded that the disposal activity would be expected to result in an impact on the benthic ecology (smothering) at the disposal ground due to the predicted accumulation of material on the seabed.

A review of MarLIN has been undertaken to determine the sensitivity of the key species present within and immediately adjacent to the Tees Bay C offshore disposal site to smothering. This data is provided in Table 26.3.

Table 26.3 Sensitivity of key species within the Tees Bay C offshore disposal site to impacts likely to arise from offshore disposal of dredged material

Species	Pressure	Intolerance	Recoverability	Sensitivity	Evidence / confidence
Sabellaria spinulosa	Smothering	Low	Immediate	Not sensitive	Moderate
	Increase in suspended sediment	Low	Immediate	Not sensitive	Moderate
	Introduction of non-native species	No information available			

The short-term impact of the disposal activity would be expected to smother the seabed within the footprint of the disposal site. Hydrodynamic and sedimentary modelling has predicted some short-term build-up of fine sandy sediment at the disposal site, however, this would be dispersed over time. No peak deposition depths greater than 1mm were predicted outside the boundary of the disposal areas during the simulation.

Based on the information available from MarLIN, the species which is by far the most abundant within the samples recovered in and adjacent to the Tees Bay C offshore disposal site (i.e. *Sabellaria spinulosa*) is not sensitive to smothering or increases in suspended sediment.

Overall, it is recognised that there would be an impact on the benthic ecology within and adjacent to the disposal site (an area which is designated specifically for the disposal of dredged material), however the dominant species within the disposal site is not sensitive to the effects of smothering and is reported to have an immediate recoverability following smothering. It is therefore concluded that the impact would be of **negligible** significance.

Mitigation measures and residual impact

No mitigation measures are required. The residual impact would be of **negligible** significance.

Spread of invasive species

The benthic survey undertaken in March 2019 confirmed the presence of invasive species within samples from the Tees estuary, as well as within samples from the offshore disposal sites in Tees Bay. Two individuals of the invasive species *Theora lubrica* were found in a samples from the Tees estuary (TG23, within the NGCT dredge footprint).

Yoldiella c.f hyperborea was found in samples from the Tees estuary, Tees Bay C (two individuals) and Tees Bay A (one individual). The stations within the Tees estuary which contained *Yoldiella c.f hyperborean* are within the areas which are subject to regular maintenance dredging by PDT, however are located outside of the proposed dredge footprint for NGCT. The proposed dredging and offshore disposal required for the proposed scheme therefore has potential to result in the spread of *Theora lubrica* and possibly *Yoldiella c.f* *hyperborean*, should it colonise substrate within the proposed dredge footprint prior to the dredge taking place.

Given the very small number of individuals encountered during the survey, it is concluded that the species are not present at levels of concern within the Tees estuary. Maintenance dredged material from the Tees (which contains both invasive species) has been disposed of at the offshore disposal sites in Tees Bay for a number of years. As a result, the disposal of dredged material within Tees Bay C would not introduce a further source of potential impact (beyond that which has already occurred from previous maintenance dredge disposal operations). Overall, the potential impact would be of **negligible** significance.

Mitigation measures and residual impact
No mitigation measures are required. The residual impact would be of **negligible** significance.

26.3.3 Impacts on navigation

To undertake the disposal operation, the TSHD or disposal barges would transport dredged material from the proposed dredge footprint to the Tees Bay C offshore disposal site. Consequently, there is potential for conflict with other vessels using the approach channel and the coastal waters of Tees Bay.

The disposal operations are linked to the dredging task and would require regular movements of dredging plant between the dredge site and the disposal site, via the navigation channel and the coastal waters of Tees Bay. In the context of the existing numbers of vessel movements in and out of the Tees estuary (as reported in Section 13), the numbers of vessels transiting through the channel at any one time to deposited dredged material offshore would be low (i.e. a TSHD and/or a barge), and **no impact** is predicted.

The proposed disposal of dredged material has the potential to result in shallowing of the water depth above the Tees Bay C disposal site. The Tees Bay C disposal site has an overall area of approximately 294ha (equating to 2,940,000m^2), with water depths ranging between 39m and 42m bCD (as shown on the Admiralty Chart). Given the volume of material to be deposited (approximately 3.8million m^3), which would be evenly spread across the Tees Bay C site, it is considered that shallowing of the sea bed would not occur to such an extent that it significantly impacts navigation. It is concluded that the proposed disposal of dredged material into the Tees Bay C site would result in **no impact** on navigation as a result of potential shallowing.

Mitigation measures and residual impact
No mitigation measures are required. There would be **no residual impact.**

26.4 Implications on disposal site monitoring proposals (bathymetry and benthic ecology)

The following monitoring proposals were recommended within the 2006 ES:

Bathymetric monitoring

- High resolution bathymetric monitoring (i.e. tight line spacing), with multibeam bathymetric survey to provide 100% coverage of the area. The aim of this monitoring would be to do determine whether, and to what extent, dredged material accumulates at the disposal sites.
- The first survey would be undertaken immediately prior to disposal of dredged material, with a repeat survey on completion of disposal and at six monthly intervals for a further 12 months. This will enable determination of whether any material detected on the seabed immediately after the disposal activities has dispersed and the potential magnitude of any longer-term accumulation of

material on the seabed. An area 100m from the boundary of the Tees Bay C disposal site will also be surveyed to ensure that any movement of material from the site is detected.

- An opportunity will be provided to the MMO and relevant statutory consultees for comment on the survey results following each survey and, therefore, there the potential will exist for the methodology to be modified, should this be deemed necessary.

Benthic ecology

- Six monitoring stations will be established at the disposal area (Tees Bay C) in order to assess the impact of the disposal on the subtidal communities (infaunal species). Two of the six stations will be located outside of the disposal site, away from any likely routes of dispersing material. These stations will form the control stations. The other four will be located within the disposal site in question.
- All samples will be collected using a $0.1m^2$ day grab operated from a survey vessel and, in addition to collecting samples for benthic ecology, sub-samples will also be taken for particle size analysis. The sampling methodology would be the same as that adopted for the sampling undertaken in 2019. Monitoring will be undertaken immediately following disposal and then at six months and 12 months, following completion.
- To analyse the data, univariate and multivariate statistical methods will be applied to describe the structure and variability of the biological communities. Statistical techniques will also be applied to determine the difference in communities between the stations sampled within the disposal sites and those outside.
- An opportunity will be provided to the MMO and relevant statutory consultees for comment on the survey results following each survey and, therefore, there will be the potential to modify the methodology should this be deemed necessary.

Based on the information presented throughout this section, it is concluded that the monitoring proposals should be implemented following completion of the disposal activity. No further monitoring is considered necessary.

27 CUMULATIVE IMPACT ASSESSMENT

27.1 Introduction

In addition to identifying and assessing the potential impacts of the NGCT in isolation, the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) require an assessment of its potential cumulative impacts (CIA). A CIA assesses the potential impacts of a project with other past, present (current) and reasonably foreseeable (proposed) projects.

With respect to past projects or existing/completed projects, a useful ground rule in CIA is that the environmental impact of schemes that have been completed should be included within the environmental baseline. As such, these impacts are already taken into account in the EIA process for the proposed scheme. Consequently, completed projects can be excluded from the scope of CIA. However, the environmental impacts of recently completed projects may not be fully manifested and, therefore, care is needed in respect of how the potential impacts of such projects are taken into account.

Projects that are currently being constructed or that are in the planning process (where sufficient information is publicly available), as well as on-going activities that have the potential to influence the same environmental parameters as the NGCT, are the focus of this CIA. Future plans or projects for which sufficient information is not available on which to base a reliable assessment, which are unlikely to be submitted or receive consent until after the proposed scheme has been completed, cannot reasonably be assessed as part of a CIA. However, the applicants for such projects will be required to take the effect of the NGCT scheme into account in their own application.

27.2 Guidance on cumulative impacts and cumulative effects assessment

The IEMA 'Guidelines for Environmental Impact Assessment' (IEMA, 2004) define cumulative impacts as:

"…the impacts on the environment which result from incremental impacts of the action when added to other past, present and reasonably foreseeable future actions…"

Cumulative impacts can be therefore additive or interactive. Typically, additive impacts occur when different project activities have an impact on the same environmental receptor at the same time. Interactive impacts are assessed in relation to a specific receptor but are caused by the interaction of different types of impacts from project activities even if individually these are insignificant (e.g. the interaction of underwater noise disturbance and increased suspended sediments on migratory fish).

To be considered within the CIA, other plans and projects should meet the following criteria. They should:

- generate their own residual impacts of at least minor significance;
- be likely to be constructed or operate over similar time periods to the proposed scheme (or their environmental consequences have the potential to be realised over the same time period);
- be spatially linked to the predicted zone of influence of the proposed scheme (for example, influencing the same area as affected by the sediment plume); and,
- be either consented (but not operational) or the subject of consent applications with the statutory authorities in the study area or part of another statutory procedure.

27.3 Assessment methodology

27.3.1 Definition of temporary boundaries

Temporal boundaries provide the timescales over which a project and, therefore, the assessment are undertaken and they give temporal limits to the CIA. When determining temporal boundaries, it is necessary to consider the longevity of effects, the potential nature of effects over time and the importance of seasonal variations in populations and sensitivities.

The temporal boundary for this assessment includes present plans and projects where the impacts are still occurring, or where mitigation measures are still operating; and reasonably foreseeable future plans and projects with which there could be a temporal or spatial overlap.

PDT's intention is to construct the proposed scheme prior to the expiry date of the HRO (which as noted in Section 1 is 7th May 2028). As noted in Section 3, dredging the mudstone in the upper reach is predicted to take approximately 33 weeks, whilst dredging of the granular material and clay is predicted to take between four and 11 weeks.

As detailed in Section 3.1, the phasing of the scheme has not yet been determined, however, for the purposes of the EIA, it is estimated that the scheme would be developed in two phases. It is anticipated that the construction period for Phase 1 of the proposed development (i.e. construction of the initial 700m of quay) would last for an overall duration of 80 weeks. Piling, which is expected to be the most significant source of noise during the construction period, is estimated to take approximately 44 weeks within the 80-week period.

Phase 2 of the proposed development (i.e. construction of the remaining 300m of quay) is predicted to last for an overall duration of 40 weeks. Piling is estimated to take approximately 24 weeks within this period. Overall, for the purposes of the EIA, the construction period for the full development is expected to be 120 weeks in total, with this total period being split into two phases of 80 and 40 weeks.

27.3.2 Definition of spatial boundaries

Spatial boundaries define the area likely to be affected by the proposed scheme. The study area can therefore be defined by the hydrodynamic model extent which is determined on the basis of the potential extent of the dredging and disposal plumes.

27.3.3 Identification of relevant plans and projects

Based upon the temporal and spatial boundaries described above, a comprehensive list of plans and projects relevant or potentially relevant to the CIA has been compiled and is provided in Section 27.4. This includes an explanation as to why plans/projects were taken forward for detailed assessment in the CIA or why they were screened out of the need for further assessment.

27.4 Scope of assessment

27.4.1 Introduction

Cumulative impacts derive from the predicted impacts of the proposed scheme which, when considered with other plans and projects, may have an additive or interactive impact on receptors.

27.4.2 Screening

As noted in Section 1 of this report, the landside elements of the NGCT scheme have commenced under the planning permission granted by RCBC. The focus of this CIA, therefore, is on the marine elements of the NGCT only, including consideration of any impacts predicted on the estuary or adjacent waterbodies (i.e. Bran Sands lagoon and Dabholm gut) associated with relevant landside projects. Plans and projects identified within the vicinity of the proposed scheme are outlined in Table 27.1. Where data is available, details of project type, construction dates, duration of works and other relevant data are provided, along with the distance from the proposed works.

Summary of projects included in the CIA
Based on the information presented above, the following projects have been considered in this CIA:

- York Potash Harbour Facilities (consented but not yet built).
- Ongoing maintenance dredging (consented and ongoing).
- Sirius Minerals MHF at Wilton (consented but not yet built).
- Sirius Minerals Storage Facility at Bran Sands (consented but not yet built).

As the landside elements of the proposed scheme have commenced under the planning permission granted by RCBC, the focus of the CIA is on the marine elements of the NGCT, specifically:

- the hydrodynamics and sedimentary regime;
- sediment and water quality;
- marine ecology;
- waterbird populations;
- fish and shellfish;
- commercial navigation; and
- the disposal of dredged material.

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Table 27.1 Plans and projects identified in the vicinity of the proposed scheme

Plan or project	Description and timing	Distance from proposed scheme	Status	Screening assessment rationale, including potential effects and impacts
York Potash Harbour Facilities	The York Potash Harbour Facilities scheme was granted a DCO in 2016. The DCO permits the following activities which are yet to commence: Phase 1 • site compounds; • construction of a 28m wide and 280m long quay including ship loads and ship loader rails; • dredging up to 750,000m3 of material from the approach channel and berth pocket; • lagoon habitat enhancement works; • installation of a surge bin; • installation of a conveyor system and transport towers; • construction of buildings and parking area; • erection of security fencing; • provision of ancillary infrastructure. Phase 2 • extension of the quay to provide a total quay length of 486m including ship loader and ship loader rails; • dredging up to 372,000m3 of material from the approach channel and berth pocket; • installation of a second surge bin; • installation of a second conveyor within the conveyor housing installed during Phase 1; • provision of ancillary infrastructure.	Immediately downstream	Marine licence granted.	The consented York Potash Harbour Facilities is located in very close proximity to the proposed scheme footprint and therefore is screened into the CIA. **Screened into the CIA.**
Hartlepool approach channel	PDT is proposing to undertake a programme of works within and adjacent to the existing approach channel into Victoria Harbour, located to the immediate south of Hartlepool Headland on the north-east coast of England. The current approach channel dimensions are limiting the size of vessels which can gain entry into the harbour. PDT is therefore proposing to deepen, realign, widen and extend the length of the	Approximately 6km north	Marine licence granted	In order to assess whether the hydrodynamic effects arising from the Hartlepool channel scheme will act in a cumulative manner with those arising from the NGCT, numerical modelling was undertaken in support of the Hartlepool approach channel marine licence application using the MIKE21-FM hydrodynamic model (Royal HaskoningDHV, 2018). The model has shown that under all tidal conditions, there is a clear separation of effect between the proposed

Plan or project	Description and timing	Distance from proposed scheme	Status	Screening assessment rationale, including potential effects and impacts
	approach channel, to allow Victoria Harbour to accept deeper drafted and larger beam vessels through a wider tidal window. In addition to the proposed dredge (and associated disposal of dredged material), PDT is proposing to construct an underwater retaining wall, immediately adjacent to the Middleton Breakwater, which is located at the mouth of Victoria Harbour. The underwater retaining wall is required to avoid the risk of Middleton Breakwater being undermined following the proposed dredge.			scheme at Hartlepool and the planned works in the Tees estuary (i.e. the effects and impacts of the proposed scheme at Hartlepool are not predicted to extend into the Tees estuary), indicating no cumulative effect on hydrodynamics will exist. Consequently, there will in turn be no cumulative effect on sediment transport or morphology between the NGCT scheme and Hartlepool approach channel. No further consideration of the Hartlepool channel scheme is therefore necessary. **Screened out of CIA**
South Bank Wharf	Able UK is planning on developing a new port facility in the Tees to support the renewable energy sector. The new quay is proposed to be over 1km long, and will be suitable for vessels with up to -12m draft. In order to permit vessel access within a commercially viable time window, the existing channel will need to be dredged to -12mCD and the berths will be dredged to depths of up to -15mCD. It is estimated that the total capital dredge will be around 2Mm3.	Immediately upstream	No marine licence application submitted.	There is no environmental assessment information available in the public domain and therefore it is not possible to include this within the CIA. **Screened out of CIA.**
Ongoing maintenance dredging at Hartlepool and in the Tees estuary	This activity has been ongoing for many years.	0km	Marine licence granted for offshore disposal.	Given the frequency, duration and the ongoing nature of this activity, maintenance dredging and disposal is represented in the baseline conditions for the area. However, maintenance dredge could be undertaken at the same time as the capital dredging activity required for NGCT (albeit within a different part of the estuary). **Screened into the CIA (excluding maintenance dredging at Hartlepool channel as the effects of this would not extend into the Tees).**
Inter Terminals Jetty 1 refurbishment	Inter Terminals has submitted a planning application and a marine licence application to undertake refurbishment works to its existing Jetty 1 on the northern bank of the Tees estuary. The scheme involves minor 'top-side' works to the existing infrastructure at Jetty 1 and Dolphin D, and a dredge of the river bed (with associated disposal of dredged material) to extend the existing berth pocket downstream. The works would result in Dolphin D	Immediately adjacent to the dredge footprint	Consent in place	The proposed works to Jetty 1 are highly localised and the construction works would be short term. The works are considered to be of a sufficiently small scale that there would be no significant cumulative impacts. **Screened out of the CIA.**

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Plan or project	Description and timing	Distance from proposed scheme	Status	Screening assessment rationale, including potential effects and impacts
	being used as an operational structure rather than simply a berthing dolphin.			
Tees Channel Dredge	The Tees Channel Dredge project involves a proposed deepening of the Tees navigation channel, the turning circle and Tees Dock to a maximum maintained depth of 14m below CD. An Environmental Scoping Report (Royal HaskoningDHV, 2016) was submitted to the MMO alongside a request for a scoping opinion for the project in 2016; however, the environmental assessment proposed within that report has not yet been undertaken. The footprint of the proposed Tees Channel Dredge overlaps largely with that of the upstream end of the NGCT channel dredge (with the exception of the proposed dredge in Tees Dock proposed as part of the former).	0km	No application submitted to date	Given that the dredge footprint largely overlaps with that for NGCT (with the exception of dredging in Tees Dock, which, given its location, would have no means of affecting the hydrodynamic and sedimentary regime of the estuary system), the area would be dredged by either the NGCT project or the Tees Channel Dredge project (not both). This removes the potential for cumulative impacts to arise. The Tees Channel Dredge project, therefore, has not been considered further. **Screened out of CIA**
Tees GasPort	Trafigura is proposing a scheme to import Liquefied Natural Gas (LNG) at Teesport (within the Tees estuary), on the north-east coast of England. The proposed LNG import comprises floating storage regasifation unit (FSRU) at an existing, currently unused jetty (located within the footprint of the NGCT scheme). Once the FSRU is in place, LNG carriers will berth next to the FRSU in a side-to-side mooring configuration and discharge the LNG into the FSRU before leaving again. In order to enable the LNG import facility to function the following works are required, referred to herein as the 'proposed works': • Concrete and steel work repairs to the existing jetty. • Modifications to the existing mooring dolphins. • Replacement / repair of ancillary items on the existing jetty. • Modifications to onshore mooring blocks. • Dredging of the existing berth and disposal of dredged material.	Within the proposed scheme footprint	Application submitted but no licence granted	The marine licence application has not yet been submitted. The non-statutory environment assessment undertaken in support of the marine licence application concluded that there would be no significant impact on any environmental parameters as a result of the proposed scheme. It is therefore concluded that this project should be screened out of the CIA. **Screened out of the CIA.**
Sirius Minerals Materials Handling Facility at	Sirius Minerals secured planning permission from RCBC for a Materials Handing Facility (MHF) on land at Wilton, Teesside, in	2km and 1km respectively	Both schemes are	No works are required within the estuary itself, with all works being located on land. The potential exists, however, for

Plan or project	Description and timing	Distance from proposed scheme	Status	Screening assessment rationale, including potential effects and impacts
Wilton and Storage Facility at Bran Sands	2015 (reference R/2014/0626/FFM). The associated York Potash Harbour Facilities DCO was also granted under s114 (1)(a) of the Planning Act 2008 (reference SI 2016 No. 772). Together the permission and consent provide for the construction and operation of facilities to process, transfer and handle for export the material emerging from a portal at the Wilton site, which will serve the consented mine and underground materials transfer system. The permissions led to progression of detailed design engineering, from which emerged requirements for an amended conveyor routing, and an additional storage facility (Use Class B8) at Bran Sands, Redcar. The Storage Facility has indicative dimensions of 1300m long x 170m wide x 40m high.		consented by RCBC	noise and visual disturbance as a result of this scheme to impact on waterbirds, and therefore this project has been considered below. **Screened into the CIA.**
Dogger Bank Teesside A and Dogger Bank Teesside B (now Sofia Offshore Wind Farm, referred to throughout as Sofia)	Dogger Bank Teesside was Forewind's second stage of development of the Dogger Bank Zone. Originally planned to be four separate wind farms known collectively as Dogger Bank Teesside, this stage was divided into two separate applications - Dogger Bank Teesside A & Sofia and Dogger Bank Teesside C&D. Only Dogger Bank Teesside A & Sofia was progressed through to application. The A & Sofia application comprised two wind farms, each with a maximum installed capacity of 1.2GW. They will connect to the national grid at the existing Lackenby Substation in Teesside via an export cable to be located within an export cable corridor. The Dogger Bank Teesside A & Sofia schemes both have consent, currently sharing the same Development Consent Order (DCO). The DCO states that construction should commence by August 2022. It is understood that both Teesside A and Sofia will potentially bid into the next Contracts for Difference (CfD) round in Spring 2019, which would commit the developers to construction timelines.	5km	DCO granted for the scheme which contains a deemed marine licence from the MMO	The consented Dogger Bank Teesside A & Sofia scheme is located within the coastal waters of Tees Bay. Although this scheme has received consent, it is yet to be constructed, and therefore the potential exists for in-combination impacts during cable-laying from underwater noise and water quality on prey species of the qualifying features of the Teesmouth and Cleveland pSPA and Ramsar site. As neither of the consents (assuming a marine licence is granted for the NGCT) specify timings for the construction works, it is conservatively assumed that the construction programmes could overlap. However, a review of the ES undertaken for the Dogger Bank scheme has confirmed that the zones of influence of both schemes would not interact, and therefore, there is no pathway for cumulative impacts with the NGCT. **Screened out of the CIA.**

27.5 Cumulative assessment of development in the Tees estuary

27.5.1 Introduction

A detailed CIA was undertaken for the York Potash Harbour Facilities, which considered all relevant plans and projects at the time. The CIA for York Potash Harbour Facilities included the Tees Dock No.1 Quay, the Sirius Minerals MHF at Wilton and the NGCT. The findings from that CIA are therefore directly relevant to this CIA. The key issues identified as part of the York Potash Harbour Facilities CIA are presented below and supplemented with information to take account of other relevant plans and projects which were not considered (as they were not proposed at the time) within the York Potash Harbour Facilities CIA.

27.5.2 Hydrodynamics and sedimentary regimes

Introduction

The NGCT has the potential to result in the following cumulative impacts with the York Potash Harbour Facilities and the ongoing maintenance dredging:

- dispersion of suspended sediment during capital dredging and deposition;
- changes to tidal propagation;
- changes to wave conditions;
- changes to tidal currents; and
- changes to the sediment budget.

The Sirius Minerals MHF at Wilton and the Sirius Minerals Storage Facility at Bran Sands are not considered further in this regard, on the basis that such schemes are located on land and therefore there is no pathway for cumulative impacts on the hydrodynamic and sedimentary regime.

All of the potential cumulative effects identified above were considered within the York Potash Harbour Facilities CIA and, therefore, the findings from that assessment are summarised, where relevant, below. The potential for cumulative impacts to arise between the projects that have been scoped into the CIA, an assessment of the significance of such impacts and recommendation of appropriate mitigation measures (where appropriate) are also presented in the subsections below.

Dispersion of suspended sediment and deposition on the seabed during capital dredging

All projects scoped into the assessment will involve capital dredging. This activity will create a plume of sediment which will disperse throughout the estuary according to the prevailing currents, prior to settling on the sea bed.

During the capital dredging works for the proposed NGCT, other port facilities on the Tees will remain operational. Maintenance dredging is, therefore, expected to continue throughout the capital dredge period. The capital dredge is also expected to influence the maintenance dredging requirements during and immediately after the period of construction. This is because fine material will be released into suspension, some of which will then settle in the various maintained areas.

However, dredging of the lower reaches of the river to remove sands driven into the mouth of the river, represents the main maintenance dredging operation undertaken by PDT on the Tees. The capital dredging also requires the dredging of sands from the lower reaches of the river, which are to be used in the reclamation behind the new quay wall (assuming a closed quay is constructed). When capital dredging of the lower reaches is being undertaken, therefore, this will negate a large proportion of the requirement for maintenance dredging.

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As a consequence, PDT will use this opportunity to undertake maintenance dredging elsewhere, for example, at Hartlepool and the Tees upstream of Tees Dock. Monitoring of accretion at the berths will also be undertaken, particularly the ConocoPhillips berths and the Corus Redcar Ore Terminal berth. These are areas which are close to where the dredging for sands will be taking place for NGCT. If required, PDT will mobilise their own dredger to keep these berths at their required depths. This requirement, however, is unlikely to be significant. Nevertheless, the in-combination effects of the capital and maintenance dredging have been considered through modelling, reported in Section 6 of this report.

The extent of the sediment plume created by capital dredging is heavily dependent on the dredging plant that is adopted, and this is determined by (amongst other factors) the nature of the bed and the dredge volume. The EIAs have made informed assumptions about the most likely dredge plant that would be adopted and, in some cases, assumed that different types of plant would be used for dredging different sediment types as part of the same project. Consequently, for the purposes of this CIA, the maximum potential spatial extent of sediment plume generation and deposition footprint has been identified from the EIA studies undertaken for each project and the CIA assumes that the construction phases of the projects could be implemented at the same time.

A review of all EIA studies for the above projects highlights that the maximum increase in suspended sediment in the water column was predicted to be in close proximity to the dredger, with plume dispersion resulting in a significantly reduced concentration of suspended sediment beyond the source of the plume.

Significant deposition of sediment was also only predicted in close proximity to the dredging (and reclamation for NGCT) over the slack water period. In practice, much of this deposited material will be re-dredged as part of the capital works for each scheme. Beyond the immediate deposition footprint, significant deposition was not predicted for any of the schemes (with deposition in the order of a few millimetres only). Furthermore, as the deposited material will be unconsolidated, it is expected to disperse as tidal currents increase with no long-term accumulation on the seabed at the initial point of deposition. The suspended sediment and sediment deposition plots for each of the schemes referred to above are presented in Figures 27.1 to 27.3.

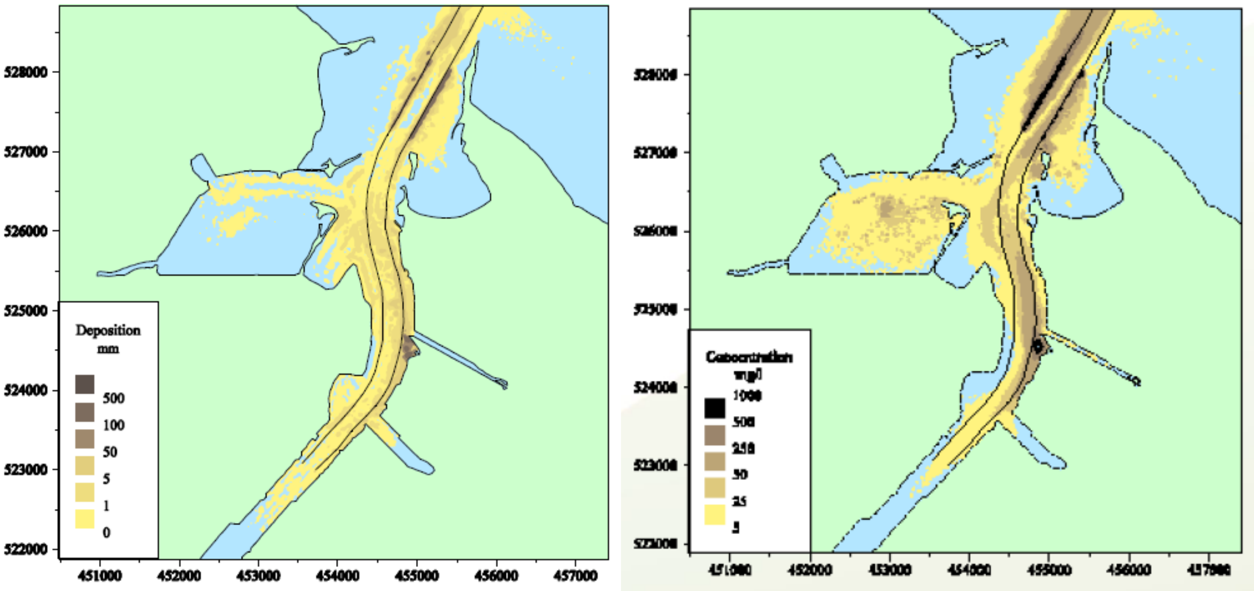

Figure 27.1 Predicted increase in suspended sediment concentration (left) and deposition on the seabed (right) as a result of the NGCT

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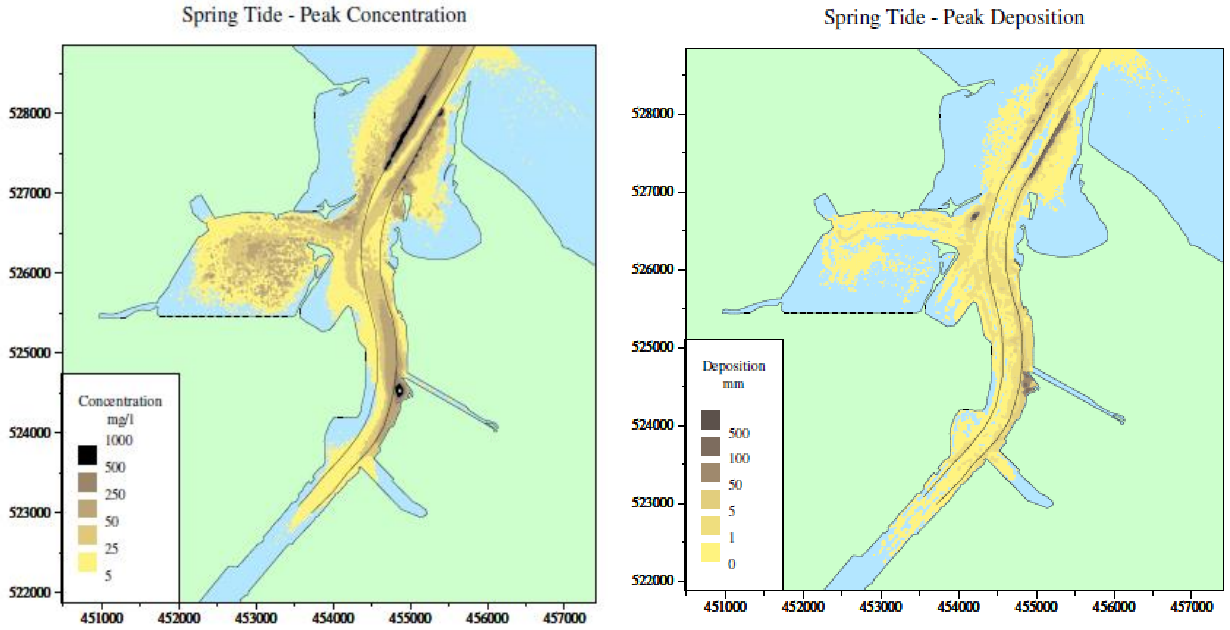

Figure 27.2 Predicted peak concentration and peak deposition for combined NGCT capital and maintenance dredging in the Tees estuary, spring tide, low flow conditions

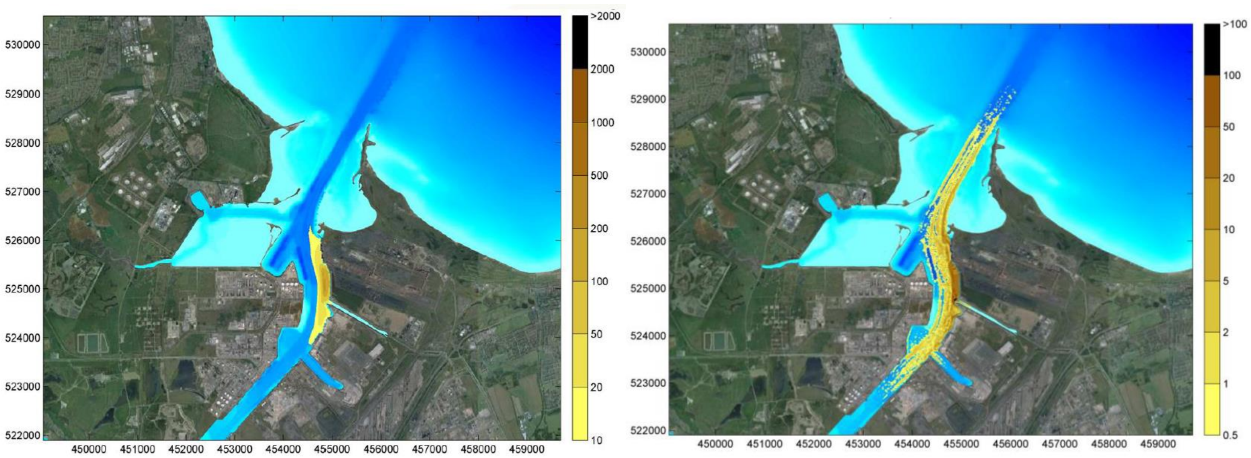

Figure 27.3 Predicted increase in suspended sediment concentration (left) and deposition on the seabed (right) as a result of the York Potash Harbour Facilities

It should be noted that the potential for cumulative effects only arises should the dredging for the NGCT scheme and York Potash Harbour Facilities schemes coincide. Under such circumstances, the effect would be a greater increase in SSC than predicted for the NGCT alone, but with the same predicted spatial extent of the plume for the NGCT scheme. The effect would be additive rather than cumulative (i.e. the predicted impacts of each project would not interact to result in an impact that is of greater or lesser magnitude than the sum of the impacts in isolation).

In the main Tees Channel, the addition of maintenance dredging activity in the Seaton Channel turning circle during the capital dredging for NGCT is not predicted to change either the peak concentration or deposition away from the immediate area of the maintenance dredging. The overall footprint of the concentration and deposition on Seal Sands is very similar to that for the capital dredge alone. However, the area of peak concentration greater than 50ppm is increased by the inclusion of the maintenance dredging.

At the sensitive receivers, whilst the presence of the sediment released by the maintenance dredging is discernible in the time series of concentration, the results are not significantly different (i.e. no extended period of concentration above 50ppm). A number of peaks in concentration are shown at Seal Sands but these disappear very shortly after they occur. The time series of deposition shows an increase compared to the capital dredging alone, but the resultant increases in deposition remain less than 0.1mm over the simulated period.

The predicted footprints of sediment deposition for the NGCT and the York Potash Harbour facilities are similar, although the effect of the NGCT capital dredge is more extensive and extends into Seaton Channel and onto Seal Sands. The only project scoped into the CIA with any potential to effect intertidal areas due to sediment deposition is the NGCT project (alone); deposition due to the NGCT project is predicted to be of very low magnitude. No intertidal sediment deposition is predicted during capital dredging for the York Potash Harbour facilities and, therefore, there is no potential for an in-combination effect to arise.

Mitigation measures to limit the suspension of sediment and subsequent deposition of sediment during capital dredging have been proposed for the York Potash Harbour facilities and the NGCT. For the former project, mitigation comprises the use of specialist dredging equipment (i.e. an enclosed grab loading into a sealed barge) for dredging of unconsolidated material to minimise resuspension in the water column. This requirement is specified because of the elevated concentration of contaminants within the dredged sediment, and this measure would limit sediment release into the water column as far as practicable. The implications of the potential cumulative effects identified above on other environmental parameters (e.g. sediment and water quality, marine ecology, ornithology, fish and fisheries) is discussed below.

Potential effects on tidal propagation

The NGCT is predicted to have a very small effect on water levels. Tidal range in the Tees estuary is predicted to be increased by less than 4mm, with the tide arriving up to 2 minutes earlier. The EIA studies undertaken for the York Potash Harbour Facilities predicted that there will be no impact on tidal propagation or water levels due to the limited area of proposed dredging for this project. Hence, no cumulative impacts are predicted to arise.

Predicted effects on wave conditions

Predictive modelling of the effect on wave conditions has been undertaken for the NGCT and the York Potash Harbour Facilities.

Wave modelling for the NGCT (presented in Section 6) has considered the wind and swell components separately. It is predicted that wind waves within the estuary will be affected by the reflective properties of the terminal but, it is also predicted that such waves will be unaffected by the increased depth of the channel. Swell waves (long period waves from offshore) do not penetrate far into the estuary and, therefore, are not predicted to be affected by the proposed NGCT. Swell waves, however, will be affected by the increased depth of the channel in the lower estuary that will arise from capital dredging for the NGCT.

The EIA studies undertaken for the York Potash Harbour Facilities showed that the harbour facility itself does not have the potential to affect swell waves; therefore there is no potential for cumulative effect on swell waves due to the NGCT and this aspect is not assessed further within the CIA.

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Predicted effects on tidal currents

The modelling studies undertaken for the NGCT predict that current speed changes, of low magnitude, will occur in the vicinity of the development and at the mouth of the estuary. A decrease in current speeds of up to 0.10m/s is predicted in the vicinity of the terminal, with increases of a similar order of magnitude closer to the shores of the estuary. This area (adjacent to the proposed reclamation) is predicted to experience the greatest effect on flows. Further downstream at the mouth of the estuary, very little effect on tidal current speeds is predicted (decreases in current speeds of the order of 0.05m/s).

The York Potash Harbour Facilities EIA predicted that currents will be reduced within the deepened areas. Some current speed increases are predicted on the shoreline adjacent to the works, suggesting that the dredging is predicted to draw some of the flow to the south side of the estuary, although such effects are shown to be relatively localised to the proposed works. Based on the above, no cumulative impact is predicted to occur (as a result of the York Potash Harbour Facilities with NGCT).

Changes to estuarine sediment budget

The NGCT is predicted to have some effect on estuary morphology; as noted in Section 6, the effect of construction on tidal propagation will be minor, with no change in elevation of either high or low water downstream of the site of the proposed scheme. A minor increase in the level of low water of the order of 2mm (at low water on spring tides) is predicted at the site of the NGCT. It is estimated that the effect of this change will be to convert approximately 30 to 40m^2 of intertidal habitat on the North Tees mudflat to very shallow subtidal habitat under these tidal conditions.

Section 6 of this report describes the potential integrated effect of the scheme on physical processes which have the potential to combine to result in an effect on estuarine morphology. For the deepened approach channel, reduced through-depth flows are predicted which, combined with a strengthened near-bed landward flow, are expected to result in the increased import of fine material to the Tees estuary from offshore; with the potential to increase the maintenance dredging requirements by approximately 10%. No increase in sandy infill is predicted. A small morphological effect is predicted at Seal Sands, with an increase in the supply of fine material to Seal Sands via Seaton Channel. No changes to tidal flow are predicted in this area. No significant effects are predicted at North Gare and Bran Sands as a result of the NGCT.

The York Potash Harbour Facilities will not make any change to the outer sections of the approach channel. It can be concluded that there will be no effect on the supply of material into the Tees estuary from offshore as a result of this scheme. In addition, no changes to sediment transport in the predominantly sandy areas around Teesmouth are anticipated from either the York Potash Harbour facilities, and so no effect on sand transport is predicted.

The York Potash Harbour Facilities are predicted to result in a localised redistribution of sediment deposition in response to predicted changes in current speeds due to the works. It is predicted that this very small change in the overall fine sediment regime will not alter the present frequency of, or methodology used for, maintenance dredging, and no effect on sediment supply to intertidal areas throughout the Tees estuary will occur. Consequently, no effect on the morphology of intertidal areas was predicted due to the Harbour Facilities.

The ongoing maintenance dredging programme in the Tees estuary represents a potential supply of fine material to Seal Sands. However, the latest annual update to the Maintenance Dredging Baseline Document (Royal HaskoningDHV, 2018) concludes that no means have been identified by which the current maintenance dredging regime could adversely affect the overall estuary morphology and the ongoing morphological processes at work. Based on the above, it is concluded that there is no potential for cumulative impacts to arise to the estuarine sediment budget as a result of the projects screened into the assessment.

27.5.3 Marine water and sediment quality

Potential for cumulative increase in suspended sediment during capital and maintenance dredging
A cumulative effect on water quality as a result of dredging induced sediment plume generation will only occur should the dredging programme for the NGCT coincide with that of the York Potash Harbour Facilities. In addition, the predictions made for each project (shown in Figures 27.2 to 27.4) represent sediment plume dispersion under specific tidal conditions (to enable a realistic worse case to be identified and assessed). It is unlikely, therefore, that the timing of the projects and their respective programmes of capital dredging will coincide to result in a scenario where sediment plumes combine at peak concentration (as predicted by the EIA studies for each project) at any location.

The sediment plume predicted due to the NGCT encompasses, and extends beyond, the area of the plume predicted for the York Potash Harbour Facilities. Any impact, therefore, will be additive rather than cumulative (i.e. the predicted impacts of each project will not interact to result in an impact that is of greater or lesser magnitude than the sum of the impacts in isolation).

With regard to the potential for cumulative effects associated with the re-mobilisation of contaminated sediment, this is only applicable to the York Potash Harbour Facilities. Mobilisation of contaminated sediment has not been identified as a risk for the NGCT scheme (Section 7). The sediment overlying the geological material within the dredge footprint for the consented York Potash Harbour Facilities was found to be contaminated, and therefore the DCO (and deemed marine licence) ensures that this material is removed using an enclosed grab loading into a sealed barge (with the contaminated material prohibited from being disposed offshore).

It is therefore concluded that if the above dredging projects were to coincide, there would be an increase in peak suspended sediment above those normally experienced in the estuary (this effect would be additive). The CIA for the consented York Potash Harbour Facilities concluded that this impact would be of minor adverse significance, going on to state that this impact is anticipated to be acceptable given the temporary nature of capital dredging, in addition to the intermittent nature of the peaks related to both tidal influence and location of the dredger. Mitigation incorporated into each project (and enforced through the permissions granted by the MMO and Secretary of State respectively) will avoid a water quality impact associated with dredging and disposal of contaminated material.

The latest Tees estuary Maintenance Dredging Baseline Document (Royal HaskoningDHV, 2019) concludes that, at water body level, maintenance dredging at current levels has no significant impact on water quality within the estuary. The significance of the potential cumulative impact between maintenance dredging and proposed capital dredging works was investigated as part of the NGCT studies. These concluded that the combined effect of maintenance dredging being undertaken during the capital works will not be significantly different from those predicted as a consequence of the capital dredging alone, and this conclusion applies for the potential cumulative impact with the York Potash Harbour Facilities.

Mitigation and residual impact
Measures to minimise the risk of a reduction in water quality associated with the re-mobilisation of contaminants known to be present in sediments from the York Potash Harbour Facilities dredge footprint are presented above (i.e. use of an enclosed grab).

In terms of uncontaminated sediment dispersion, a significant cumulative impact is not anticipated due to dredging required for York Potash Harbour Facilities or ongoing maintenance dredging, with that required for NGCT. Consequently, it is concluded that there is no requirement for non-standard mitigation measures. It is concluded that the residual impact would be of minor adverse significance.

Potential for cumulative water quality impact due to maintenance dredging
It is necessary to include maintenance dredging in the CIA to assess whether the potential exists for the NGCT to affect the nature of the ongoing maintenance dredge programme. The assessment presented in Section 6 concludes that there will be requirement to change the current maintenance dredging strategy in the Tees as a result of the NGCT scheme. The cumulative impact on water quality due to maintenance dredging for the NGCT scheme with the wider maintenance dredging programme in the Tees estuary, therefore, is predicted to be of negligible significance.

27.5.4 Marine ecology

Loss of intertidal habitat
As noted in Section 9, the proposed NGCT is predicted to result in the loss of 1.19ha of intertidal habitat within the footprint of the proposed reclamation (on the assumption that the closed quay structure is progressed). The significance of this impact is reported to be minor adverse due to the low value nature of the intertidal. To offset the predicted loss of intertidal, PDT proposes to work in partnership with the Tees Rivers Trust to deliver the habitat improvement measures along a 265m stretch of intertidal area downstream of Newport Bridge (an area of 0.54ha). The proposed measures comprise recharging the intertidal area with maintenance dredged silt, thereby enhancing the ecological value of the intertidal area from its current degraded condition.

The consented York Potash Harbour Facilities scheme would also result in the direct loss of intertidal due to reclamation (for the solid quay) and revetment installation (for the open quay). The maximum area of intertidal loss would be associated with the solid quay and was calculated as 3.6ha. In light of the quality of intertidal habitat present with the footprint of the York Potash Harbour facility scheme, the receptor was considered to be of low value; but the magnitude of the effect would be high. It was estimated that of the maximum area that would be lost beneath the footprint of the port terminal (3.6ha), approximately 1.85ha would be mud, with the remainder consisting of hard substrata. All of the area that would be lost represents available ‘habitat’ for waterbirds and fish but, taken as a whole, it is of poor quality. Hence it was predicted that the impact associated with the loss would be of minor adverse significance.

Based on the above, the proposed NGCT and York Potash Harbour Facilities schemes would result in the total loss of 3.7ha of intertidal. However, given the low ecological value of the intertidal within the footprint of the proposed NGCT and the York Potash Harbour Facilities, a cumulative impact of minor adverse is predicted.

In order to offset the loss of intertidal due to the consented York Potash Harbour facilities scheme, YPL (now Sirius Minerals) progressed discussions with the Tees Valley Wildlife Trust regarding making a contribution to habitat creation proposals that the Wildlife Trust are considering at Portrack Marsh. Specifically, the habitat creation proposals involve controlled inundation of land to create habitat for eel and feeding waders and softening and naturalising banks in the Tees to provide feeding habitat for wading birds. It is estimated that these measures would improve and create up to 3ha of intertidal habitat on land that is currently of lower ecological value. Taken together, the habitat enhancement proposals for Bran Sands lagoon (which form part of the consented York Potash Harbour facilities scheme) and the proposed habitat improvement measures at Portrack Marsh and in the Tees (to which YPL would contribute) would deliver approximately 8.7ha of new or improved habitat. When considered in the context of the loss of up to 3.6ha of low-quality habitat, and only 1.85ha of mud from York Potash Harbour Facilities, this represents an overall gain in both the area and quality of habitat that would be available. As a whole, the measures would make a significant and positive contribution to the functioning of the estuarine system and provide a biodiversity gain.

Smothering of benthic invertebrate communities due to deposition of sediment dispersed during capital dredging

The predicted footprints of sediment deposition for the NGCT and the York Potash Harbour Facilities are largely similar; however the effect of the NGCT dredge is larger, with deposition predicted to extend into Seaton Channel and onto Seal Sands. As the deposition footprint for the York Potash Harbour Facilities project is predicted to be within that of the NGCT deposition footprint, the direct effect of NGCT will have the overriding impact on the benthic community. However, the predicted deposition as a result of the NGCT and the York Potash Harbour Facilities is anticipated as being in the order of a few millimetres. This deposition is likely to be temporary due to the unconsolidated nature of the sediment, and the cumulative impact is predicted to be negligible.

Maintenance dredging is targeted at areas that require dredging to maintain navigable depths and, although it would result in some losses of material into the water column, deposition onto the seabed due to maintenance is predicted to be insignificant. Given this, a cumulative impact is not expected.

Effects on benthic invertebrate communities due to effects on the morphology of intertidal and subtidal habitats

The proposed NGCT is predicted to have an effect on sediment supply into the estuary, with a predicted 10% increase in supply of material from offshore.

The studies for the York Potash Harbour Facilities concluded that there will not be a change in the supply of fine sediment to the Tees due to the York Potash Harbour Facilities. The scheme has no potential to affect the sediment budget of the estuary and, therefore, there will be no impact on morphology of intertidal areas.

It is concluded that there will be no cumulative effect on the maintenance dredging commitment and, therefore, no cumulative impact on the supply of material to intertidal and subtidal areas or effect on morphology of estuarine habitats.

Disturbance to marine mammals and fish due to underwater noise generated during construction works

The potential exists for a cumulative underwater noise impact to arise from the NGCT and York Potash Harbour Facilities schemes, should the construction phases of these projects (particularly any piling works) overlap.

Given the close proximity of the NGCT site to the York Potash Harbour facilities, it is considered likely that the spatial extent of its underwater noise impact will not be dissimilar to that predicted for the York Potash Harbour Facilities. If the piling associated with both schemes overlaps, there is likely to be increased underwater noise levels and potentially an overall longer duration of impact compared to the impacts of each scheme when considered alone. Without mitigation, the cumulative impact could be of major adverse significance for marine mammals and fish.

Mitigation measures and residual impact

The JNCC's guidelines 'Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise' (JNCC, 2010) should be adhered to during pile driving. This includes checking for marine mammals during a pre-piling search prior to piling operations commencing, the establishment of a mitigation zone (i.e. an area within which a marine mammal could be exposed to sound levels which could cause damage) and the use of soft start techniques to allow any marine mammals time to leave the area of greatest disturbance.

If the NGCT is undertaken at the same time as the York Potash Harbour Facilities, it is proposed that the mitigation measures identified for both individual projects would reduce the significance of the potential cumulative impact.

With the implementation of the above measures, a minor adverse residual cumulative impact is predicted.

27.5.5 Waterbird populations

Potential effect on waterbird feeding resource due to increased suspended sediment during capital dredging

This potential cumulative impact is linked to that described in Section 27.5.6 (Effects on fish populations due to a sediment plume during capital dredging), given that the waterbirds potentially affected would be feeding on small fish. It is concluded in Section 27.5.6 that a cumulative behavioural effect on fish would occur, with movement away from the zone of increased SSC. However, the effect of a combined plume (in the zone of interaction) is not likely to result in a different behavioural response in fish and, therefore, a cumulative impact of negligible significance is predicted on feeding waterbirds.

Morphological effect on habitats used by feeding and roosting waterbirds

Section 27.5.2 concludes that there will be no potential for a cumulative effect on the supply of material to intertidal or subtidal areas given that there will be no effect on the maintenance dredging requirement due to the NGCT and York Potash Harbour Facilities. Based on this conclusion, there is no potential for a cumulative impact on the morphology of habitats used by waterbirds in the Tees estuary.

Noise disturbance during construction and operation

A cumulative noise assessment was undertaken in support of the York Potash Harbour Facilities project. This considered the noise that will be generated as a result of the combined construction and operation of the NGCT and York Potash Harbour Facilities. It was concluded that the cumulative construction and operational noise impact will be of negligible significance at all locations.

The Sirius Minerals Storage Facility at Bran Sands is to be located to the immediate north of Bran Sands lagoon; this represents an additional source of disturbance to waterbirds, should the construction phases of each development overlap. The NGCT scheme was not included in the CIA for the consented Sirius Minerals Storage Facility at Bran Sands, however, it is considered that a pathway for cumulative impacts does exist given the proximity of the schemes to each other and sensitive ornithological receptors.

Airborne noise modelling was undertaken as part of the EIA studies for both projects. Based on the modelling predictions for the Storage Facility at Bran Sands, as a worst case some birds may be temporarily disturbed and take flight from the lagoon during construction, but no abandonment of the area is predicted. The most likely response, based on the predicted noise levels in comparison with the response categories defined by Wright *et al* (2010) is non-flight behavioural response for waterbirds within the northern half of the lagoon, and it is likely these birds will move away from the noise source, resulting in some redistribution within the lagoon. No observable behavioural response is predicted for waterbirds within the southern half of the lagoon. No effect is predicted on waterbirds within Dabholm Gut or on the intertidal area adjacent to the scheme (Royal HaskoningDHV, 2017). An impact of minor adverse significant was predicted. No impact to waterbirds was predicted during the operational phase, and therefore, there is no mechanism for cumulative operational phase impacts.

As reported in Section 11, an impact of minor adverse significance has been predicted to waterbirds and seabirds due to construction phase noise disturbance from the NGCT scheme. Should the construction phase for this scheme overlap with that of the consented Storage Facility at Bran Sands, it is predicted that there could be a cumulative impact of moderate adverse significance to waterbirds and seabirds in Bran Sands lagoon.

Mitigation measures and residual impact

In order to mitigate the construction phase noise disturbance impact for both the NGCT and the Storage Facility at Bran Sands, the use of localised screening around noisy equipment is proposed. Assuming that both schemes are constructed at the same time, the use of localised screening for both schemes is predicted to significantly reduce noise levels to birds in Bran Sands lagoon (a residual impact of negligible significance at worst is predicted for both schemes). The residual cumulative impact is considered to be of negligible significance.

27.5.6 Fish and shellfish

Effects on fish populations due to a sediment plume during capital dredging

There is potential for the sediment plumes predicted to be generated by the dredging required for NGCT, York Potash Harbour Facilities and maintenance dredging to interact (assuming the dredging for each is undertaken at the same time), resulting in an additive effect on SSC. An increase in SSC is predicted to result in a behavioural effect on fish, with movement away from the source of disturbance likely. The capital dredging associated with these projects will result in an effect over a larger spatial extent than predicted for the NGCT alone; however, this effect will be additive as opposed to cumulative.

Significantly, however, the effect of a combined plume (in the zone of interaction) is not likely to result in a different behavioural response in fish compared with the effect of the projects in isolation and, therefore, a cumulative impact of negligible significance is predicted.

27.5.7 Commercial navigation

Potential effect on commercial navigation during construction

During the construction phase of the NGCT, there is potential for a cumulative navigation impact to arise should the timing of the construction phases of the projects included in the CIA coincide. Such an impact could include potential delays to shipping, increased collision risk, obscuring navigation aids and the presence / interference of activities on other operators.

The NGCT is in close proximity to the footprints of the York Potash Harbour Facilities scheme. The NGCT dredge footprint will pass adjacent to the site of the York Potash Harbour Facilities.

There is a range of mitigation measures that are typically adopted during construction works to manage the risks to navigation. These measures comprise the following:

- one-way control of vessels and potentially re-timing of commercial vessel movements – this will be implemented via the VTS;
- deployment of additional buoys (as required) to mark construction areas and to warn other shipping of the works that are taking place;
- red lights will mark the location of the construction works (e.g. at either end of the construction site) as an aid to navigation;
- Trinity House will be consulted prior to the implementation of changes to buoyage and lighting that may be required during construction; and,
- a Notice to Mariners will be issued which will set out all of the above measures.

It is anticipated that the implementation of these measures will effectively manage the risks to commercial navigation, should the construction phases of the relevant projects coincide. It is likely that there will be some effect on commercial navigation due to the need to adjust movements to accommodate any ongoing works, but the potential cumulative impact is predicted to be of negligible significance.

Potential implications for vessel traffic management associated with increased commercial activity during operation

It is anticipated that the NGCT will result in an increase in traffic of approximately 100 movements per month in the estuary. As detailed in Section 13, this impact is considered to be of negligible significance.

The ESs produced for the York Potash Harbour Facilities reported that there will be an increase in the annual shipping traffic of 191 vessels.

During the York Potash Harbour Facilities CIA (which included a cumulative impact assessment on commercial navigation that took account of each successive project), the Harbour Master was consulted and had no concerns with regard to shipping and navigation. The cumulative assessment undertaken for the York Potash Harbour Facilities, considered the impacts of all of these schemes, and concluded that a cumulative impact of negligible significance will arise. All vessel traffic in the Tees estuary and Tees Bay is controlled by the VTS and this will, therefore, be equally applicable to all vessel traffic generated as a consequence of the NGCT. No further mitigation measures are considered to be necessary.

27.5.8 Disposal of dredged material

The NGCT scheme involves the requirement to dispose of up to 3,830,000m^3 of dredged material to be generated during the construction phase of the NGCT offshore, should no beneficial re-use options be forthcoming prior to the dredge taking place. Section 26 concludes that the disposal of dredged material will have no impact on fisheries, a negligible impact on marine ecology and no impact on navigation; hence, no significant cumulative effects are predicted.

28 WATER FRAMEWORK DIRECTIVE COMPLIANCE ASSESSMENT

The WFD compliance assessment is included as Appendix 19. To avoid repetition, the assessment has not been presented in full within this section, however, the following text provides a summary of the assessment.

The assessment has considered all elements of the proposed scheme (including landside infrastructure). The proposed offshore disposal was screened out of the assessment, on the basis that the disposal sites are located outside of the coastal water body and the effects of disposal are predicted to remain within the vicinity of the disposal sites (i.e. impacts from the disposal activity are not predicted to directly or indirectly impact the coastal water bodies). In addition, as the proposed scheme is not predicted to result in a change to the maintenance dredging strategy for the Tees estuary, maintenance dredging during the operational phase was also screened out of the assessment.

The assessment considered impacts to the Tees transitional water body (GB510302509900), the Tees coastal water body (GB650301500005) and the Tees Mercia Mudstone & Redcar Mudstone groundwater body (GB40302G701300).

Comparison of the activities required for the NGCT against the WFD scoping criteria identified several risks to WFD compliance receptors, namely:

- Hydromorphological impacts from capital dredging and the construction of a new quay.
- Effects on biological habitats from capital dredging (removal of habitat / sedimentation).
- Effects on fish due to the creation of a sediment plume from dredging.
- Effects on water quality due to the creation of a sediment plume from dredging.
- Effects of capital dredging on protected areas.
- Effects on fish due to construction and presence of the terminal (noise).
- Effects on the chemical status of the groundwater body due to construction and presence of the container terminal and landside elements (i.e. piling).

Environmental assessment has been undertaken to consider the potential risks in more detail as part of the WFD compliance assessment presented in Appendix 19. The results of the assessment indicate that, for the majority of risks identified, effects are not anticipated with regard to WFD compliance. However, the risk of disturbance to fish due to creation of a sediment plume was a particular concern and therefore several mitigation measures are recommended to reduce this risk as far as possible, namely:

- Undertaking dredging operations using a TSHD in long strips along the axis of the estuary rather than dredging along the width of the river. This is to reduce both the extent and impact of the plume.
- Locating the CSD on either the western or eastern side of the estuary.

With the implementation of the above measures, deterioration in the ecological status of the Tees transitional water body and the Tees coastal water body is not anticipated.

A risk to the Tees Mercia Mudstone & Redcar Mudstone groundwater body was also identified, particularly as a result of piling required for the land side elements of the proposed scheme. As noted in Section 1, the landside elements of the proposed scheme have commenced. As noted in Section 8, there are a number of conditions attached to the planning permission (reference R/2006/0433/00) (relating to land quality), which had to be discharged prior to commencement of the landside works. Section 8 notes that the future development of the wider NGCT (beyond the commencement works) will be subject to additional site investigation, and therefore there are controls in place to manage any risks associated with soil quality and geology (and consequently controlled waters, including the groundwater body). With these mitigation measures in place, the proposed NGCT is deemed to be complaint with the WFD.

29 HABITATS REGULATIONS ASSESSMENT

29.1 Introduction

This section of the EIA Report draws together information regarding the potential for the proposed scheme to affect the Teesmouth and Cleveland Coast pSPA and Ramsar site and presents an assessment of the potential effects with respect to the interest features, and the supporting habitats, of these sites.

This section should be read in parallel with other sections of the report which provide further detail. Relevant sections are as follows: Section 7 (marine sediment and water quality); Section 9 (marine ecology); Section 11 (ornithology) and Section 12 (fish and shellfish). The assessment process is explained below, but in summary the following is presented in this section:

- An overview of the HRA process (Section 29.2);
- Screening the predicted effects of the proposed scheme to determine LSE in respect of the designated interest features of the European and Ramsar sites, both alone and in-combination (Section 29.3);
- Consideration of other plans and projects to include in the in-combination assessment (Section 29.4);
- Provision of information to inform the AA (Section 29.5); and,
- A summary and conclusion (Section 29.5).

29.2 Overview of the HRA process

The HRA process is a requirement of Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (the Habitats Directive). Together with the Birds Directive (2009/147/EC), the Habitats Directive establishes a network of European important sites designated for their ecological status, referred to as the Natura 2000 network. SACs and Sites of Community Importance (SCIs) are designated under the Habitats Directive and promote the protection of flora, fauna and habitats. SPAs are designated under the Birds Directive in order to protect rare, vulnerable and migratory birds.

The Habitats Directive is transposed into UK law by means of The Conservation of Habitats and Species Regulations 2017 (the 'Habitats Regulations'). The Habitats Regulations incorporate all SPAs into the definition of European sites and, consequently, the protections afforded to European sites under the Habitats Directive also apply to SPAs designated under the Birds Directive. In addition, SPAs, possible PSAs (pSPA), possible SACs (pSACs) and Ramsar sites are also to be considered (DCLG, 2012).

In accordance with Regulation 63 of the Habitats Regulations, HRA is required for any plan or project, not connected with the management of a European site, which is likely to have an LSE on the site either alone or in-combination with other plans or projects.

Typically, a staged process to assessment under the Habitats Regulations is undertaken, as follows:

- **Screening/LSE assessment (Stage 1):** The process to identify the likely impacts of a project upon a European site, either alone or in combination with other plans and projects and consider whether the impacts are likely to be significant.
- **Appropriate Assessment (Stage 2):** A decision (by the competent authority) with regard to the effect on the integrity of the European site, either alone or in combination with other plans and projects. Where there are adverse impacts, an assessment of mitigation options is carried out to determine adverse effect on the integrity of the site. If these mitigation options cannot avoid adverse

effects on site integrity, then development consent can only be given if subsequent tests (see Stages 3 and 4 below) can be satisfied.

- **Consideration of Alternative Solutions (Stage 3):** Examining alternative ways of achieving the objectives of the project to establish whether there are solutions that would avoid an effect - or have a lesser effect - on European sites.
- **Imperative Reasons of Overriding Public Interest (IROPI) (Stage 4):** If the above tests cannot be satisfied, it is necessary to demonstrate that the project is required for IROPI. If this test is met, then the project can only proceed if sufficient compensatory measures can be identified and implemented to maintain the overall coherence of the Natura 2000 network.

All four stages of the process are referred to collectively as the HRA, to clearly distinguish the whole process from the stage within it referred to as the 'Appropriate Assessment'.

In respect of Stage 1, a recent ruling (April 2018) by the Court of Justice of the European Union (CJEU) referred to as *People Over Wind and Sweetman v Coillte Teoranta* (C-323/17) has provided a judgement that *"…it is not appropriate, at the screening stage, to take account of the measures intended to avoid or reduce the harmful effects of the plan or project on that site"*. As such, no such mitigation measures have been taken into account when undertaking the LSE screening exercise.

In respect of Stage 2, the integrity of a European site is defined as: "*the coherence of the site's ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and/or populations of species for which the site has been designated*" (EC, 2001). An adverse effect on integrity, therefore, is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature(s) as it did at the time of designation.

Natural England's Habitats Regulations Guidance Note 1 'The Appropriate Assessment (Regulation 48)' (English Nature, 1997) described how an Appropriate Assessment should be undertaken. This guidance bases the assessment on a series of nine steps that the competent authority should follow in undertaking an Appropriate Assessment. These steps, including consultation, data collection, impact identification and assessment, recommendation of project modification and/or restriction and reporting, are outlined in **Table 29.1** below.

Table 29.1 Recommended key steps in the preparation of information for Appropriate Assessment

Step	Description of requirements
1	Must consult with Natural England
2	May consult with other organisations and the general public
3	Clearly define the site's conservation objectives
4	Require the applicant to provide such information as may reasonably be required to undertake the assessment
5	Identify the effects of the proposal on habitats and species of international importance and how those effects are likely to affect the site's conservation objectives
6	Decide whether the plan or project, as proposed, would adversely affect the integrity of the site in light of the site's conservation objectives
7	Consider the manner in which the plan or project is proposed to be carried out, whether it could be modified, or whether conditions or restrictions could be imposed, so as to avoid adverse effects on the integrity of the site
8	Conclude whether the proposal, as modified by conditions or restrictions, would adversely affect the integrity of the site
9	Record the assessment and notify Natural England of the conclusions

It is Natural England's role to advise the competent authority on the potential significance of effects on European sites. This section of the EIA Report is intended to present all of the information necessary to assist Natural England (and the competent authority) in reaching a conclusion.

29.2.1 Consultation and responses received

Table 29.2 summarises the comments provided by the MMO in its Scoping Opinion (that the MMO considered were applicable to the marine licensing process). Also presented are the comments made by MMO, Environment Agency / Natural England during pre-application discussions that are of relevance to the HRA.

Table 29.2 Summary of consultation responses regarding HRA

Consultee	Comment	Response / signpost to where the comment has been addressed
MMO (HRO extension Scoping Opinion)	An HRA will need to be submitted and reviewed prior to any works being consented.	This section presents the findings of the HRA.
MMO (pre-application meeting)	Natural England advised that the applicant should be mindful of the MMO's position on habitat loss in response to case law, notably Peter Sweetman and Others v An Bord Pleanála (C-258/11).	During the meeting with Natural England, it was discussed that this case law applied to SAC habitat and the proposed NGCT scheme lies within a pSPA whose qualifying features are waterbird populations rather than habitat. It was acknowledged that the condition and ecological value of the habitats within the proposed scheme footprint would need to be assessed as part of the EIA for their potential to support waterbirds. The outcomes of the ecological assessments and ornithological assessments presented elsewhere in this EIA Report have informed this HRA.

29.2.2 Implications of the scheme in-combination with other plans and projects

When assessing the implications of a plan or project in light of the conservation objectives of the European site in question (i.e. assessing the potential for LSE and ascertaining the potential for effect on site integrity), it is necessary to consider the potential for in-combination effects, as well as effects due to the project in isolation. Natural England's Habitats Regulations Guidance Note 4 (English Nature, 2001) provides guidance on in-combination effects and, at paragraph 2.3, states that other plans or projects should include:

- approved but as yet uncompleted plans or projects;
- permitted on-going activities such as discharge consents or abstraction licenses; and,
- plans and projects for which an application has been made and which are currently under consideration but not yet approved by competent authorities.

It is also noted that in some circumstances it may be appropriate to include plans and projects not yet submitted to a competent authority for consideration but for which sufficient detail exists on which to make judgements on their effect on the European site.

In undertaking an in-combination assessment, it is important to consider the potential for each plan or project to influence the site. In order for an in-combination effect to arise, the nature of two effects does not necessarily have to be the same. The in-combination effects assessment, therefore, focusses on the overall implications for the site's conservation objectives, regardless of the type of effect.

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29.3 Screening for likely significant effect

29.3.1 Introduction

The screening process comprises an assessment of the capacity for the likely effects of the proposed scheme to influence the qualifying interest features of the relevant European and Ramsar sites, such that an LSE could arise. There is no specific definition of what constitutes LSE; however, guidance produced by Natural England (English Nature, 1999) provides information on the determination process and the criteria that can be applied in reaching a decision.

The guidance states that:

> "*likely significant effect is, in this context, any effect that may reasonably be predicted as a consequence of a plan or project that may affect the conservation objectives of the features for which the site was designated, but excluding trivial or inconsequential effects. Proposals having no, or de minimis, effects can be progressed without further consideration under the Habitats Regulations (i.e. there is no requirement to undertake appropriate assessment), although reasons for reaching this decision must be justified and recorded*".

The following criteria are cited as potential types of effects that are likely to be significant:

- causing change to the coherence of the site or the Natura 2000 series (e.g. presenting a barrier between isolated fragments, or reducing the ability of the site to act as a source of new colonisers):
- causing reduction in the area of habitat or of the site;
- causing direct or indirect change to the physical quality of the environment (including the hydrology) or habitat within the site;
- causing on-going disturbance to species or habitats for which the site is notified;
- altering community structure (species composition);
- causing direct or indirect damage to the size, characteristics or reproductive ability of populations on the site;
- altering the vulnerability of populations to other impacts;
- causing a reduction in the resilience of the feature against external change (for example its ability to respond to extremes of environmental conditions); and,
- affecting restoration of a feature where this is a conservation objective.

The types of effects associated with a proposed scheme, particularly their spatial extent and duration, are of particular importance in identifying the European and Ramsar sites and associated designated interest features that may be influenced.

29.3.2 Screening for likely significant effect (alone)

The locations of European and Ramsar sites which have potential to be affected by the proposed scheme (based on the zones of influence determined by the information presented in Section 11) are presented in Figure 11.2. Table 29.3 sets out the results of the screening for LSE associated with the proposed scheme in isolation. The potential environmental impacts have been assessed for each interest feature of the designated sites with the potential to be impacted by the proposed scheme. The offshore disposal site in Tees Bay (namely Tees Bay C) is out with the boundary of European/Ramsar sites and, therefore, the effects of disposal are not considered within this HRA.

Table 29.3 Screening of European and Ramsar sites for likely significant effect

Site (distance and direction from proposed scheme)	Interest features	Supporting features	Potential pathway for likely significant effect during construction	Potential pathway for likely significant effect during operation	Screened in/out of Appropriate Assessment
Teesmouth and Cleveland Coast pSPA and Ramsar site[4] (0km)	The site qualifies under Article 4 of the Birds Directive for the following Annex I species: • During the breeding season: Little tern, pied avocet, ruff, common tern and Sandwich tern (non-breeding) The site regularly supports two regularly occurring migratory species not listed in Annex I: • Red knot and common redshank The site also qualifies under Article 4.2 of the Birds Directive as it is used regularly by over 20,000 waterbirds, including all Annex 1 species outlined above	• Sand and shingle • Intertidal sand and mudflats • Shallow coastal waters • Rocky shores • Terrestrial wet grassland • Saltmarsh • Deep and shallow pools	• Loss of subtidal and intertidal waterbird feeding resource due to reclamation. • Airborne noise disturbance to waterbirds due to construction. • Underwater noise disturbance to waterbird prey resource. • Water quality reductions from dredging, reclamation and piling impacting on waterbird prey resource. • The little tern colony is located at Crimdon Dene, approximately 13km north of the proposed scheme footprint. The feeding grounds of the little terns that nest at Crimdon Dene lie predominantly in marine areas within 5km alongshore of the colony and within 3.5km offshore. This area does not overlap with the proposed scheme footprint, or the zone of influence from any impacts arising from it. It is therefore concluded that there would be no LSE on little tern (either the breeding colony itself or those within the foraging grounds) and therefore this species has been screened out of the assessment. • As the Tees Bay C disposal site is located beyond the seaward boundary of the Teesmouth and Cleveland Coast pSPA and Ramsar site, and the potential effects of the disposal activity are predicted to remain largely within the boundary of the disposal site, impacts associated with offshore disposal of dredged material have been screened out of the assessment.	• Noise and visual disturbance to waterbirds due to operation of the container terminal. • Effects on waterbird feeding habitat due to changes in coastal processes.	• Screened in

[4] *The Teesmouth and Cleveland Coast pSPA and Ramsar extends the existing Teesmouth and Cleveland Coast SPA and Ramsar in terms of species and boundary. The assessment has therefore been undertaken against the pSPA and the proposed revised boundary of the Ramsar site.*

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Site (distance and direction from proposed scheme)	Interest features	Supporting features	Potential pathway for likely significant effect during construction	Potential pathway for likely significant effect during operation	Screened in/out of Appropriate Assessment
Durham Coast SAC (9.5km north)	The SAC is designated under Article 4(4) of the Directive (92/43/EEC) for the following habitats listed in Annex I: • Vegetated sea cliffs of the Atlantic and Baltic coasts	• Not applicable	• This feature is not present within the proposed scheme footprint and no effects on coastal processes within the SAC boundary are predicted.		• Screened out
Northumbria Coast SPA (9.5km north)	The site qualifies under Article 4.1 of the Birds Directive for the following Annex I species: • During the breeding season: Little tern (breeding) The site also qualifies under Article 4.2 of the Birds Directive for: • Over-wintering: ruddy turnstone and purple sandpiper	• Shallow inshore waters • Sandy beaches • Rocky shores with associated boulder and cobble beaches • Hide tide artificial roost sites	• No pathway for disturbance exists due to the separation distance between the source of disturbance and the SPA boundary. • Foraging grounds of common and little tern are unlikely to interact with the proposed scheme as the colony is located over 90km north.	• No pathway for effects during operation given the separation distance in relation to the predicted zone of influence from operational phase effects.	• Screened out
Northumbria Coast Ramsar site (9.5m north)	Ramsar criteria 6 Species / populations occurring at levels of international importance. Species regularly supported during the breeding season: • Little tern Species with peak counts in winter: • Purple sandpiper • Ruddy turnstone	• As for the Northumbria Coast SPA	• As for the Northumbria Coast SPA	• As for the Northumbria Coast SPA	• Screened out

Based on the information presented within Table 29.3, it is considered that the Teesmouth and Cleveland Coast pSPA and Ramsar site should be screened into the AA stage for construction and operational activities (i.e. there is potential for LSE alone).

Background information for the Teesmouth and Cleveland Coast pSPA and Ramsar site is presented in Section 11 of this EIA Report. Although the qualifying interest features of the Teesmouth and Cleveland Coast pSPA differ from the qualifying criteria for the Ramsar site, the proposed scheme will affect the features / criteria in the same way, given that the habitats of importance to the features of / criteria for both the pSPA and Ramsar site are the same. For this reason, the potential effects of the proposed scheme are presented for both the pSPA and Ramsar sites together.

There is no potential for LSE on the Northumbria Coast SPA and Ramsar site, or on the Durham Coast SAC on the basis of their location and qualifying interest features (i.e. there is no conceivable pathway for effect on these sites). No further consideration of potential impacts to the interest features of these sites has been undertaken within this HRA.

29.3.3 Conservation objectives for designated sites screened into the assessment

Natural England has developed conservation objectives for the Teesmouth and Cleveland Coast pSPA which aim to maintain, in favourable condition, the quality, distribution and extent of the designated habitats which support the cited bird species.

The conservation objectives which apply to the Teesmouth and Cleveland Coast pSPA are provided below (Natural England, 2018b):

"With regard to the SPA and potential SPA and the individual species and/or assemblage of species for which the site has been, or may be, classified, and subject to natural change, ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

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

29.4 Consideration of other plans and projects to include in the in-combination assessment

Relevant plans and projects to be considered in the in-combination assessment have been identified through a search of MMO and RCBC public registers. A high-level screening exercise has been undertaken to remove certain types of development that are judged to be insignificant in nature and scale (e.g. minor change of use application or conversions to existing buildings, minor residential developments etc.) and, as such, there is no pathway for in-combination effects due to the minor nature of those schemes.

Relevant plans and projects identified within the vicinity of the proposed scheme are screened in Table 29.4. Where data is available, details of project type, construction dates, duration of works and other relevant data are provided, along with the distance from the proposed works.

Royal HaskoningDHV

Table 29.4 Plans and projects identified in the vicinity of the NGCT scheme

Plan or project	Description and timing (where available)	Distance from proposed scheme	Status	Screening assessments rationale, including potential effects and impacts	Information sources
Sirius Minerals Harbour Facility	The York Potash Harbour Facilities scheme was granted a DCO in 2016. The DCO permits the following activities that have not yet begun: Phase 1 • site compounds; • construction of a 28m wide and 280m long quay including ship loads and ship loader rails; • dredging up to 750,000m^3 of material from the approach channel and berth pocket; • lagoon habitat enhancement works; • installation of a surge bin; • installation of a conveyor system and transport towers; • construction of buildings and parking area; • erection of security fencing; • provision of ancillary infrastructure. Phase 2 • extension of the quay to provide a total quay length of 486m including ship loader and ship loader rails; • dredging up to 372,000m^3 of material from the approach channel and berth pocket; • installation of a second surge bin; • installation of a second conveyor within the conveyor housing installed during Phase 1; • provision of ancillary infrastructure. The ES (Royal HaskoningDHV, 2014) concluded that the effects and impacts of the proposed scheme would not extend beyond the Tees estuary.	Immediately adjacent to the proposed scheme	DCO granted for the scheme which contains a deemed marine licence from the MMO	Should the consented Sirius Minerals Harbour facility scheme occur at the same time as the NGCT, in-combination effects to the interest features of the Teesmouth and Cleveland Coast pSPA and Ramsar site could occur in the form of underwater and airborne noise and water quality reductions, which may have the potential to reduce the available foraging area for the qualifying species of the Teesmouth and Cleveland Coast pSPA and Ramsar site. Both schemes will also result in the loss of intertidal habitat which could represent loss of feeding grounds for pSPA and Ramsar site species. **Screened into the AA.**	Royal HaskoningDHV, 2014
Sirius Minerals Materials Handling Facility	Sirius Minerals plc (Sirius Minerals) secured planning permission from RCBC for a Materials Handing Facility (MHF) on land at Wilton, Teesside, in 2015 (reference R/2014/0626/FFM). The	2km and 1km respectively	Both schemes are consented by RCBC	Should the proposed NGCT occur at the same time as the Sirius Minerals Materials Handling Facility, in-combination effects to	Royal HaskoningDHV, 2014 and Royal HaskoningDHV, 2017

Plan or project	Description and timing (where available)	Distance from proposed scheme	Status	Screening assessments rationale, including potential effects and impacts	Information sources
(MHF) at Wilton, and the Sirius Minerals Overhead Conveyor Route and Storage Facility	associated York Potash Harbour Facilities DCO was also granted under s114 (1)(a) of the Planning Act 2008 (reference SI 2016 No. 772). Together the permission and consent provide for the construction and operation of facilities to process, transfer and handle for export the material emerging from a portal at the Wilton site, which will serve the consented mine and underground materials transfer system. The permissions led to progression of detailed design engineering, from which emerged requirements for an amended conveyor routing, and an additional storage facility (Use Class B8) at Bran Sands, Redcar. The Storage Facility has indicative dimensions of 1300m long x 170m wide x 40m high. An ES was produced for the Product Conveyor Route and Storage Facilities (Royal HaskoningDHV, 2017), and outline planning permission was granted by RCBC in April 2018 (R/2017/0906/OOM). No works are required within the estuary itself, with all works being located on land.			the interest features of the Teesmouth and Cleveland Coast pSPA and Ramsar site could occur in the form of airborne noise and visual disturbance, which may have the potential to reduce the available foraging area for the qualifying species of the Teesmouth and Cleveland Coast pSPA and Ramsar. **Screened into the AA.**	
Tees Channel Dredge	The Tees Channel Dredge project involves a proposed deepening of the Tees navigation channel, the turning circle and Tees Dock to a maximum maintained depth of 14m below CD. An Environmental Scoping Report (Royal HaskoningDHV, 2016) was submitted to the MMO alongside a request for a scoping opinion for the Tees Channel Dredge; however, the environmental assessment proposed within that report has not yet been undertaken. The footprint of the proposed Tees Channel Dredge overlaps largely with that of the upstream end of the NGCT channel dredge (with the exception of the proposed dredge in Tees Dock proposed as part of the former). Given that the two dredge footprints largely overlap (with the exception of dredging in Tees Dock, which, given its location, would have no means of affecting the hydrodynamic and sedimentary regime of the estuary system), the area would be dredged by either the NGCT project or the Tees Channel Dredge	0km	No consent in place	The dredge footprint for NGCT overlaps with the proposed Tees channel dredge. There is very limited environmental assessment information on the latter project, as the scheme has not progressed beyond the Environmental Scoping process. However, it is understood that the Tees Channel dredge would not be undertaken should the NGCT dredge go ahead first. **Screened out of AA.**	Royal HaskoningDHV, 2016.

Plan or project	Description and timing (where available)	Distance from proposed scheme	Status	Screening assessments rationale, including potential effects and impacts	Information sources
	project (not both). Given the findings of the NGCT EIA, it is concluded that any effects of the Tees channel dredge would be contained within the Tees estuary.				
Ongoing maintenance dredging at Hartlepool and in the Tees estuary	This activity has been on-going for many years.	0km	Marine licence granted by the MMO for offshore disposal	Given the frequency and duration and long-term nature of this activity, maintenance dredging and disposal is represented in the baseline conditions for the area. Although maintenance dredging would not be undertaken in the NGCT footprint at the same time as the capital dredging works required for the proposed scheme, there is potential for maintenance dredging to occur elsewhere within the Tees which could result in in-combination effects on water quality. The effects of maintenance dredging at Hartlepool (which is also within the source area on PDT's maintenance dredge disposal licence) would not extend into the Tees estuary and therefore this is screened out of the assessment. **Screened into the AA (for the Tees only).**	Royal HaskoningDHV (numerous)
Dogger Bank Teesside A and Dogger Bank Teesside B (now Sofia Offshore Wind Farm, referred to throughout as Sofia)	Dogger Bank Teesside was Forewind's second stage of development of the Dogger Bank Zone. Originally planned to be four separate wind farms known collectively as Dogger Bank Teesside, this stage was divided into two separate applications - Dogger Bank Teesside A & Sofia and Dogger Bank Teesside C&D. Only Dogger Bank Teesside A & Sofia was progressed through to application. The A & Sofia application comprised two wind farms, each with a maximum installed capacity of 1.2GW. They will connect to the national grid at the existing Lackenby Substation in Teesside via an export cable to be located within an export cable corridor. The Dogger Bank Teesside A & Sofia	5km	DCO granted for the scheme which contains a deemed marine licence from the MMO	The consented Dogger Bank Teesside A & Sofia scheme is located within the coastal waters of Tees Bay. Although this scheme has received consent, it is yet to be constructed, and therefore the potential exists for in-combination impacts during cable-laying from underwater noise and water quality on prey species of the qualifying features of the Teesmouth and Cleveland pSPA and Ramsar site.	

Plan or project	Description and timing (where available)	Distance from proposed scheme	Status	Screening assessments rationale, including potential effects and impacts	Information sources
	schemes both have consent, currently sharing the same Development Consent Order (DCO). The DCO states that construction should commence by August 2022. It is understood that both Teesside A and Sofia will potentially bid into the next Contracts for Difference (CfD) round in Spring 2019, which would commit the developers to construction timelines.			As neither of the consents (assuming a marine licence is granted for the NGCT) specify timings for the construction works, it is conservatively assumed that the construction programmes could overlap. A trench of approximately 2.2km long required for the Dogger Bank Teesside A & Sofia export cable burial falls within the pSPA and Ramsar site boundary. The impacts associated with trenching for the wind farm export cable (reduced water quality, removal of benthic species) would have the potential for in-combination effects with the NGCT on the foraging tern species within the Teesmouth and Cleveland Coast pSPA. **Screened into the AA.**	
Hartlepool approach channel	PDT is proposing to deepen, realign, widen and extend the length of the approach channel, to allow Victoria Harbour to accept deeper drafted and larger beam vessels through a wider tidal window. In addition to the proposed dredge (and associated disposal of dredged material), PDT is proposing to construct an underwater retaining wall, immediately adjacent to the Middleton Breakwater	5.5km	Consent in place	Should the proposed scheme at Hartlepool channel occur at the same time as the NGCT, in-combination effects to the interest features of the Teesmouth and Cleveland Coast pSPA and Ramsar site could occur in the form of underwater and airborne noise and water quality reductions, which may have the potential to reduce the available foraging area for the qualifying species of the Teesmouth and Cleveland Coast pSPA and Ramsar. **Screened into the AA.**	Royal HaskoningDHV, 2018
Inter Terminals Jetty 1 Refurbishment	Inter Terminals has submitted a planning application and a marine licence application to undertake refurbishment works to its existing Jetty 1 on the northern bank of the Tees estuary. The scheme	Immediately adjacent to	Consent in place	The proposed works to Jetty 1 are highly localised and the construction works would be short term. The works are	Royal HaskoningDHV, 2019

Plan or project	Description and timing (where available)	Distance from proposed scheme	Status	Screening assessments rationale, including potential effects and impacts	Information sources
	involves minor ‘top-side’ works to the existing infrastructure at Jetty 1 and Dolphin D, and a dredge of the river bed (with associated disposal of dredged material) to extend the existing berth pocket downstream. The works would result in Dolphin D being used as an operational structure rather than simply a berthing dolphin.	the dredge footprint		considered to be of a sufficiently small scale that there would be no significant in-combination effects with the proposed NGCT. **Screened out of the AA.**	
Able UK – South Bank Wharf	Able UK is planning on developing a new port facility in the Tees to support the renewable energy sector. The new quay is proposed to be over 1km long and will be suitable for vessels with up to -12m draft. In order to permit vessel access within a commercially viable time window, the existing channel will need to be dredged to -12mCD and the berths will be dredged to depths of up to -15mCD. It is estimated that the total capital dredge will be around $2Mm^3$.	Immediately upstream	No application has been submitted to date.	Although no environmental assessment is available at this stage, it is evident that in-combination effects would occur should the two schemes be undertaken at the same time. However, as an EIA has not been undertaken for the scheme at the time of writing and detail within the scoping report is lacking, it is not possible to include this project within the HRA. **Screened out of the AA.**	

Where there is potential for these projects and plans to have an in-combination effect on the Teesmouth and Cleveland Coast pSPA and Ramsar site, these have been screened into the AA and are considered further in Section 29.5. Unless otherwise stated, it is assumed that if LSE for the project alone is determined with respect to a particular site / feature, this conclusion also stands with regard to potential in-combination effects. Where LSE for the project alone is excluded, then consideration is given as to whether LSE would arise through potential interactions with the effects of other plans or projects, and a final conclusion reached with regard to the potential for likely significant in-combination effect to arise.

29.4.1 Summary of HRA screening

The HRA screening stage has determined that the proposed scheme has potential to result in LSE on the following European and Ramsar sites (alone):

- Teesmouth and Cleveland Coast pSPA and Ramsar site (excluding little tern).

The following potential construction phase effects will be assessed within the HRA:

- Loss of subtidal and intertidal feeding resource due to reclamation.
- Airborne noise disturbance to waterbirds due to construction works.
- Indirect impacts on foraging behaviour due to impacts on prey resource from to capital dredging and piling works (water quality reductions and underwater noise generation).

The following operational phase effects will be assessed within the HRA:

- Disturbance due to operation of the NGCT.
- Effects on existing habitats due to changes in coastal processes.

Given the separation distance between the little tern colony and foraging areas at Crimdon Dene, and the predicted zone of influence of the proposed NGCT, impacts to little tern have been screened out of the assessment. Impacts associated with the offshore disposal of dredged material are also screened out.

It is concluded that the in-combination LSE cannot be ruled out with the following schemes:

- Sirius Minerals Harbour Facility
- Sirius Minerals MHF
- Dogger Bank Teesside A and Sofia
- Hartlepool approach channel
- Maintenance dredging.

All other plans and projects have been screened out of the in-combination assessment either due to a lack of pathway for in-combination effects or due to the lack of environmental information to allow an in-combination assessment to be undertaken.

29.5 Provision of information to inform the Appropriate Assessment: proposed scheme alone

29.5.1 Introduction

This section of the HRA provides the information required for AA of the proposed NGCT on the Teesmouth and Cleveland Coast pSPA and Ramsar site. With reference to the relevant sections of the EIA Report where appropriate, this section describes the potential impacts of the NGCT insofar as they are relevant to the qualifying features / criteria of the pSPA and Ramsar site. The potential impacts are then considered in the context of the defined conservation objectives for the relevant qualifying features / criteria and a view is given on whether the NGCT (alone) is predicted to have an adverse effect on the integrity of the pSPA and Ramsar site.

29.5.2 Approach to assessment of potential adverse effects

Determining whether, in view of a European site's conservation objectives, the plan or project either alone or in combination with other plans or projects would have an adverse effect (or risk of this) on the integrity of the site has been assessed in light of:

- site-specific information obtained from surveys and studies undertaken as part of the EIA for the proposed scheme;
- the advice of statutory bodies;
- the potential effects on the Teesmouth and Cleveland Coast pSPA and Ramsar site;
- evidence provided within the EIA Report; and,
- professional judgement and lessons learned from other development projects.

The following definitions and approach were used to determine whether the NGCT would result in an adverse effect on the Teesmouth and Cleveland Coast pSPA and Ramsar site. Although this information is specifically developed for the assessment of potential effects on European sites, the same principles apply to assessment of potential effects on the qualifying criteria of Ramsar sites.

Site integrity
The assessment of adverse effects on the integrity of a site is addressed in light of the conservation objectives for each site. The integrity of a site is defined as the "*the coherence of the site's ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and/or populations of species for which the site has been designated*" (ODPM Circular 06/2005).

EC guidance (European Commission, 2000) emphasises that site integrity involves its ecological functions and that the assessment of adverse effect should focus on and be limited to the site's conservation objectives.

Adverse effect
The potential impacts of the proposed scheme during the construction and operation phases have been considered in the context of their effects on the qualifying features and criteria (the species and their supporting habitats) of the Teesmouth and Cleveland Coast pSPA and Ramsar site.

An adverse effect on integrity is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of designation. In addition, an adverse effect would be one which caused a detectable reduction in the species for which the sites are designated, at the scale of the site rather than at the scale of the location of the impact.

Article 1 of the Habitats Directive defines the conservation status of a natural habitat as 'favourable' when "*the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future*". An adverse effect on site integrity will not occur if it can be shown that, in the long term, the habitat or population of the species in question as a viable component of the site will be maintained despite potential impacts. Long-term is considered to be a period of at least five years. This is considered to be an appropriate timescale for the assessment of adverse effect on integrity because, for example, SPAs are usually designated in the UK on the basis of five-year population estimates. A five-year rolling mean is used because it is considered to take account of sufficient data to demonstrate that birds use sites regularly, smoothing out any short-term peaks and troughs in numbers.

Using the same argument, it is therefore logical to continue to review populations over the same timescale in order to demonstrate that observed use or 'non-use' of habitat is typical, and not a chance event. In addition, bird breeding performance and productivity varies between species and between years, and many species have long life spans. Population dynamics data therefore need to take into account the possible short-term fluctuations in the numbers of any species.

European Commission (2000) also recommends that, when considering the 'integrity of the site', it is important to take into account a range of factors, including the possibility of effects manifesting themselves in the short, medium and long-term.

29.5.3 Coastal processes

An assessment of the potential effects of the proposed NGCT on coastal processes (comprising effects on tidal propagation, wave climate, current speeds and sediment budget of the estuarine system) has been undertaken and is presented in Section 6 of this report (with further detail provided in Appendix 6). A summary of the predicted effects is provided below to inform potential impacts on the features of the Teesmouth and Cleveland Coast pSPA and Ramsar site.

Effects of completed scheme on tidal current speeds

Minor changes in current speeds are predicted in the estuary in the vicinity of the proposed NGCT and at the mouth of the estuary. In the vicinity of the proposed scheme, a decrease in current speed of up to 0.10m/s is predicted with localised decreases of up to 0.20m/s.

Increases in current speeds of a similar order of magnitude are predicted for closer to the shores of the estuary. The area adjacent to the proposed reclamation is predicted to experience the greatest effects on flows. Further downstream at the mouth of the estuary, very little effect is predicted and decreases in current speeds are in the order of 0.05m/s.

Changes to current direction are also predicted in the location of the proposed scheme, as the overall cross section of the estuary would be altered. The overall predicted effects are described as being of low magnitude.

One of the main effects of the proposed scheme is to result in enhanced current flows near the bed of the estuary, which is predicted to result in a 10% increase in the supply of fine material from Tees Bay into the estuary.

Effects of completed scheme on tidal range

The proposed scheme is predicted to have a very small effect on water levels. Tidal range is predicted to increase by less than 4mm and the tide is predicted to arrive up to two minutes earlier.

Effects of completed scheme on wave activity

Wind waves that are generated within the estuary are predicted to be affected by the reflective properties of the proposed scheme but would be unaffected by the increase in channel depth.

Swell waves generated offshore do not penetrate far into the estuary and therefore are not predicted to be affected by the proposed terminal development. Swell waves however are predicted to be impacted by the increase in depth of the proposed channel.

Changes to swell waves during predominant wind conditions (i.e. south westerly at 20m/s) show a small increase in wave height of less than 10cm due to the proposed scheme. With stronger south westerly winds, wave height increases of 10cm are predicted. This pattern is not predicted to be altered by the presence of proposed dredged trenches at the edges of the channel.

In more extreme events, the modelling predicts that waves approaching from a northerly direction with a swell height of 6m (return period of 1 in 1 year) will be reflected on the side of the dredged channel and reach the area around the ConocoPhillips Oil Terminal. This is predicted to increase the significant wave height on the western side of the ConocoPhillips Dock by up to 30cm. The reflection within the channel also leads to a decrease in wave height for swell waves North Gare Sands and Bran Sands.

Overview of main effects on intertidal areas

Changes to the cross-sectional area of an estuary due to capital dredging and reclamation can influence tidal propagation. As a consequence, the level of high and low water can be affected, which can change the extent of intertidal exposed at low water.

The North Tees mudflat (located upstream of the proposed NGCT) is the only area of importance that has the potential to be impacted by the predicted increase in tidal range (4mm for spring tides). No effects on other intertidal areas are predicted as a result of the effect on tidal range given that no change is predicted downstream of the proposed development site.

The predicted changes, however, will not affect the intertidal area at high water as the water level will change against the river walls. For low water, the predicted increase of 2mm on spring tides has the potential to convert up to 40m^2 of intertidal to very shallow subtidal. However, it should be noted that this area would not be lost, rather, the frequency at which it would be submerged will change. This change in low water level would result in a notional shift of the low water line 10cm towards the river edge, and a narrow strip of presently drying intertidal area remaining wet. The water depth in this area would be up to 2mm.

The 10% increase in import of fine material from Tees Bay is predicted to result in an increased supply of fine material to Seal Sands. At present, it is estimated that Seal Sands experiences accretion of approximately 3.5mm/year. The proposed scheme is predicted to increase this rate of accretion by approximately 0.3mm/year.

The intertidal areas at the mouth of the estuary (Bran Sands and North Gare Sands) are outside any predicted changes in tidal hydrodynamics. Swell wave conditions are predicted to be unchanged or decrease. No change to the tidal range or phasing is predicted.

Since no change in sandy infill is predicted for the channel, it is expected that the overall volume of intertidal will be unchanged. However, the changes to the pattern of extreme wave conditions may result in local redistribution of bed material and either an increase in net accumulation or reduction in net erosion.

Royal HaskoningDHV

29.5.4 Loss of habitat due to reclamation

Subtidal habitat

Natural England's Technical Information Note TIN172 published prior to formal designation of the pSPA and Ramsar site (titled: *A possible extension to the Teesmouth and Cleveland Coast Special Protection Area*) stated that the main channel of the River Tees below the Tees Barrage and the estuary waters are proposed for inclusion within the SPA to protect foraging areas for common tern.

As noted above, the NGCT will result in the permanent loss of 8.5ha of subtidal habitat within the footprint of the Teesmouth and Cleveland Coast pSPA and Ramsar site as a result of the proposed reclamation. The loss of 8.5ha of subtidal habitat, therefore, would result in a permanent reduction in foraging areas for this species. This equates to approximately 0.06% of the habitat within the pSPA and Ramsar site boundary (approximately 14,300ha).

Natural England's TIN138 (Common tern: species information for marine SPA consultations) states that common terns take food from the uppermost waters by plunge-diving to a depth of 1 to 2m, often hovering, or by 'contact dipping' where only the bill enters the water and the bird remains in flight throughout. TIN138 also states that common terns feed on small fish, both marine and freshwater, as well as crustaceans, terrestrial insects and occasionally squid. Therefore, in order to understand the potential for the area of subtidal habitat in question to be used as a supporting habitat for the prey species of common tern, a review of the benthic ecological survey data has been undertaken.

As reported in Section 9, it is considered that the subtidal habitat in the reclamation area has some potential to support prey species for common terns. However, in the context of the higher quality of the habitat available elsewhere in the estuary, and the size of the area to be lost in relation to the wider pSPA (0.06%), the permanent loss of this habitat is not expected to have an adverse effect on the integrity of the Teesmouth and Cleveland Coast pSPA.

Intertidal habitat

As well as the loss of subtidal, the proposed reclamation required for the solid quay structure would result in the loss of approximately 1.19ha of intertidal habitat; the open quay structure would have a lesser effect on intertidal. As reported in Section 9, the 2019 benthic survey concluded that the habitat present is predominantly artificial due to adjacent industrial development. Such industrial development restricts the ability for a more natural rocky shore community to develop and as such was relatively species poor with only a few biotopes present. There was no evidence of intertidal mudflats present in the survey area. This, in addition to the findings of the WeBS counts results in a conclusion that the intertidal habitat does not represent an important feeding ground for waterbirds or seabirds.

As detailed in Section 11, Bran Sands lagoon and Dabholm Gut represent important feeding grounds for pSPA and Ramsar site species; the proposed scheme would have no direct impact on these feeding areas with all works being located outside the boundary of these waterbodies.

The loss of intertidal would therefore not result in an adverse effect on the integrity of the Teesmouth and Cleveland Coast pSPA and Ramsar site.

29.5.5 Disturbance of the subtidal resource due to capital dredging

The capital dredging required for the NGCT will result in the disturbance to 120ha of subtidal within the footprint of the Teesmouth and Cleveland Coast pSPA. Such works have the potential to cause disturbance to prey species, which in turn has the potential to impact on the terns themselves (by reducing the availability of prey).

It should be noted however, that the vast majority of this area (approximately 116.5ha) comprises the existing navigation channel and, therefore, is already dredged on a regular basis to maintain the advertised dredge depth. This area has been subject to ongoing maintenance dredging for a number of years and was subject to disturbance from maintenance dredging when Natural England proposed the revision to the boundary of the Teesmouth and Cleveland Coast SPA and Ramsar site.

This regular disturbance is reflected in the findings of the benthic ecological surveys undertaken in support of the NGCT (and previous schemes within the Tees, including the York Potash Harbour Facilities), which show that the infaunal species assemblage in the main channel is numerically dominated by a small number of species and appears to show signs of disturbance. Following completion of the NGCT capital dredge, recolonisation with similar species assemblages will occur. The fact that Natural England has revised the boundary of the SPA over an area that has been, and is, subject to regular disturbance from maintenance dredging, leads to the conclusion that the capital dredging of the channel for NGCT will not result in an adverse effect on the integrity of the Teesmouth and Cleveland Coast pSPA and Ramsar site as no material change will occur.

29.5.6 Disturbance to the interest features of the Teesmouth and Cleveland Coast pSPA and Ramsar site

As noted above, the NGCT is located within and adjacent to the Teesmouth and Cleveland Coast pSPA and Ramsar site boundary. The potential therefore exists for disturbance to waterbirds that might be using this habitat (i.e. common terns for feeding) during the construction and operation of the terminal.

Disturbance could arise due to the following:

- Airborne noise disturbance to birds during construction and operation.
- Underwater noise disturbance to prey species for common tern during construction and operation.
- Visual disturbance during construction and operation.
- Indirect effects on foraging behaviour due to reductions in water quality

Airborne noise disturbance generated by construction and operation
As reported in Section 11.5, a worst-case impact of minor adverse significance is predicted to waterbirds as a result of construction related noise disturbance. It has been concluded that the temporary noise disturbance impact would not represent a population level impact. Although mitigation measures are not considered necessary to avoid an adverse effect on integrity, it is proposed that noise attenuation barriers (i.e. temporary screens) are positioned along the western boundary of Dabholm Gut to minimise disturbance to birds in this area (as best practice).

Underwater noise disturbance generated by construction and operation
With regard to underwater noise from piling, the assessment presented in Section 12.5 concludes that traumatic injury could arise if fish are located in very close proximity to the source of the impact noise. The modelling predicts that there is greater potential for behavioural response in fish in comparison with traumatic injury (from impact piling) due to the larger modelled impact range for behavioural response. Piling would not however represent a constant noise source and the periods between pile driving (e.g. when repositioning the rig and overnight when no piling would be undertaken) would provide the opportunity for unimpeded movement.

In conclusion, it is predicted that the overriding consequence of the generation of noise during piling operations (as well as the dredging and construction activities) will be for fish to move away from the source. Therefore, in the worst case, the construction works are expected to result in the localised redistribution of resident fish species and temporary disturbance to migration patterns of fish throughout the Tees estuary. This could feasibly increase the feeding opportunities for terns within the Tees, as fish may congregate in undisturbed areas of the river, providing increased density for feeding. As a result, no significant adverse effect is predicted on pSPA waterbird populations as a result of underwater noise during construction.

Underwater noise generation was considered by Subacoustech during the York Potash Harbour Facilities EIA. That study concluded that the increased movements of vessels associated with that scheme (which will result in an additional 191 vessel calls per year at the port terminal) will result in a negligible underwater noise disturbance impact on fish. It is recognised that the NGCT will result in a greater number of vessel movements per year (1,200 movements per year) than the York Potash Harbour Facilities (in the order of a 10% increase per month as a result of NGCT compared with approximately 2% for the York Potash Harbour Facilities). However, given the existing context of the Tees estuary (with regard to existing noise generated by ongoing shipping activity), it is concluded that the impact from NGCT will also be negligible. No effect is predicted on pSPA or Ramsar site waterbird populations as a result of underwater noise during operation.

Visual disturbance during construction and operation (movements of construction plant and personnel and lighting)

Section 12.5 and 12.6 considers the potential impacts of construction and operational phase lighting on fish populations within the Tees estuary. This assessment is applicable to the HRA as fish within the estuary represent prey species for foraging terns. Section 12.5 reports that the construction works (with the exception of piling) will take place 24 hours a day and, therefore, lighting will be required at night during this phase. Under existing conditions there is a degree of light spill into the water column from operations on the quay side; however, the reclamation and piling works will require lighting further out into the estuary than at present. Consequently, there is the potential for additional disturbance to fish beyond that occurring at present day levels.

In addition to the above impact, the construction phase of the NGCT will require various personnel to be present on site depending on the nature of the works being undertaken. Construction plant will also be present on site throughout the construction phase. The presence of both construction personnel and plant / machinery has potential to cause visual disturbance to the interest features of the Teesmouth and Cleveland Coast pSPA and Ramsar site, given that the NGCT is located within and immediately adjacent to the boundary of the site. It is considered likely that waterbirds will exhibit a behavioural response to visual disturbance from construction personnel and machinery, with a temporary redistribution of birds away from the immediate vicinity of the disturbance. However, it is considered likely that the birds will become habituated to the visual disturbance over time.

As part of the construction phase lighting design, the strategies set out below will be considered to ensure that the effect of construction phase lighting on the surrounding environment is minimised as far as possible and minimises the lighting effect on sensitive areas for waterbirds (namely Bran Sands lagoon, Dabholm Gut as well as the Tees estuary):

- Artificial lighting during the construction phase will only be used during the hours of darkness, during low levels of natural light or during specific construction methods or tasks.
- Lighting will be directed to focus inwards (to the site) wherever possible to reduce external glare.
- The luminaires to be mounted on lighting columns will comprise of a flat glass construction, appropriate to the nature and location of the installation. The aiming angle of the peak intensity of the luminaire will be limited to maintain the light output from the luminaire within five degrees from the downward vertical. This will control the lighting of the area and minimise any potential glare, sky glow and obtrusive lighting to the surrounding areas. The luminaires to be mounted on the lighting columns will also incorporate the appropriate photometry reflectors to control the distribution

of light from the luminaires and maintain the illumination within the construction development areas, boundary or task area. The proposed horizontal lighting illuminance levels (minimum and average levels) will comply with the lighting standard and guidance documents relevant to the method and construction work being undertaken.

- During low levels of activity, public holidays or lulls in construction, the contractors will be required to maintain only appropriate minimum levels of illumination around the development site.

With the above mitigation strategy in place, in combination with the use of barriers to provide an acoustic and visual screen between the proposed construction works and the Bran Sands lagoon, Dabholm Gut and the Tees estuary itself, no effect on population levels of waterbirds, and hence on the Teesmouth and Cleveland Coast pSPA and Ramsar site, is predicted to occur.

The measures adopted during construction will also be utilised during operation (with the exception of the acoustic barriers) and, consequently, an adverse effect on the pSPA and Ramsar site is not predicted during this phase either.

Reductions in water quality due to resuspension of sediment

The proposed scheme will result in a reduction in water quality during the construction phase, which could indirectly impact on foraging behaviour for birds. As reported in Section 7, the sediment to be dredged does not contain concentrations of contaminants in excess of Action Level 2 (with generally only marginal exceedances of Action Level 1, with the exception of PAHs which are naturally elevated in the Tees), and therefore, is considered to be suitable for offshore disposal. The only pathway for potential effect to the interest features of the pSPA and Ramsar site is therefore via an increase in suspended sediment within the water column.

Figures 6.2 to 6.4 indicate that the magnitude of the effect (i.e. increased suspended sediment) is likely to extend over a relatively large area of the pSPA boundary within the Tees estuary. However, the increase in SSC is relatively minor in the vast majority of the estuary (in the order of 25mg/l increase outside of the immediate vicinity of the dredger). Therefore, it is predicated that the impacts beyond the immediate vicinity of the dredger would be negligible in terms of reductions in foraging ability, as the predicted increases in SSC are within the natural variability of the system. The predicted impact would be short term, with the SSC returning to background levels relatively quickly following completion of the dredge. Terns are considered likely to be able to continue feeding effectively within the estuary and in the near shore waters of Tees Bay.

Given the duration of the proposed dredge (up to 33 weeks for mudstone and between four and 11 weeks for granular material and clays) and the predicted extent of the sediment plume, it is expected that there could be a temporary displacement impact on foraging species of waterbirds and seabirds, particularly within the immediate vicinity of the dredger. This would in fact lead to a marginal increase in density in the areas out with the affected area, which would be also favoured by foraging species during the construction period (i.e. no net change in prey availability within the coastal areas used by foraging terns). The current occurrence of daily maintenance dredging already occurring in this area suggest that alternative areas for feeding are often utilised.

However, in order to manage the reduction in water quality within the Tees, which, as reported in Section 11 presents an important foraging ground for common and Sandwich tern, the following mitigation measures would be adopted.

To reduce the impact associated with the predicted increase in suspended sediments, the use of a TSHD will be limited to one side of the river at a time. Operations will, therefore, be undertaken in long strips along the axis of the estuary, rather than dredging across the width of the river. This will reduce both the extent and impact of the dredged plume, as any plume generated by operations has been predicted (by HR Wallingford during 2006) to remain on the same side of the river as the dredging operation.

This methodology will ensure that a completed strip of the river is clear before the dredger is deployed to the other side. This will allow time for the plume to disperse before operations are moved to a different location. Water quality will, therefore, only be impacted on one side of the river at a time, leaving areas unaffected where birds can continue to feed within the estuary.

Mitigation of the plume effects by reducing the size of the dredger, and thus reducing the rate of overflow, is not viable since the size of dredger has to be sufficient to carry a large enough drag head and to have sufficient propulsion power to undertake the required dredging operation.

For the CSD, the most significant impact in terms of producing suspended solids is the overflow from the barge loading equipment. To reduce the potential risk to water quality, the barge will be located either on the eastern or western side of the estuary. As with the TSHD, the plume from the barge loading operations will remain on one side of the river, albeit dispersing to a lesser extent and tending to be more confined to the shallower waters. Mitigation of the suspended sediment generated by reducing the size of the dredger, and thus reducing the rate of overflow, will not be possible as a smaller dredger would have insufficient power to be able to cut though the stronger materials and, hence, the smaller equipment would not be able to carry out the work.

With the implementation of the above measures, it is concluded that an adverse effect on integrity would not occur due to impacts on prey resource as a result of reductions in water quality.

29.5.7 Conclusion in light of conservations objectives

The updated conservation objectives for the Teesmouth and Cleveland Coast pSPA are:

> *"With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified, and subject to natural change:*
>
> *Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;*

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

The assessment presented above has illustrated that any disturbance effects arising from construction and operation of the proposed scheme (alone) will have no effect on the conservation objectives. An adverse effect on the integrity of the Teesmouth and Cleveland Coast pSPA and Ramsar site would therefore not occur.

29.6 Assessment of in-combination effects

This section considers the in-combination effects of the proposed scheme with other plans and projects on the Teesmouth and Cleveland Coast pSPA and Ramsar site. The assessment has been informed by the appropriate assessment undertaken for the York Potash Harbour Facilities in 2014, supplemented as required to take account of additional plans and projects screened into the NGCT assessment since production of the York Potash Harbour Facilities EIA in 2014. This approach is considered appropriate, as the York Potash Harbour Facilities HRA took account of all major planned development in the Tees estuary since 2006, including the NGCT. The York Potash Harbour Facilities HRA was also undertaken on the assumption that the proposed changes to the Teesmouth and Cleveland Coast SPA had been adopted at the time of writing.

The potential effects screened into the assessment comprise:

- Direct loss of intertidal and supporting habitat.
- Noise disturbance during the construction phase (airborne and underwater).
- Effects on marine water quality during dredging.
- Effects on the hydrodynamic and sedimentary regime during operation.

These potential in-combination effects are considered further below.

29.6.1 Direct loss of intertidal and supporting habitat

The Sirius Minerals Storage Facility and Dogger Bank Teesside A and B are not applicable to this potential in-combination effect.

The York Potash Harbour Facilities HRA considered the potential for in-combination effects of that project with the MHF site at Wilton only. This assessment was undertaken as the MHF site at Wilton was reported to support a small population of curlew, which are included within the pSPA and Ramsar site assemblage. The Harbour Facilities ES stated that the Harbour Facilities in combination with the MHF would result in a loss of habitat used by waterbirds (but not the same habitat). No mitigation measures were proposed for the effect of the MHF given the very minor effect predicted in addition to the fact that the habitat to be affected at the MHF site is present and common in the wider area.

The NGCT will result in the loss of intertidal habitat (and subtidal) within the footprint of the pSPA boundary, however (as discussed in Section 29.5), the loss of this habitat (alone) is not predicted to have an adverse effect on foraging terns at population level. As the York Potash Harbour Facilities scheme will result in the loss of the same type of intertidal habitat as the NGCT (equating to 3.6ha for the worst-case solid quay option), there will be a greater overall loss of intertidal within the pSPA boundary when the two projects are considered in-combination.

As detailed in the York Potash Harbour Facilities HRA, habitat enhancement measures have been incorporated into the design of that scheme to provide additional feeding habitat in Bran Sands lagoon, while also mitigating the impact to waterbirds due to the loss of intertidal due to construction of the port terminal. The measures proposed would provide shallow water areas with intertidal fringes and would be designed to enable waterbird feeding across the area throughout the tidal cycle. As that habitat to be lost as a result of the proposed NGCT is not supporting habitat to be the pSPA and Ramsar site, an adverse effect on the integrity of the pSPA and Ramsar site due to in-combination loss of intertidal would not occur.

Loss of subtidal habitat within the pSPA was not considered relevant to the HRA for the York Potash Harbour Facilities ES (which considered the NGCT and ongoing maintenance dredging). Consequently, it is considered that this effect does not require further assessment.

The Hartlepool approach channel would not result in the loss of intertidal as all works are located within the subtidal. There is therefore no pathway for in-combination effect on potential feeding grounds with the NGCT.

29.6.2 Noise disturbance during construction

The Sirius Minerals MHF is not considered relevant to this potential in-combination effect as the MHF is approximately 3km distant from the boundary of the pSPA. Maintenance dredging is also not considered relevant in the context of this potential effect as this activity is ongoing within the estuary and therefore forms part of the baseline noise environment.

A construction phase noise assessment has been undertaken for the proposed NGCT (see Section 16); the findings for the assessment have been used to determine the significance of potential impact to waterbirds in Section 11 of this report.

The York Potash Harbour Facilities ES presented the findings of a cumulative noise impact assessment of the NGCT and the Harbour Facilities project. The assessment concluded that the cumulative impact of noise and vibration on sensitive receptors was not predicted to be significant at any of the noise sensitive receptor sites considered.

A noise assessment was also undertaken for the proposed construction of an export cable landfall for the Dogger Bank Teesside A and B landfall on the coast (Royal HaskoningDHV, 2014). The assessment concluded that usage of the frontage at the location of the landfall by foraging or roosting waterbirds is low, probably reflecting the limited available foraging resource and high levels of existing disturbance. The disturbance predicted from the scheme was expected to be localised, of short-term duration and unlikely to have a measurable effect on the designated SPA populations. In addition, there would be no interaction in noise as a result of the two schemes, given the separation distance between them. Hence an in-combination effect is not predicted in conjunction with the construction phase of the NGCT.

The Sirius Minerals Storage Facility at Bran Sands has the potential to result in in-combination noise disturbance effects with the NGCT, given the proximity of the schemes to each other (the two schemes are approximately 400m apart). The noise assessment undertaken for the Storage Facility at Bran Sands concludes that there is potential for noise disturbance to waterbirds using Bran Sands lagoon during the construction phase. This potential impact would however be mitigated by the use of localised screening around noisy plant, with a predicted impact of negligible significance (Royal HaskoningDHV, 2017). Should the construction phase for the Storage Facility overlap with that of the NGCT, there is potential for an in-combination noise disturbance impact to waterbirds. As detailed in the HRA for the Storage Facility (Royal HaskoningDHV, 2017), this impact is however not expected to result in a significant impact on Bran Sands lagoon, based on knowledge of the predicted impact of the percussive piling for the quay for the Harbour Facilities (which are closer to the lagoon than the site of the NGCT) and were predicted to have a negligible residual effect.

A construction phase noise assessment has been undertaken for the consented Hartlepool approach channel project. In total, the area experiencing an increase in noise levels above baseline (> 45 dB) as a result of the Hartlepool channel scheme is 0.99% of the total area of the pSPA. However, the area within which a behavioural impact is expected, where noise levels are above 65dB is 0.032km^2 (equivalent to 0.026% of the total pSPA area). Given the localised, temporary and short term impacts of noise levels predicted to be generated by the Hartlepool approach channel, alongside the conclusions previously made for consented schemes (i.e. the in-combination noise impact assessment undertaken for the NGCT, Sirius Minerals Harbour Facilities and the Dogger Bank Teesside A and Sofia export cable), which concluded no significant impacts at noise sensitive receptors, it is concluded that there would be no adverse impact on integrity of the Teesmouth and Cleveland Coast pSPA and Ramsar site due to in-combination noise disturbance with Hartlepool approach channel.

29.6.3 Effects on marine water quality and prey for waterbirds due to capital and maintenance dredging

Given the marine nature of this potential effect, the only projects that have potential to result in in-combination effects are those that would require capital and maintenance dredging. Such projects comprise the York Potash Harbour Facilities, ongoing maintenance dredging, Dogger Bank A and B and Hartlepool channel. The Sirius Minerals MHF and the Sirius Minerals Storage Facility are not relevant as these are located wholly on land.

An interaction between the sediment plumes predicted to be generated by capital dredging associated with consented projects in the Tees estuary (and at Hartlepool) would only occur should the dredging programmes of each scheme overlap (which is considered unlikely). If the dredge programmes do overlap, the effect is predicted to be a greater increase in SSC to that which would arise as a result of the NGCT alone, but within the same predicted spatial extent of the plume for NGCT (as the NGCT dredge footprint overlaps with all other projects screened into the assessment, with the exception of Hartlepool channel).

Such an increase in SSC could cause disturbance to the fish populations in the estuary (which represents prey species for some waterbird species). This disturbance would be likely to result in fish moving away from the area of increased suspended sediment. It should be noted, however, that the effect of the combined plume in the Tees is not likely to result in a different behavioural response in fish compared to that which will result from each project alone. Should the NGCT coincide at the same time as the Hartlepool approach channel works, the spatial extent of the plume (and consequently the effect on fish) would be significantly larger than that arising from the NGCT alone.

In addition to the above impact, capital dredging has the potential to disturb fish by smothering feeding habitats (i.e. deposition of sediment). As reported in Section 27, the predicted deposition footprints of the NGCT and the York Potash Harbour Facilities are similar, although the effect of NGCT capital dredging is more extensive in terms of its spatial magnitude. No intertidal sediment deposition was predicted as a result of the York Potash Harbour Facilities dredge, and therefore there is no potential for an in-combination effect to arise to the intertidal feeding resource for fish as a result of these two projects.

For each project considered in this assessment, significant deposition onto the seabed is predicted to occur only in close proximity to the dredging (and reclamation) over the slack water period. In practice, much of this deposited material would be re-dredged as part of the capital works. The magnitude of deposition beyond this zone is predicted to be in the order of a few millimetres and given the nature of the material (unconsolidated), no long-term accumulation on the seabed is expected at the initial point of deposition. No in-combination effect on the feeding resource due to subtidal deposition therefore will occur.

The potential in-combination impact between maintenance dredging and proposed capital dredging works has been modelled and the results are provided in Section 6. The modelling has illustrated that the combined effect of maintenance dredging during the capital works is not significantly different from that predicted as a consequence of the NGCT capital dredging alone. However, in practice, it is likely that maintenance dredging in the wider estuary will not be undertaken during a significant capital dredge; this will mitigate the potential for an in-combination effect on water quality.

As outlined in Section 27, the impacts associated with the re-mobilisation of contaminated sediment are only applicable to the York Potash Harbour Facilities. Mobilisation of contaminated sediment has not been identified as a risk in this EIA Report for the NGCT project. The mitigation measures proposed for the York Potash Harbour Facilities (i.e. use of an enclosed grab for dredge contaminated sediments) would remove the potential for the re-suspension of contaminated sediment and subsequent deposition over other areas in the estuary. No such measures are considered necessary for the NGCT and, therefore, no in-combination effects are predicted to occur.

The effect of sediment suspension on feeding birds (terns) in the nearshore zone associated with the construction of the export cable landfall for the Dogger Bank Teesside A and B windfarm project was assessed by Royal HaskoningDHV (2014). It was concluded that the small-scale and temporary nature of the works in the nearshore zone for the Dogger Bank Teesside A and B windfarm (and within foraging range of terns) would not constitute a source of disturbance that would influence the foraging behaviour of terns such that potential adverse impacts at the population level would arise. No significant effect on fish prey species was predicted due to either suspended sediments or habitat change. As outlined in Section 12, the capital dredging required for NGCT is predicted to result in an increase in SSC, which has potential to result in adverse effects on small fish that represent food resource for terns. The potential for a significant in-combination effect to arise as a result of the combined disturbance arising from NGCT and Dogger Bank Teesside A and B is considered below.

Section 6 of this report states that the predicted increase in SSC is relatively minor in the majority of the estuary (in the order of 25mg/l increase outside of the immediate vicinity of the dredger). As noted in Section 6, the predicted impact will be short term, with the SSC returning to background levels relatively quickly following completion of the dredge. Terns are considered likely to be able to continue feeding effectively within the estuary and in the near shore waters of Tees Bay. Overall, the effect of the NGCT on the feeding resource for terns due to a change in water quality is predicted to be of negligible significance.

Given the conclusions of the Dogger Bank A and B assessment (i.e. no significant effect on suspended sediment or habitat change) and the conclusion of the NGCT assessment (i.e. negligible effect on feeding resource for terns), no long-term effect on the population or distribution of the terns within the pSPA is predicted. Consequently, no significant in-combination effect is predicted.

The potential in-combination effect of the Hartlepool approach channel with the NGCT was considered within the HRA undertaken for the Hartlepool approach channel project (Royal HaskoningDHV, 2018). The magnitude of the potential effect on water quality due to the consented Hartlepool approach channel is low, with any effect confined to the footprint of the proposed dredge. The predicted increase in suspended sediment from Hartlepool channel is not considered sufficient to result in a lethal effect on fish, with any impact dissipating within 10 minutes following completion of the dredge. It was therefore concluded that an adverse effect on the integrity of the pSPA and Ramsar site would not occur in-combination with the NGCT. The same conclusion therefore applies to this application.

29.6.4 Effects on prey resource due to underwater noise generation during construction

The potential exists for underwater noise impact to arise from the NGCT, York Potash Harbour Facilities and Hartlepool approach channel schemes, should the construction phases of these projects (particularly any piling works) overlap.

The in-combination effect of underwater noise generation has potential to adversely impact on pSPA and Ramsar site birds, due to potential impacts on prey resource.

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Given the close proximity of the NGCT site to the York Potash Harbour facilities, it is considered likely that the spatial extent of its underwater noise impact will not be dissimilar to that predicted for the York Potash Harbour Facilities. If the piling associated with both schemes overlaps, there is likely to be increased underwater noise levels and potentially an overall longer duration of impact compared to the impacts of each scheme when considered alone.

The underwater noise modelling carried out for the consented Hartlepool approach channel has illustrated that noise levels from impact piling are likely to create the largest noise levels and impact ranges, with noise levels predicted to be higher at high tide and when piling is closest to open water (i.e. at the eastern extent of the proposed underwater retaining wall required for Hartlepool approach channel). Should the proposed NGCT and Hartlepool approach channel proceed at the same time (which is considered unlikely) fish could be subject to temporary disturbance both within the Tees estuary and within the coastal waters of Tees Bay (albeit locally). The predicted impact zones from each of these projects would be spatially separated, with large expanses of open water within the wider pSPA and Ramsar site that are predicted to be unaffected. In addition, the maximum impact ranges as a result of Hartlepool approach channel are related to temporary threshold shift or impairment, rather than mortality.

In terms of how this potential in-combination impact on fish translates into a potential effect on foraging terns, it is anticipated that prey species for terns could become more densely grouped into waters which are predicted to be unaffected by the underwater noise disturbance from all projects. This temporary redistribution of prey species could be considered a beneficial in-combination effect on foraging terns, as terns would likely expend less energy foraging once they had identified the denser population of prey species. However, any beneficial impact to foraging terns would be temporally limited, with the impact being reversible on completion of the individual projects (i.e. on completion of the noise generating activity, it is predicted that the prey resource would redistribute across a wider area). Terns are also understood to be attracted to areas where fish are temporarily or permanently injured due to underwater noise and, therefore, an effect on prey due to underwater noise does not necessarily translate into a negative effect on tern foraging ability.

The JNCC's guidelines 'Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise' (JNCC, 2010) is to be adhered to during pile driving. Although this guidance was developed for marine mammals, it is considered that the principles within it would also be of benefit for fish.

Given the localised, temporary, intermittent and short-term impacts of increased noise levels generated by the proposed construction works for the proposed NGCT and the Hartlepool approach channel (as well as the proposed adoption of the JNCC's guidelines), it is concluded that there would no significant in-combination effect. No adverse integrity on the pSPA and Ramsar site would occur

29.6.5 Changes to the hydrodynamic and sedimentary regime

Given the marine nature of this potential effect, the following plans and projects are not relevant in the context of this potential effect: Sirius Minerals MHF, Dogger Bank A and B and the Sirius Minerals Storage Facility. The ongoing maintenance dredging is also not considered here as this forms part of the baseline environment.

Section 6 details that there would be an increased supply of material to the Tees estuary from offshore (by 10%) as a result of the proposed NGCT. This effect arises due to the deepening of the approach channel through the mouth of the Tees and the resultant effect on tidal flows and sediment transport.

The studies for the York Potash Harbour Facilities concluded that the Harbour Facilities would not change the supply of fine sediment to the Tees, and the sediment predicted to deposit in its berth pocket would be material that would have deposited in the approach channel anyway. Such material would have been subject to maintenance dredging and offshore disposal as part of ongoing maintenance dredging. Predicted modelling for the York Potash Harbour Facilities scheme concluded that there would be no potential for an effect on the sediment budget of the estuary to arise and, therefore, there would be no impact on morphology of intertidal areas.

Sedimentary and hydrodynamic modelling undertaken for the consented Hartlepool approach channel project confirmed that the magnitude of effect on tidal hydrodynamics and wave regime arising from the proposed scheme is predicted to be low. The magnitude of effect on the baseline sediment transport regime and sea bed morphology arising from the proposed scheme during its operational phase is medium, directly in the vicinity of the approach channel. There is no predicted effect on the baseline sediment transport regime and sea bed or shore morphology across the wider study area as a result of Hartlepool approach channel. Given the localised nature of potential effects during the operational phase of the proposed scheme, it is concluded that there is no pathway for in-combination effects with the NGCT.

29.7 Conclusion

In light of the revised conservation objectives for the Teesmouth and Cleveland Coast SPA, it is predicted that the NGCT, when assessed alone and in-combination with other plans and projects, will not have an adverse effect on the integrity of the Teesmouth and Cleveland Coast pSPA and Ramsar site.

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Appendix 1

2008 Harbour Revision Order

Royal HaskoningDHV

Uploaded onto MCMS separately due to document properties (unable to combine into this EIA Report as the document is password protected).

Appendix 2

2007 Planning permission

TOWN AND COUNTRY PLANNING ACT 1990

NOTICE OF OUTLINE PLANNING PERMISSION

Reference No: R/2006/0433/OO

Agent Name And Address	Applicant Name And Address
NATHANIEL LICHFIELD AND PARTNERS GENERATOR STUDIOS TRAFALGAR STREET NEWCASTLE UPON TYNE NE1 2LA	P D TEESPORT 17-27 QUEEN'S SQUARE MIDDLESBROUGH TS2 1AH

The Council as the Local Planning Authority **HEREBY GRANT OUTLINE PLANNING PERMISSION** for the development proposed by you in your application valid on 26/04/2006

DETAILS: **OUTLINE APPLICATION FOR DEVELOPMENT OF A CONTAINER TERMINAL**

LOCATION: **LAND AT TEESPORT GRANGETOWN**

Subject to the following conditions:

(1) No part of the development hereby permitted shall be commenced until details of siting, design, external appearance, means of access and landscaping (hereinafter called the reserved matters) in respect of that part of the development have been submitted to and approved in writing by the Local Planning Authority, and the development shall not be carried out otherwise than in complete accordance with the details so approved. Application for the approval of the reserved matters for the first phase of development (as shown on drawing 9R0155/PA/1000 Revision 4) shall be made to the Local Planning Authority before the expiration of five years from the date of this permission and application for the approval of the reserved matters for the second phase of development (as shown on drawing 9R0155/PA/1000 Revision 4) shall be made to the Local Planning Authority before the expiration of fifteen years from the date of this permission.

REASON: By virtue of the provision of section 92 of the Town and Country Planning Act 1990 (as amended).

(2) The development hereby permitted must be begun either before the expiration of five years from the date of this permission, or before the expiration of three years from the date of the approval of the last of the reserved matters for the first phase of the development (as shown on drawing 9R0155/PA/1000 Revision 4), whichever is the later.

REASON: By virtue of the provision of section 92 of the Town and Country Planning Act 1990 (as amended).

(3) The development hereby permitted shall not be carried out other than substantially in accordance with Parameter Plans No, 9R0155/PA/1001 Revision 3 and 9R0155/PA/1002 Revision 4 contained in the planning application.

REASON: The development of the site is the subject of an Environmental Impact Assessment and any alteration to the layout, land use or design which is not substantially in accordance with the approved parameter plans may have an impact which has not been assessed by that process.

(4) Prior to the commencement of development of each part of the development for which reserved matters have been approved, details and samples of all materials to be used in the construction of the external surfaces of the buildings and any external plant and equipment in that part of the development shall be submitted to and approved in writing by the Local Planning Authority and the development shall be implemented using the approved materials.

REASON: In the interests of visual amenity to ensure a satisfactory standard of development is achieved.

(5) No part of the development approved by this permission shall be commenced until:
a) a desk top study has been carried out for that part which shall include the identification of previous site uses, potential contaminants that might reasonably be expected given those uses and other relevant information. And using this information a diagrammatical representation (Conceptual Model of the geology and hydrogeology) for the site of all potential contaminant sources, pathways and receptors has been produced.

b) A site investigation has been designed for that part of the site using the information obtained from the desk top study and any diagrammatical representations (Conceptual Model of the geology and hydrogeology). This should be submitted to, and approved in writing by the Local Planning Authority prior to that investigation being carried out on the site. The investigation must be comprehensive enough to enable:

- a risk assessment to be undertaken relating to ground and surface waters associated on and off the site that may be affected, and
- refinement of the Conceptual Model; and
- the development of a Method Statement detailing the remediation requirements

c) The site investigation has been undertaken in accordance with details approved by the Local Planning Authority and a risk assessment has been undertaken.

d) A Method Statement detailing the remediation requirements, including measures to minimise the impact on ground and surface waters, using the information obtained from the Site Investigation has been submitted to the Local Planning Authority. This should be approved in writing by the Local Planning Authority prior to that remediation being carried out on the site.

REASON: To protect Controlled Waters and ensure that the remediated site is reclaimed to an appropriate standard.

(6) If during development, significant contamination not previously identified, is found to be present at any part of the site then no further development (unless otherwise agreed in writing by the Local Planning Authority) shall be carried out at that part until the applicant has submitted, and obtained written approval from the Local Planning Authority for, an addendum to the Method Statement. This addendum must detail how this unsuspected contamination shall be dealt with.

REASON: To ensure that the development complies with the approved details in the interests of protection of Controlled Waters.

(7) Upon completion of the remediation detailed in the Method Statement a report shall be submitted to the Local Planning Authority that provides verification that the required works regarding contamination have been carried out in accordance with the approved method Statement(s). Post remediation sampling and monitoring results shall be included in the report to demonstrate that the required remediation has been fully met. Future monitoring proposals and reporting shall also be detailed in the report.

REASON: To protect Controlled Waters by ensuring that the remediated site has been reclaimed to an appropriate standard.

(8) Each part of the development shall be carried out in accordance with the approved Method Statement.

REASON: To ensure that the development complies with approved details in the interests of protection of Controlled Waters.

(9) No part of the development approved by this permission shall be commenced unless the method for piling foundations for that part has been submitted to and approved in writing by the Local Planning Authority. The piling shall thereafter be undertaken only in accordance with the approved details.

REASON: The site is contaminated/potentially contaminated and piling could lead to the contamination of ground water in the underlying aquifer.

(10) Prior to the commencement of development of each part of the development for which reserved matters have been approved, drawings showing both foul and surface water drainage (including the provision of oil interceptors and sustainable forms of drainage as far as is practicable) connected with the development shall be submitted to and approved in writing by the Local Planning Authority. Thereafter the works shall be undertaken in complete accordance with the approved scheme. The works approved shall be completed prior to the occupation of the first building in that part of the development. The scheme shall be retained throughout the life of that part of the development unless otherwise agreed in writing with the Local Planning Authority.

REASON: To prevent pollution of the water environment.

(11) Prior to the commencement of development an oil spill contingency plan shall be submitted to and approved in writing by the Local Planning Authority.

Thereafter the oil spill contingency plan or any replacement of the same approved in writing by the Local Planning Authority shall be implemented in accordance with the approved details.

REASON: To prevent pollution of the water environment.

(12) Prior to the commencement of development a programme for the reclamation and construction works, which avoids disturbance to breeding birds, shall be submitted to and approved in writing by the Local Planning Authority. Construction work shall thereafter be carried out in accordance with the approved programme.

REASON: To prevent unacceptable disturbance to breeding birds.

(13) Prior to the installation of any external lighting on any part of the new terminal, including temporary lighting, details of a scheme of external lighting to be used within that part shall be submitted to and approved in writing by the Local Planning Authority. Such details shall include the location, type, angle of direction and wattage of each light which shall be so positioned to prevent any glare or light spillage especially towards the estuary. Thereafter the lighting shall be implemented in accordance with the approved scheme.

REASON: In the interests of visual amenity and to avoid nuisance or harm to fisheries resources as a result of light spillage.

(14) Prior to the commencement of development of each part of the site a written scheme of archaeological investigation for that part shall be submitted to and approved in writing by the Local Planning Authority. Development shall thereafter be carried out in accordance with the approved scheme of investigation unless otherwise agreed in writing by the Local Planning Authority.

REASON: To enable the identification and recording of archaeological and paleaeoecological remains.

(15) Prior to the commencement of development a Construction Method Statement shall be submitted to and approved in writing by the Local Planning Authority. This should ensure compliance with the principles of Best Practicable Means as outlined in BS5228 Part 1 1997 and the Control of Pollution Act and include measures to minimise dust generation and noise from the site. Thereafter all work shall be carried out in strict accordance with the approved construction method statement.

REASON: To prevent nuisance from noise and dust and in the interests of the visual amenity of the area.

(16) A Business Travel Plan shall be agreed with the Local Planning Authority and the detailed provisions of the Travel Plan shall be implemented immediately following the commencement of development of the first building of the development hereby approved.

REASON: In the interest of achieving a sustainable form of development.

(17) Prior to the commencement of development a detailed phasing timetable for the whole site shall be submitted to and approved in writing by the Local Planning Authority.

REASON: In the interest of achieving an acceptable form of development.

(18) Prior to the commencement of development, details of emergency access arrangements shall be submitted to and approved in writing by the Local Planning Authority. The approved scheme shall be implemented in full prior to the terminal coming into use.

REASON: In the interests of achieving an acceptable form of development.

(19) No building on any part of the development hereby permitted shall exceed 14 metres in height.

REASON: The development of the site is the subject of an Environmental Impact Assessment and the development of buildings in excess of this height may have an impact which has not been assessed by that process.

(20) Container stacking shall only take place within the areas indicated on parameter plans 9R0155/PA/1001 Revision 3 and 9R0155/PA/1002 Revision 4.

REASON: The development of the site is the subject of an Environmental Impact Assessment and the storage of containers in other areas may have an impact which has not been assessed by that process.

(21) Container stacks shall be restricted to the maximum heights set out on parameter plans 9R0155/PA/1001 Revision 3 and 9R0155/PA/1002 Revision 4.

REASON: The development of the site is the subject of an Environmental Impact Assessment and the stacking of containers above the agreed heights may have an impact which has not been assessed by that process.

(22) Within the quay and crane back reach area (as identified on parameter plans 9R0155/PA/1001 Revision 3 and 9R0155/PA/1002 Revision 4) the maximum crane height with the jib in the vertical position shall not exceed 100 metres. Elsewhere on the site maximum crane height shall not exceed 25 metres.

REASON: The development of the site is the subject of an Environmental Impact Assessment and the use of cranes in excess of the agreed heights may have an impact which has not been assessed by that process.

(23) The maximum paved area of the container terminal as identified on parameter plans 9R0155/PA/1001 Revision 3 and 9R0155/PA/1002 Revision 4 shall not exceed 31 hectares.

REASON: The development of the site is the subject of an Environmental Impact Assessment and an increase in the area of the container terminal may have an impact which has not been assessed by that process.

(24) The Northern Gateway Container Terminal: Dredging Protocol (PD Teesport, February 2007, Final Report 9S2047) submitted as Appendix 2 of the Northern Gateway Container Terminal, Supplement to the Environmental Statement, February 2007 will be implemented in full during the period of capital dredging operations.

This will entail the submission of a dredging programme to the relevant statutory bodies prior to the start of these operations.

REASON: To minimise the impacts on water quality, inter-tidal and sub-tidal habitat and SPA waterbird interests, and in the interests of safeguarding the broader estuaries and marine environment.

(25) A programme of monitoring of dissolved oxygen and suspended solid concentrations during capital dredging activities will be agreed with the Local Planning Authority prior to development commencing and thereafter implemented in accordance with the agreed scheme.

REASON: To verify the findings of the Environmental Statement and supplementary documents with respect to water quality and sub-tidal habitats, and in the interests of safeguarding the broader estuaries and marine environment.

(26) The Seal Sands monitoring protocol (PD Teesport, February 2007) submitted as Appendix 3 of Northern Gateway Container Terminal, Supplement to the Environmental Statement, February 2007 will be implemented in full. This will entail sampling of bed sediment types, erosion/deposition measurements and silt flux recording at the recommended frequencies before, during and for a period of five years following NGCT construction. An initial report will be presented to the relevant statutory bodies after collection of data on completion of construction; annual updates will then follow and a final report issued once five years post-construction data have been gathered.

REASON: To verify the finds of the ES with respect to the hydrodynamic and sedimentological effects of NGCT on the SPA/SSSI inter-tidal habitats of Seal Sands.

(27) A programme of monitoring waterbird usage/behaviour and noise levels will be designed, instituted and implemented on the Vopak foreshore during the period of percussive piling operations on the new NGCT quay frontage.

REASON: To verify the findings of the ES with respect to noise levels and consequent waterbird disturbance derived from piling operations.

(28) Phase 2 of the terminal development shall not operate until the new rail terminal has been completed and is available for use and the Shell Sidings Rail Spur has been reconnected and completed to satisfaction of the Local Planning Authority.

REASON: In the interests of achieving a satisfactory form of development.

(29) Prior to development commencing, a mammal and amphibian survey shall be carried out and the survey and any necessary mitigation measures shall be submitted to and agreed with the Local Planning Authority.

REASON: To protect any mammals or amphibians which may be present on the site.

(30) No development approved by this planning permission shall be commenced until a scheme for water column monitoring (water quality) and suspended

sediment monitoring during dredging/construction has been submitted to and approved in writing by the Local Planning Authority. Once approved, the scheme shall be complied with.

REASON: To prevent the pollution of the water environment.

(31) No development approved by this planning permission shall be commenced until a scheme for post implementation water column monitoring has been submitted to and approved in writing by the Local Planning Authority. Once approved, the scheme shall be complied with unless otherwise agreed in writing with the Local Planning Authority.

REASON: To monitor the impact on the Tees estuary ecology and water quality.

(32) No development approved by this planning permission shall be commenced before a report identifying the likely impact of the proposed scheme on the migratory fishery and detailing the mitigation measures necessary to offset any detrimental impact, including a timetable for these measures has been submitted to and approved in writing by the Local Planning Authority. The agreed mitigation measures shall be implemented in accordance with the timetable.

REASON: To ensure the resilience of the migratory fishery is maintained.

(33) The development hereby granted consent shall not be brought into use unless and until the highway improvement works as shown in principle on the Steer Davis Gleave (SDG) drawing numbers 206219 001 REV C; 206219 002 REV E; 206219 003 REV D and 206219 Work_ B have been completed to the written satisfaction of the Local Planning Authority and Highways Agency.

REASON: To ensure that the A19, A174, A1053 and A66 trunk roads might continue to fulfil their purpose as part of a national system of routes for through traffic, in accordance with Section 10(2) of the Highways Act 1980, maintaining the safe free flow of traffic on the road.

NOTE: The following development plan policies were relevant to this decision:-

Local Development Framework Policy CS4, CS10, CS20, DP2 and DP3 and Policies T16 & EL7 of the Regional Planning Guidance 1 and Policies 22, 7 & 49 of the emerging Regional Spatial Strategy.

REASON FOR DECISION: The proposed development of the container terminal at Teesport accords with regional, sub-regional and local planning policy which seeks to encourage and promote the development of port facilities at Teesport. The location of the application is such that construction works and the operational development will not impact on local residents. Subject to suitable safeguarding conditions and monitoring regimes being set up the proposal will not adversely affect the integrity of the protected areas or have an unacceptable impact on wildlife, water quality or the sedimentary regime. It is considered that there is capacity on the rail network to accommodate additional rail traffic and subject to some junction improvements, the existing road network has sufficient capacity to accommodate additional road traffic. The proposal is therefore acceptable in highway terms. The proposal represents a sustainable form of development, on previously developed land, and one which will have significant economic and social benefits to the Tees Valley and wider region.

Signed : P. A. Furniss
Mrs P Furniss
Head of Planning Services

Date: 04 October 2007

YOUR ATTENTION IS DRAWN TO NOTES ATTACHED

IMPORTANT NOTE: Please note that any works carried out without compliance with the conditions attached to this approval will be entirely at the risk of the persons involved and may result in formal action being taken by the Local Planning Authority.

Appendix 3

Meeting minutes October 2018

Royal HaskoningDHV
Enhancing Society Together

Minutes

HaskoningDHV UK Ltd.
Industry & Buildings

Present:	Melissa Gaskell-Burnup (MG-B; MMO); Adam Chumbley (AC; MMO); Mark Pearson (MP; PD Teesport); Steve Rayner (SR; RHDHV); Matt Simpson (MS; RHDHV); Claire Gilchrist (CG; RHDHV)
Apologies:	
From:	Claire Gilchrist
Date:	24 October 2018
Location:	MMO Lancaster House, Newcastle upon Tyne
Copy:	
Our reference:	I&BPB8270MM001F0.1
Classification:	Project related
Enclosures:	

Subject: **Northern Gateway Container Terminal - Marine licence application – consultation meeting with MMO**

Number	Details	Action
1	**Introductions**	
2	**Description of the NGCT scheme** MP provided an overview of the need for the scheme and a description of the works to be undertaken; including capital dredging, construction of a new quay wall, reclamation and land-side development (including buildings, cargo handling equipment, etc.), a new intermodal rail terminal, road modifications and the disposal of dredged material.	
3	**Existing consents** MS and SR provided a overview of the consents gained to date, including: • 2008 Harbour Revision Order (HRO) made in April 2008 • Planning permission from Redcar and Cleveland Borough Council issued October 2007 (and implemented) • 10-year extension to 2008 HRO granted May 2018 A Marine Licence would be required and it was suggested that this should match the duration of the HRO (i.e. to 2028). AC confirmed that this would be possible. AC enquired whether the proposed scheme would affect the maintenance dredge depth, volume and/or frequency and therefore the existing licence. MP confirmed that a change to the maintenance dredging commitment is not foreseen, however acknowledges that if the depth is stated on the Maintenance Dredging licence then a variation may be	SR

	required. SR to check. [*Post-meeting note: the maintenance licence does not specify a depth and therefore no change is envisaged to the maintenance licence. This will be kept under review]*	
4	**Proposed approach to EIA** SR outlined the proposed approach to the EIA to support the Marine Licence application. SR stated that due to the consenting routes for the project requiring EIA, it is not intended to submit an EIA Screening Report as it is acknowledged that the proposed scheme represents EIA development. AC confirmed that this is an appropriate approach. SR further outlined that due to received comments relevant to the marine licence application during the consultation on the HRO extension from statutory stakeholders and interested parties, a Scoping Opinion would not be requested. It is proposed that the Marine Licence application would incorporate those relevant comments and also targeted consultation with the Environment Agency (EA), Cefas and Natural England (NE) will be undertaken. AC stated that there is no obligation to request a Scoping Opinion. The terrestrial works assessed and subsequently authorised by the planning permission are defined in full within the 2006 ES and 2017 Supplementary Environmental Information Report (SEIR). It is intended that the marine licence application will be supported by an ES (which will be an evolution of the SEIR), with the 2006 ES appended. This approach will demonstrate that the land-side effects have been sufficiently assessed, and any changes since 2006 and further assessment requirements relevant to the marine licence will be addressed by the updated ES. AC confirmed that this is an appropriate approach.	
5	**Proposed scope of impact assessment** SR outlined the proposed approach to ES topics and impact assessments, as below. AC accepted all as an appropriate approach subject to confirmation with other relevant statutory organisations (EA, Cefas and NE)	
5.1	**Hydrodynamic and sedimentary regime** • Recovery of wave climate data from the Tyne / Tees Wave Buoy and updating the baseline environment (with specific regard to the wave climate). • No significant implications on the predicted effects presented in the 2017 SEIR anticipated. • No other works proposed	

5.2	**Marine sediment and water quality** • Sediment sampling will be undertaken (RHDHV envisages a requirement for surface sampling only) and laboratory analysis. RHDHV has submitted a sampling plan to the MMO for agreement. • RHDHV/PDT does not foresee a need for seasonal restrictions on construction activities (recommended by EA during the HRO extension process) due to all year round maintenance dredging activities. • RHDHV/PDT does not consider that a silt mitigation plan is considered necessary. • SR indicated that the above will be evidenced and discussed with the EA. AC requested that communications on this matter be forwarded to MG-B and AC.	SR
5.3	**Marine ecology** • Benthic ecological survey and laboratory analysis will be undertaken, with the sampling plan agreed with NE and the MMO. • Inspection of the intertidal at low water from the river bank is proposed to verify the nature of the intertidal within the footprint of the proposed scheme; awaiting methodology to be confirmed by NE. • No additional underwater noise assessment is proposed. AC stated that cumulative impacts would need to assess Sirius works. MP suggested that NGCT construction methods would include pre-augured piling which would reduce noise emissions. However, this is not confirmed and therefore the impact assessment will represent the worst-case scenario and assume percussive piling.	
5.4	**Waterbird populations** • Inclusion of potential impacts to additional proposed qualifying features of the Teesmouth and Cleveland Coast SPA. • Assessment of potential impacts to prey for seabirds (terns) and waterbirds due to reductions in water quality (informed by sediment quality data. AC provided recommendation to be mindful of the MMO's position on habitat loss in response to case law, notably Peter Sweetman and Others v An Bord Pleanála (C-258/11). MS pointed out that this case law applied to SAC habitat and the proposed NGCT scheme lies within a pSPA whose qualifying features are waterbird populations rather than habitat. MS acknowledged that the condition and ecological value of the habitats within the proposed scheme footprint would need to be assessed as part of the EIA for their potential to support the relevant waterbird populations.	
5.5	**Fisheries resource** • RHDHV proposes that no additional underwater noise assessment is required.	

	• Potential impacts on fish due to potential reductions in water quality will be assessed, informed by the sediment quality data.	
5.6	**Commercial navigation, archaeology and heritage and monitoring proposals** • No additional assessment is considered necessary beyond that in the 2017 SEIR.	
5.7	**Coastal protection and flood defence** • Consideration of the 2017 climate change tolerances. • No other assessment considered necessary.	
5.8	**Offshore disposal of dredged material** • RHDHV proposes recovery of benthic samples within the proposed offshore disposal site • The resulting data will be used to update the assessment presented in the 2017 SEIR	
5.9	**Water Framework Directive (WFD) compliance assessment** • RHDHV will update the 2017 assessment as required following receipt of sediment quality data and any other data relevant to the WFD compliance assessment	
5.10	**Cumulative impact assessment (CIA)** • A review of any applications submitted to the MMO since completion of the CIA presented in the 2017 SEIR will be undertaken. • Updates to the 2017 assessment will be made as required, however RHDHV does not anticipate significant changes / additions will be required. The potential cumulative effects of the proposed Hartlepool channel deepening will be assessed.	
5.11	**Habitats Regulations Assessment (HRA)** • The 2017 assessment will be updated to reflect any changes to the marine ecology, sediment and water quality, fisheries or ornithology assessment due to the collection of new data and proposed changes to the SPA qualifying features and site boundary.	
5.12	**Land-side topics** (soil quality and geology, terrestrial and coastal ecology, recreation and access, road and rail traffic, noise and vibration, air quality, landscape and visual, infrastructure and land drainage, socio-economics, climate change, use of natural resources and disaster risk) • No additional assessment is considered necessary as impacts sufficiently addressed within the 2017 SEIR (as supported by the 2006 ES). In addition, the planning permission has been implemented. • Brief text to be included in the ES outlining the justification for not undertaking additional	

	assessment and signposting to the relevant sections of the SEIR and 2006 ES. The marine licence application will be supported by a new ES, with the 2006 ES appended.	
6	**Programme** Sampling plan - MMO will respond to the sampling plan request. AC estimates that this would be done within the 6 week KPI. Marine licence application - MS confirmed that the marine licence application would be submitted in Spring 2019. MP added that construction work could commence in Autumn 2019.	
7	**AOB** No other business	

Appendix 4

NGCT MMO scoping opinion

Marine
Management
Organisation

Lancaster House
Newcastle Business Park
Newcastle Upon Tyne
NE4 7YH

T +44 (0)191 376 2791
www.gov.uk/mmo

Mr Mark Pearson
Group Projects Director
PD Ports
(by email only)

Our reference: EIA/2017/00041

12 December 2017

Dear Mr Pearson,

Ref: EIA/2017/00041 – Northern Gateway Container Terminal

Additional comments were received during the scoping consultation in relation to the proposed extension of the Teesport Harbour Revision Order 2008 (the Order).

The Marine Management Organisation (MMO) consider the following comments to be outside the scope of considerations relevant to the proposed time extension for the Order.

Any development will also require a marine licence from the MMO which will be subject to a further application, the following comments should therefore be considered when submitting any application for a marine licence.

Topic Category	Comment
Marine ecology	The development should not encroach either physically, or via its associated infrastructure (roads, drains etc.) into the intertidal environment. There should be no net loss of habitat. When encroachment is shown in plans for any new works, considerable justification for this, together with details of mitigation and compensation would need to be included.
Marine ecology	The decision regarding whether further benthic ecology survey is needed should be based on the suitability of more recent data (e.g., that identified from 2014) to allow an appropriate comparison with those acquired during 2006. For example, if the spatial representation of new data is not sufficient or relevant then this would dictate that additional contemporary, fit-for-purpose data should be acquired through targeted survey work.
Coastal protection and flood defence	A Flood Risk Assessment (FRA) must also be submitted alongside any subsequent planning application in order that flood risk is given due diligence as part of the application process.
Coastal protection and flood defence	If there is any proposed works on or near a main river, on or near a flood defence structure, in a flood plain or on or near a sea defence you may need to apply to the Environment Agency

	(EA) for a Flood Risk Activity Permit. For more information, please follow the link below. https://www.gov.uk/guidance/flood-risk-activities-environmental-permits
Alternative use of dredged material	Any future raising of land levels within the proposed terminal site, other than the landside elements that have commenced, as a result of reusing dredged material, may require an Environmental Permit under the Environmental Permitting (England and Wales) Regulations 2010 from the EA, unless a waste exemption or a "cut and fill" operation applies. A Waste Recovery Plan may need to be submitted prior to an Environmental Permit application being submitted, which details the land raising scheme and the proposed environmental measures that will be put into place. EA Guidance on the re-use of dredging materials may be found on the GOV website, while any treatment on-site will require a Mobile Plant Permit. The applicant is advised to contact NE-Waste@environment-agency.gov.uk to discuss any potential permitting issues. If any controlled waste is to be removed off site, then the site operator must ensure a registered waste carrier is used to convey the waste material off site to a suitably permitted facility. Any offsite waste used in the land raising is to be similarly conveyed and waste soils are to be correctly assessed and classified prior to import. The developer must apply the waste hierarchy in a priority order of prevention, reuse, recycling before considering other recovery or disposal options. Government Guidance on the waste hierarchy in England is at: http://www.defra.gov.uk/publications/files/pb13530-waste-hierarchy-guidance.pdf Other environmental issues to consider include the impact on other businesses and operators. Odours may arise from the storage and re-use of dredged material, while the land raising works may involve increased dust, noise and traffic.
Waterbirds, seabirds and European sites	A Habitats Regulations Assessment will need to be submitted and reviewed prior to any works being consented.
Waterbirds, seabirds and European sites & Fisheries resource	The works to the watercourse should not be undertaken between the start of October and the end of April in any given year and if works are carried out between March and September, in any given year, a Silt Mitigation Plan must be in place and/or an appropriate water quality monitoring programme must be implemented in accordance with any scheme previously agreed with the EA.
Water quality	A full Water Framework Directive (WFD) assessment must be submitted and reviewed prior to any works being consented. The disturbance of sediments and potential release of contaminants

	(priority substances) should be assessed within this. It is recommended that the EA is consulted with regards to the WFD assessment.
Marine and sediment quality	Disposal at sea will be subject to a marine licence and new samples and analysis of the dredge material may be required to assess the suitability of the material for disposal at sea. Sampling for a disposal licence should be designed through consultation with the MMO (and Cefas) via the pre-application licencing process. A regime of sediment sampling will be required to support a marine licence application for at sea disposal of the dredged material.
Noise and vibration and air quality	The MMO support the adoption of a 'soft-start' approach to any marine piling which occurs during construction. The highly audible percussive piling, in particular, has the potential to disturb, displace, injure or kill fish and marine mammals within the area. The Joint Nature Conservation Committee have guidance for the 'soft-start' approach to marine piling. The MMO would support the use of Auger Piling, as the noise and vibration disturbance is much lower than caused by other piling methods, such as percussive piling.
Noise and vibration and air quality	Underwater noise and vibration arising from the construction works, particularly the quay wall, should be revisited/reviewed as part of the environmental assessment works proposed to support the extension to the 2008 Harbour Revision Order and the potential impacts on sensitive marine receptors should be assessed.
Noise and vibration and air quality	The MMO recommend that underwater noise and vibration is considered, in line with the finalised construction activities, timings of works and updated baseline information (if applicable).
Noise and vibration and air quality	The ES concluded that the proposed development for fish populations is expected to be of negligible significance, with no overall effect on the estuarine populations of fish expected as a result of construction (as fish would be expected to move away from the noise source). No mitigation measures were proposed (see pages 389-391). The same was concluded for seals, although, the focus of the assessment seems to be on airborne noise more so than underwater noise. The MMO recommend that as part of the assessment, potential mitigation measures are also reviewed.
Fisheries resource	It is not clear whether the proposed SEIR will consider any impacts specifically related to underwater noise.
Fisheries resource	As piling is expected to be required for the construction of the quay wall, the MMO would expect that underwater noise and vibration arising from the construction works will be reviewed and the potential impacts on sensitive fish receptors assessed.
Fisheries resource	The final construction programme should be confirmed. This will help inform if any mitigation is required, e.g. for fish receptors.
Biosecurity	A biosecurity plan is expected to ensure best practice is used throughout the development.

Yours Sincerely

Jayne Burns
Marine Licensing Case Officer

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Appendix 5

Meeting minutes November 2018

Minutes

HaskoningDHV UK Ltd.
Industry & Buildings

Present:	Steven Rayner (SR) and Matt Simpson (MS) (RHDHV), Mark Pearson (MP) (PD Ports), Andy Whitehead (AW) (Natural England), Eddie Halstead (EH) (Environment Agency)
Apologies:	Claire Gilchrist (RHDHV)
From:	Steven Rayner
Date:	26 November 2018
Location:	Environment Agency, Tyneside House, Newcastle
Copy:	Marine Management Organisation
Our reference:	I&BPB8270M002F0.1
Classification:	Project related
Enclosures:	None

Subject: **Northern Gateway Container Terminal (marine licence) - Scoping meeting**

Number	Details	Action
1	**Description of the scheme** MP provided a description of the proposed Northern Gateway Container Terminal (NGCT) scheme, including a background to the consents and permissions that are in place. MP confirmed that the terminal itself would likely be phased to minimise up front capital expenditure, with construction of the terminal commencing in approximately two years' time. PD Teesport's (PDT's) aim is to undertake the dredging in advance using its own equipment, resulting in significant cost savings. EH queried whether the South Tees Development Corporation (STDC) would have any influence on the scheme. MP responded that the STDC opens up a land bank for development but access routes are needed. A new roundabout is planned on Dockside Road which would open up land in this area for development.	
2	**Existing consents** SR confirmed that the scheme already has planning permission which has been implemented, and a 10 year extension to the HRO was secured in May 2018.	
3	**Proposed approach to EIA** SR outlined that we do not propose to submit a screening request for Environmental Impact Assessment (EIA) on the basis that the scheme was previously determined as EIA during 2006, and this was also assumed for the recent extension of the HRO. In addition, SR stated that a formal scoping process is not to be undertaken as comments were received during the HRO extension process which are being used to inform the scope of the assessment. In addition, SR stated that a meeting was held with the Marine Management Organisation	

Number	Details	Action
	(MMO) in November 2018 and direct discussions with NE and EA (and potentially others) would also inform the scope. In terms of deliverables, SR advised that our proposed approach is to develop the Supplementary Environmental Information Report (SEIR) that was submitted alongside the application for the HRO extension into an EIA Report (containing all information required for the marine licence application) for submission in support of the marine licence application. No comments were received on the proposed approach. SR and MS presented the proposed approach to the environmental assessment on a topic by topic basis. Marine ecology: The Environment Agency's position on no net loss of habitat (and potential net gain) arising from the proposed scheme (assuming that the intertidal habitat has some ecological value) was discussed. EH confirmed that the 'no net loss' principle was linked to intertidal habitat only, and the principle is not specifically linked to Special Protection Area (SPA) habitat, but biodiversity in general. MS confirmed that the intertidal habitat within the area is thought to comprise a revetment and made ground. EH advised that the nature of the intertidal habitat is confirmed and its ecological value determined to inform consideration of measures potentially required to ensure no net loss. **Action: Determine the nature and ecological value of the intertidal to inform whether measures are required to ensure no net loss of intertidal.**	**RHDHV**
	EH confirmed that opportunities for net habitat gain should be investigated, potentially by working with the Tees Estuary Partnership (TEP) and the habitat banking approach. SR stated that Hartlepool Borough Council (HBC) requested the consideration of bird island creation using dredged material from the Hartlepool channel scheme being pursued by PDT. MS stated that strategic thought is required around the beneficial use of dredged sediment as it is not always possible to design and fully assess such beneficial use schemes at the same time as applying for a marine licence for the main scheme. EH advised that the TEP would likely assist with development in the Tees estuary, but the details are not yet sufficiently advanced. The no net loss of intertidal policy remains in place and would be implemented through the marine licence process (in this case). AW stated that Defra net gain metrics have been received by Natural England in draft form. These have been shared with the Industry Nature Conservation Association (INCA) to ground truth the metrics and asses their suitability in the Tees. **Action: Liaise with INCA to determine the suitability of the net gain metrics in the Tees.**	**RHDHV**

Number	Details	Action
	MP stated that there could be potential to construct the terminal as an open structure rather than a solid quay wall, however this would require confirmation by engineering designers. This would allow the existing revetment to be reinstated further forward. MP's view was that such a solution would not result in significant ecological value, but MS added that if the existing intertidal is similar to a revetment, it is not unreasonable to assume development of a similar habitat type on any newly constructed revetment. **Action: Discuss the feasibility of the alternative approach with engineers should the intertidal be found to have ecological value.**	**RHDHV**
	EH stated that the Environment Agency would want some comfort that habitat enhancement measures could be secured as part of a proposed scheme. MP stated that the implementation of such measures, if required, should be linked to the start of the quay construction rather than the dredge given that the former would result in the impact on the intertidal area.	
	EH and AW both stated that commuted sums had been considered acceptable by the Environment Agency and Natural England to contribute towards habitat enhancement initiatives. EH and AW agreed that (should it be required for the NGCT scheme), compensation off-site in a strategic manner could be a better solution for the Tees estuary., However, both reiterated that government policy remains as no net loss of intertidal. EH stated that if the intertidal is found to have some value, it would be necessary to demonstrate how the impact on the intertidal would be mitigated in the marine licence application, taking account of the above points. **Action: Determine the ecological value of the intertidal to determine whether habitat enhancement initiatives are required to ensure compliance with the no net loss policy.**	**RHDHV**
	AW confirmed that harbour seal is now a designated feature of the Teesmouth and Cleveland Coast Site of Special Scientific Interest (SSSI). **Action: Ensure the assessment incorporates potential impacts to harbour seal.**	**RHDHV**
	Sediment quality: SR and MS outlined that additional sediment quality sampling is anticipated. EH stated that should sediment be found to be contaminated, alternatives to offshore disposal will be required. **Action: review sediment quality data against the Cefas Action Levels to inform the suitability of material for offshore disposal.**	**RHDHV**
	Fisheries resource:	

Number	Details	Action
	SR outlined no additional underwater noise assessment is considered necessary as such an assessment was undertaken recently for the Sirius Minerals facility, and this can be used to provide site-specific knowledge (this approach was adopted for the SEIR for the HRO extension). A discussion was held around seasonal restrictions on the dredging and piling activities. SR and MP both reiterated that such restrictions would cause significant constraints to PDT. MP confirmed that the refurbishment works at No.1 Quay were undertaken all year round with no restrictions, and maintenance dredging is undertaken on a daily basis. MP added that the main concern would be restrictions on quay wall construction. EH stated that seasonal restrictions for fish and birds are a starting point for the Environment Agency and evidence would be required to demonstrate to the EA that these do not need to be applied in this case. **Action: Determine the suitability of seasonal restrictions for fish and birds based on the assessed level of impact. Ensure sufficient evidence is provided if it is determined that seasonal restrictions are not required.**	**RHDHV**
	MP and MS stated that the assessment would be based on a worst case basis, assuming percussive piling. Waterbird populations and Habitats Regulations Assessment: SR stated that the assessment would include all qualifying interest features of the Teesmouth and Cleveland Coast pSPA and Ramsar site. SR queried whether any additional survey data for terns was available beyond that within the pSPA and Ramsar site consultation documents. AW was not aware of any other survey data. No other comments were raised on the proposed approach. Water Framework Directive (WFD) compliance assessment: SR outlined that a WFD compliance assessment was undertaken as part of the HRO extension process, and that this assessment would be updated as required using additional data from the anticipated sediment quality survey. Hydrodynamic and sedimentary regime: SR outlined that no changes to the predicted effects presented in the 2018 SEIR are anticipated and, therefore, the assessment in the SEIR would be sufficient for the EIA Report (in RHDHV's view). No comments were raised on the proposed approach. Coastal protection and flood defence:	

Number	Details	Action
	EH stated that new climate change tolerances are due to be issued by Defra. EH recognised there is no requirement to update any documents used to support the planning permission, however, it would be useful to review the data to ensure the scheme remains robust to the new climate change tolerances (e.g. in terms of level, resilience). **Action: Review the new climate change tolerances to determine any impacts on the previous assessment.**	**RHDHV**
	Offshore disposal of dredged material: SR stated that it is proposed that samples are recovered from within the offshore disposal site to inform the assessment of impact. No other comments were made on the proposed approach.	
	Programme: It is intended that the marine licence application will be submitted in spring 2019 (likely April).	
4	**AOB**	
	EH queried whether any further discussions would be held with the Environment Agency or Natural England prior to submission of the marine licence. It was agreed that should anything substantial change with the proposed scheme design, further consultation would be undertaken to ensure no surprises within the application. Both organisation will also be kept informed on progress and any key outcomes from the assessment (in particular data form new surveys).	
	It was confirmed that consultation with Natural England should be undertaken with both Josh Parker and AW, whilst consultation with Environment Agency should be undertaken with EH (with potential for a new contact in the near future).	
	AW stated that there are likely to be some minor tweaks to the boundary of the Teesmouth and Cleveland Coast SSSI following consultation responses. AW also stated that Natural England is keen to have a decision on the Teesmouth and Cleveland Coast pSPA and Ramsar site by the end of March 2019.	

Appendix 6

Section 6 from 2006 NGCT ES

6 HYDRODYNAMIC AND SEDIMENTARY REGIME

6.1 Introduction

1. This chapter describes the studies undertaken to define the changes to the hydrodynamic and sediment regime of the Tees estuary arising from the proposed channel deepening and reclamation. It should be noted that this section defines *predicted changes* to the physical regime of the estuary (e.g. wave climate, flow regime, sediment transport pathways, etc) and it is not appropriate to assess such changes in terms of their significance in the way that is described in Section 1.5. The approach adopted is to describe and, where possible, quantify these predicted changes. The implications of the predicted changes to the physical environment are then assessed in terms of the *significance of the potential impact* on various environmental parameters (e.g. marine ecology, ornithology, water quality, etc) in the relevant chapter. Similarly, any mitigation measures that may be required in order to mitigate a potential impact on a receptor arising from a predicted effect on the physical environment are described in the relevant chapter.

2. As part of their ongoing work to understand the Tees estuary and Bay, PD Teesport has commissioned various studies to gather available understanding to assemble a conceptual model of the estuary processes (ABPmer, 2002). They have also been required to commission a maintenance dredging baseline document (ABPmer, 2005). These reports, along with other previous studies undertaken by HR Wallingford (HR Wallingford 1989, 1992, 2002), have provided much of the background to the present studies to support the EIA.

6.1.1 Historical context

1. The morphology of the coast in the vicinity of the Tees estuary is constrained by the Permian Magnesium Limestone outcrop at the Heugh at Hartlepool and a sandstone outcrop at Redcar. Between these outcrops, Tees Bay has few rock exposures and mostly consists of boulder clay and alluvial deposits up to 30m thick overlying Sandstone and topped by beach sand.

2. Prior to the mid 19th century the Tees estuary was a wide, shallow estuary bordered by extensive wetlands and had tidal ingress for about 44km from the mouth. Since this time, the estuary has undergone substantial anthropogenic changes as the channel was trained, land was reclaimed and the channel deepened to its present depth. The reclamations are summarised in Table 6.1.

3. Historical charts suggest that the natural channel level at the mouth of the Tees estuary is around -10m OD(N) (7.15m below CD). As a result of training works and deepening by dredging, the current depth at the mouth is about double this natural level. Dredging and training works have occurred since the establishment of the first dredged channel of 4.3m from Middlesbrough Docks to the sea after 1853. The present dredged channel has declared depths of 15.4m below CD in the approach channel (i.e. in Tees Bay), 14.1m below CD to upstream of Redcar Ore Terminal, 10.4m below CD up to Teesport and then

progressively less depth up to 4.5m below CD in Billingham Reach. Parts of the channel now declared at 14.1m below CD were originally dredged to a deeper depth. The present channel has a backlog of maintenance dredging and some parts of the channel are above the declared depths.

Table 6.1 Anthropogenic changes to Tees Estuary since 1740 (HR Wallingford, 2002)

Dates	Amount reclaimed (ha)	Description
1740 – 1808	590	Saltholme, Cowpen, Greatham, Haverton and Billingham
1808 – 1832	212	Mainly filling of old channels after the construction of the Mandale Cut from Bluehouse Point to Portrack in 1808/09 and a further cut (“Portrack” or “Prices”) from Bluehouse Point to Newport completed in 1830
1852 - 1906	1134	Gradual but extensive reclamation along the foreshore, mainly as a convenient way to dispose of blast furnace slag from the rapidly expanding iron and steel industry on both sides of the river
1906 - 1920	219	Various reclamations arising from disposal of maintenance dredgings
1928 - 1953	107	First stage reclamation of Seal Sands, mainly to reduce cost of disposal of maintenance dredged material
1965 - 1967	77	Extension to the Shell area using material from capital deepening and widening and upstream extension of the navigable channel, and the turning circle for Phillips Imperial
1971 - 1973	105	Mainly reclamation for steelworks development. Some continuing reclamation of Seal Sands
1973 - 1974	200	Major (Stage 2) reclamation of Seal Sands
Total	**3100**	
Intertidal remaining	*456*	*Approximate figure for remaining for total intertidal area, includes about 34 ha of saltmarsh*

4. The most recent major anthropogenic influence on the Tees estuary has been the construction of the Tees Barrage in the mid-1990s. The barrage (at Blue House Point) has truncated the tidal section (about 16.5km into the former estuary) and has reduced the tidal volume upstream of South Gare by about 7% (ABPmer, 2002).

5. In summary, anthropogenic activities over the last 150 years have resulted in an estuary that is essentially a narrow ‘canalised’ channel bordered near the estuary mouth by sandy intertidal areas partly trained by various historic training works. Within this area a remnant of the originally large Seal Sands is divided from the other intertidal areas by Seaton Channel.

6.2 Existing environment

1. As the present study is focused on any changes to the regime of the estuary following the proposed development, the baseline conditions considered are taken as the state of the estuary since the construction of the Tees barrage. Details of the pre-barrage hydrodynamic and sedimentological regimes in the Tees have been described elsewhere (ABPmer, 2002).

6.2.1 Hydrodynamics

Tides and water level

1. The tide at the mouth of the Tees estuary is observed to be very close to sinusoidal in shape with ranges of 4.6m and 2.3m for means spring and neap tides respectively (UKHO, 2006). The other tidal parameters of the estuary mouth are as follows (ABPmer 2002).

Table 6.2 Tidal levels for the Tees estuary

Description	Level (m CD)
Highest recorded water level	6.86
Highest astronomical tide	6.10
Mean High water spring tide	5.50
Mean high water neap tide	4.30
Mean sea level	3.20
Mean low water neap tide	2.00
Mean low water spring tide	0.90
Lowest astronomical tide	0.00
Lowest recorded water level	-0.38

2. The variation between the astronomical maximum and minimum and the highest and lowest levels recorded indicate that the level can be strongly influenced by meteorological effects, such as winds, surge and waves.

Fluvial flow

3. The river Tees has its source about 160km from the sea on Cross Fell in the Pennines and drains a catchment of 1932km^2. The main freshwater input to the estuary is measured at Low Moor. HR Wallingford (1992) calculated the long term monthly mean flows for the period 1981-88 as shown in Table 6.3.

Table 6.3 Monthly mean flow at Low Moor

Month	Mean daily flow (m^3/s)	Month	Mean daily flow (m^3/s)
Jan	36.7	Jul	8.6
Feb	21.2	Aug	11.2
Mar	26.6	Sep	12.5
Apr	19.6	Oct	22
May	12.5	Nov	26.1
Jun	9.3	Dec	30

4. Lewis *et al* (1998), also looked at the flows at Low Moor and presented a long term average flow of 20m^3/s, a maximum recorded flow of 563m^3/s, a minimum of les than 3 m^3/s and a 10% exceedence flow of about 47m^3/s.

5. This flow is further regulated by the Tees Barrage which is operated to maintain upstream water levels and prevent the upstream penetration of saline water. The flow through the Barrage is, therefore, very unlike the natural flow especially as the flows are no longer continuous. Figure 6.1 shows the time history of recorded discharge through the barrage during April 2005.

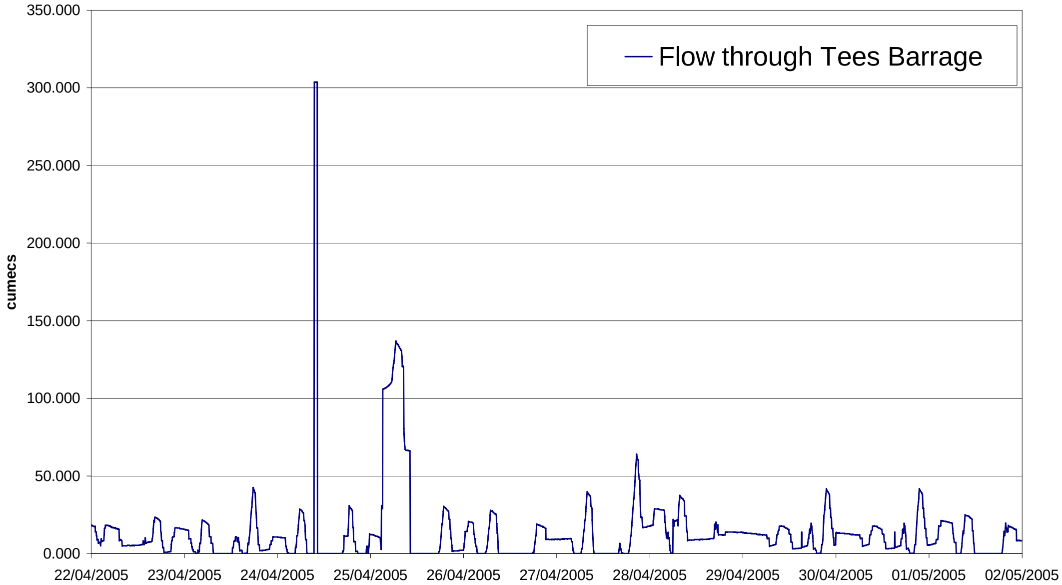


Figure 6.1 Flow measured through the Tees Barrage April 2005

Density effects

6. The regulated (as a result of the barrage) freshwater flow enters the estuary and partially mixes with saline water entering through the estuary mouth. This partial mixing and the longitudinal salinity gradient both contribute to a density driven gravitational circulation. This effect is a result of the density changing the vertical profile of the flow such that the ebb flows are strong at the surface whereas the flood flows are more evenly spread through depth. In the Tees

estuary, under many circumstances this effect becomes dominant such that continuous near-bed upstream (flood) flows are observed.

6.2.2 Waves

1. Wave conditions in the Tees estuary are a combination of offshore swell and locally generated wind waves. The direction from which swell can enter the estuary is limited by the North Gare and South Gare Breakwaters. The majority of offshore swell in the region was found in a previous study (HR Wallingford, 2002) to come from a northerly direction.

Wind climate

2. An analysis of wind speeds observed at South Gare between 1999 and 2005 undertaken as part of the present study (HR Wallingford, 2005) shows the most common winds are from the south-west (210-270^{o}N) but the most common large wind events (> 40 m/s) are from the north.

Wave climate

3. From the wave climate observed at the waverider buoy north of Tees North Buoy the following return periods for significant wave heights were calculated (HR Wallingford, 2005).

Table 6.4 Calculated wave return periods at waverider buoy locations

Return period (years)	Significant wave height (Hs (m))
0.1	3.87
1	6.03
10	8.63
50	10.69

4. Into the estuary, upstream of the ConocoPhillips Dock area, only remnants of the swell wave energy combined with short period local wind waves are to be expected due to the limitation in the penetration of swell waves into the estuary as a result of the North Gare and South Gare breakwaters.

6.2.3 Sediment

1. In general, suspended sediment concentrations are low within the estuary and within the Bay. The highest observed values tend to occur on spring tides. This relationship is not strong, but the extreme values are also attributed to either high rainfall or storm events. In general, the suspended sediment concentrations appear to be dominated by freshwater inputs above Middlesbrough Reach and marine influences further downstream. In the vicinity of the proposed development (i.e. in the Tees Dock area) suspended sediment concentrations are, for the most part, less than 20mg/l with short-term peaks from 40-80mg/l. In terms of the tidal sequence, the highest suspended sediment levels occur close to high water. After storm periods, higher concentrations of suspended sediment have been noted around the Shell Jetty, but with little

penetration further up the estuary. On other occasions the reverse has been true, thus the effect of storm events is not consistent within the estuary.

2. The sources of material into the estuary system are fluvial inputs coming through the Tees barrage, material entering from Tees Bay and any industrial inputs. These inputs are in addition to material eroded from the estuary bed. Within the system the driving forces for sediment transport are the tidal flows, density driven currents, wave induced currents, vessel induced forces and resuspension by dredging operations. These last two were postulated by HR Wallingford (1989a) as a means by which material entering the system from offshore can be resuspended and moved further upstream into the estuary.

Fluvial input

3. HR Wallingford (1989a) outlined the pre-barrage conditions for fluvial input with general very low concentrations (<10 mg/l) which rose to about 200 mg/l during occasional floods. The inputs were suggested to be closely linked to large fluvial events with about 8,000 dry tonnes entering the estuary during the 1:1 year flood (300 cumecs at Low Moor, 44km up estuary of South Gare). The average total inputs were estimated at 40,000 dry tonnes per year; however the close link to high fluvial events would suggest that this could vary considerably from year to year. Most of this material is assumed to be trapped in the estuary.

4. The construction of the Tees Barrage was assumed to not greatly alter the input of fluvial sediment into the estuary. ABPmer (2005) reported that considerable siltation has occurred upstream of the barrage with the implication that fluvial sediment input to the estuary has reduced. However, even the pre-barrage fluvial input is small when compared to marine inputs (see below).

Industrial input

5. Up to 22,000 dry tonnes per year has been discharged under license from ICI Wilton at Redcar (ABPmer, 2002). This industrial material is discharged in the Dabholm Gut (directly downstream of the proposed development). This is the remaining major industrial source of material to the Tees estuary.

Marine input

6. Comparison of the above figures with the present knowledge of the dredging requirements in the area (presently approximately 1.35 million m^3 (Andrew Ridley, PD Teesport, *pers. comm*.) shows that the remaining source of material, from Tees Bay, is the predominant source of sediment in to the system. This material comes in on the flood tide, particularly during times when concentrations in Tees Bay are raised by the resuspension of material from the sea bed during storm events. The coarser material, mostly sand, is then able to settle out in the lower estuary, whereas the finer material is drawn further up the estuary by the gravitational circulation.

7. Bed sampling undertaken by Bridgland (shown in Halcrow, 1991) and reproduced in Figure 6.2 shows the mix of sands, clay and silt in the various

chart areas used by PD Teesport to manage their maintenance dredging activity. Over recent years the fines content (silts and clay) are of the order of 50-60% of the total siltation (of the order of 300,000-500,000 m^3 per year).

8. The most recent evidence for types of maintenance dredging material from PD Teesport (*pers. comm.*) suggests that out of the 1.35 million m^3 dredged annually 250,000 m^3 is mud, mostly found in the upstream reaches beyond the Transporter Bridge. Of the remainder, 80% is clean, fine sand (~880,000 m^3) and 20% silty sand (~220,000m^3). Assuming the silty sands have a 15-35% fines content, the total fine material input is 280,000 – 330,000 m^3 per year.

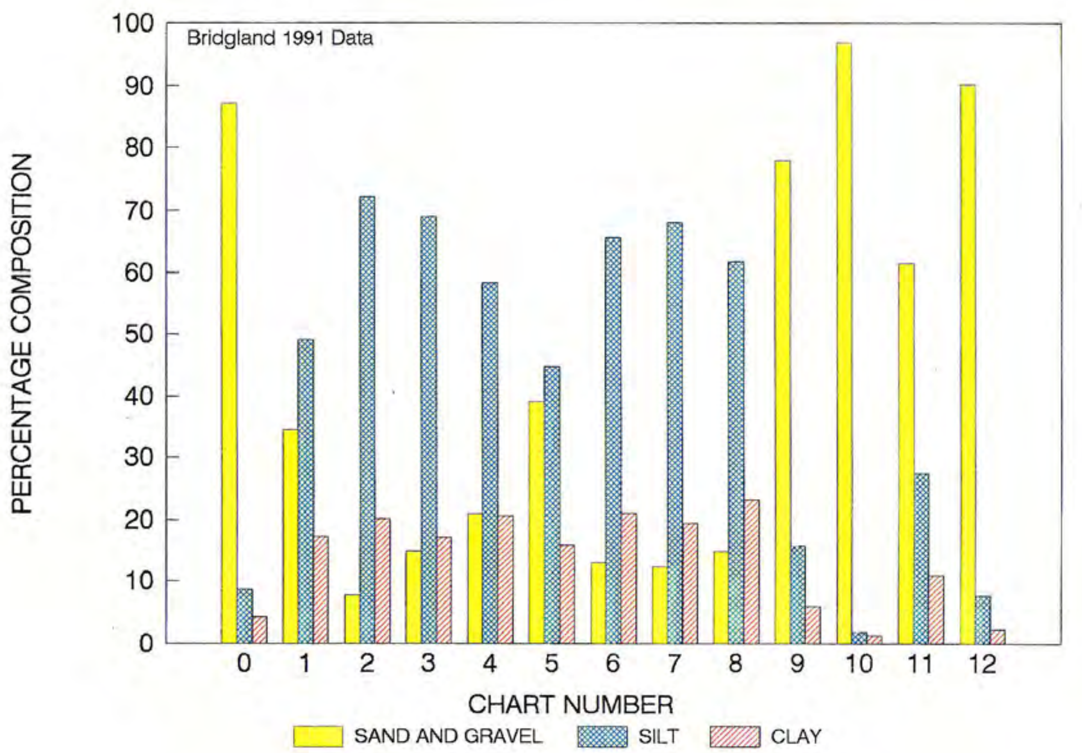


Figure 6.2 Bed types of material dredged in 1991

6.2.4 <u>Estuary morphology</u>

1. The present estuary morphology can be considered to be almost entirely man-made; 150 years of channel and entrance training works, reclamation and dredging have resulted in an estuary that is essentially a narrow ‘canalised’ channel.

2. Overall approximately 15% of the intertidal area calculated for the pre-1800 situation remains. Seal Sands covers 140ha with approximately 300ha covered by Bran and North Gare Sands at the estuary mouth. The remnant intertidal areas are partly constrained by training works.

6.3 Prediction of construction effects

6.3.1 Dispersion of material during capital dredging

1. PD Teesport commissioned Dredging Research Ltd (DRL) to undertake a study of available dredging methods for the capital dredging. DRL were also commissioned to determine the various parameters which would act as inputs to the studies on the dispersion of the sediment plume arising during dredging, as well as providing further information on the likely construction process for the development.

2. The main conclusions of the DRL study were as follows:

a) There are three potential types of dredger that might be used in the works. These are the Cutter Suction Dredger (CSD), the Trailing Suction Hopper Dredger (TSHD) and the Backhoe Dredger (BD). All have their advantages and disadvantages for dealing with separate zones of dredging.

b) Taking the entire dredging requirement into consideration, it is probable that each of the methods given in (a) above will be used at some time (for the reasons set out in c) below).

c) The choice of dredger will depend to a great extent on the location of the material to be dredged, its strength and thickness, and the impact of the operations on shipping. In addition, the economics and availability of different types of dredgers will also play a significant role in making this choice.

d) Losses of suspended sediment are inevitable at the dredging face or draghead, where hoppers or barges are being loaded and also from run-off from reclamation. The losses from loading the hoppers and barges are generally an order of magnitude greater than those occurring at the dredging face or draghead.

e) Rates of productivity, and hence rates of loss, tend to be similar for both CSDs and THSDs in these conditions. Hence, the choice of dredger type is unlikely to be influenced by the overflow loss rates. In any case, mitigation of these rates is not possible due to the fact that smaller dredgers would be ineffective in the stronger materials to be dredged.

3. Of the three types of dredger that might be used, the BD has a working rate that is considerably slower than the other two (CSD and TSHD) resulting in much less instantaneous release of solids. Therefore, sediment plume studies were restricted to the simulation of the CSD and TSHD. In addition, in view of the above, the BD would only be used for a very limited proportion of the dredging.

4. The TSHD sails up and down a section of the area to be dredged sucking up a mixture of sediment and water from the sea bed and discharging this mixture into a hopper on the dredger. The proportion of sediment loaded into the hopper can be increased by continuing to dredge after the hopper is initially filled with a solids/water mixture to increase the solids contained in the hopper. The excess water is discharged overboard from the hopper and contains a proportion of the finer sediment fractions. This overspilled sediment will either fall to the bed or

remain in suspension, forming a sediment plume. The plume from the overspill discharge is an order of magnitude greater than sediment resuspension from the dredger draghead and so it is the only sediment source considered for sediment plume simulations.

5. The CSD involves an integrated cutter and suction device. The cut bed material (and water) is sucked to the dredger before being discharged either ashore or most likely (in this case) to a pontoon from where barges will be filled. Similarly to the TSHD the proportion of sediment loaded into the barge can be increased by continuing to dredge after the plant is filled with the overspill resulting in plumes of suspended fine sediment. Importantly the TSHD will result in a source of fine sediment released along the path of the dredging activity (i.e. in the main channel) whereas the CSD will result in overflow from a fixed location (the barge loading pontoon) at the side of the channel (at a location with water depths greater than about 6m below CD to accommodate the size of barge likely to be used).

6. It is proposed that a TSHD will be used for the dredging and reclamation of granular material (approximately 1 million m^3) from the Seaton Channel Turning Circle and the downstream reaches of the Channel (Areas C and D; see Table 3.1)). It is proposed that a CSD loading into barges will be used for the bulk of the dredging of the mudstone (approximately 3.8 million m^3). If mudstone is to be pumped ashore this can also be undertaken by the CSD when operating close to the reclamation area.

7. The HR Wallingford developed model SEDPLUME-RW(3D) was used to simulate the dispersion, deposition and resuspension of the released sediment within the Tees Estuary. SEDPLUME-RW(3D) used tidal currents computed by TELEMAC-3D to determine the advection of material within the water column and calculates areas in which suspended particles may settle on the bed, either temporarily (around slack water) or longer-term. In this way, areas where discharged solids are deposited may be identified. Dispersion in the direction of flow is simulated in the model by the shear action of differential speeds through the water column, while turbulent dispersion is parameterised using a random walk technique. The deposition and resuspension of particles at the seabed are modelled by assuming critical shear stresses for erosion and deposition.

8. Parameters for the sediment plume simulations for the CSD were established from the DRL report, as follows:

<u>Cutter Suction Dredger</u>

Barge filling time	= 27 mins
Overflow time	= 224 mins
Release rate	= 44 kg/s

(Production Rate approximately 18,600m^3/day)
(Loss rate (fines) approximately 3,400 dry tonnes/day)

9. Parameters for the sediment plume simulations for the TSHD were established, as follows:

Trailing Suction Hopper Dredger (6,000m^3 capacity)

Dredge cycle time = 190 mins
Total dredge time = 60 mins
Overflow time = 60 mins
Release rate (overflow) = 173 kg/s
Release rate (run-off) = 87kg/s
Transect length = 1km
Speed of dredger when dredging = 0.75 m/s (1.5 knots)

(Production Rate approximately 38,400m^3/day)
(Loss rate (fines) approximately 7,500 dry tonnes/day)

10. For the EIA investigations the SEDPLUME-RW(3D) model was used to simulate three dredging scenarios. Two of these scenarios represented a CSD loading barges with mudstone at two different locations (see Figure 6.3). The third scenario represented a 6,000m^3 TSHD removing sandy material in the lower channel (see Figure 6.3). In this scenario, the TSHD worked on the northern side of the channel during the ebb tide and the southern side of the channel on the flood tide. Overflow for one hour during the dredging was represented along with run-off from the reclamation during the put ashore period. Pumping ashore commenced 30 minutes after the overflow ceased.

11. All the simulations were run for three spring tidal cycles with low river flow with the dredgers and barge overflow releasing material into the bottom metre of the water column throughout the overflow period. This release point is chosen because the sediment enters the water firstly in a dynamic plume phase (i.e. not being significantly influenced by the ambient flow). Subsequently, as the sediment mixes with the water it behaves as a passive plume that is transported by the currents; this passive phase is simulated in the modelling. The simulations assume that by the passive plume phase occurs at about 1m above the bed. The run-off in the TSHD scenario was simulated as entering the surface waters as this represents how the activity would be undertaken

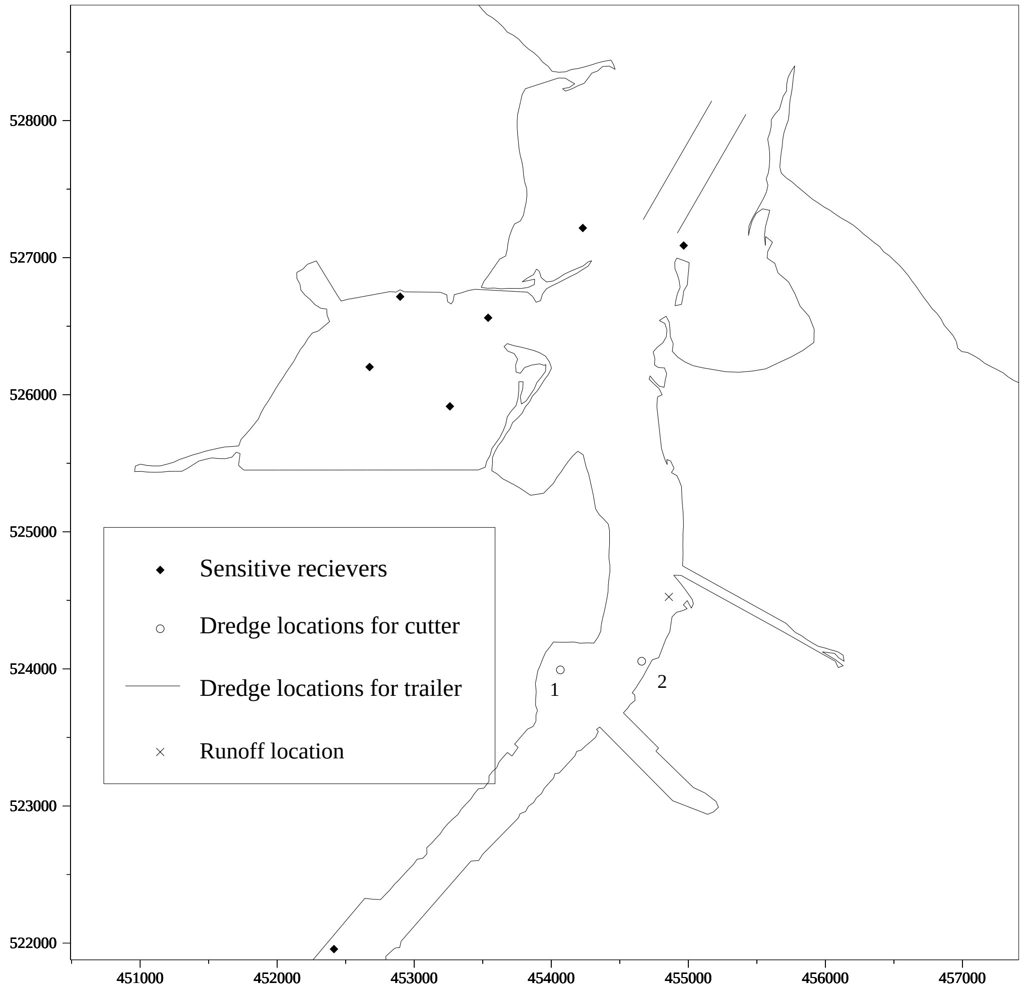
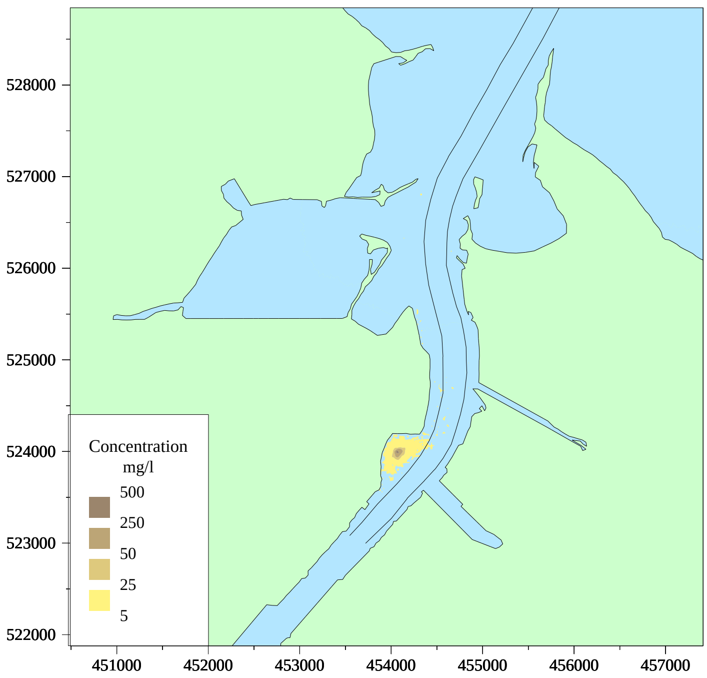


Figure 6.3 Simulated dredge locations for CSD and THDS and 'sensitive' receptor points

Implications of dredging using a cutter suction dredger

12. For all the dredger simulations, the largest rise in peak concentrations and deposition were in the immediate vicinity of the dredger, centred either at the location of the barge loading pontoon or along the line of the trailing suction dredger track. Figures 6.4 to 6.5 show the results from the simulation of the CSD in terms of predicted peak concentration of suspended sediments and peak deposition on the seabed arising from dredging at the two upstream locations.

Spring Tide - Peak Concentration



Spring Tide - Peak Deposition

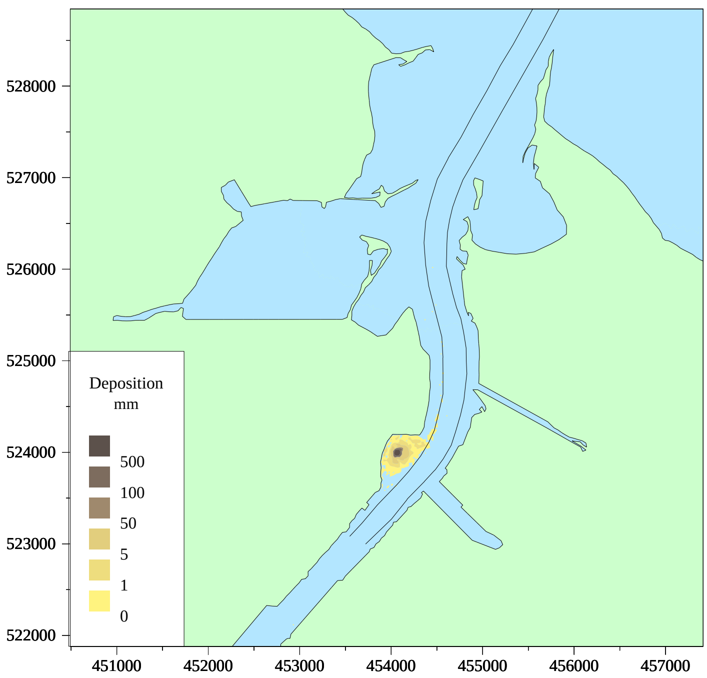


Figure 6.4 Peak concentration and peak deposition for cutter suction dredger at location 1, spring tide, low flow

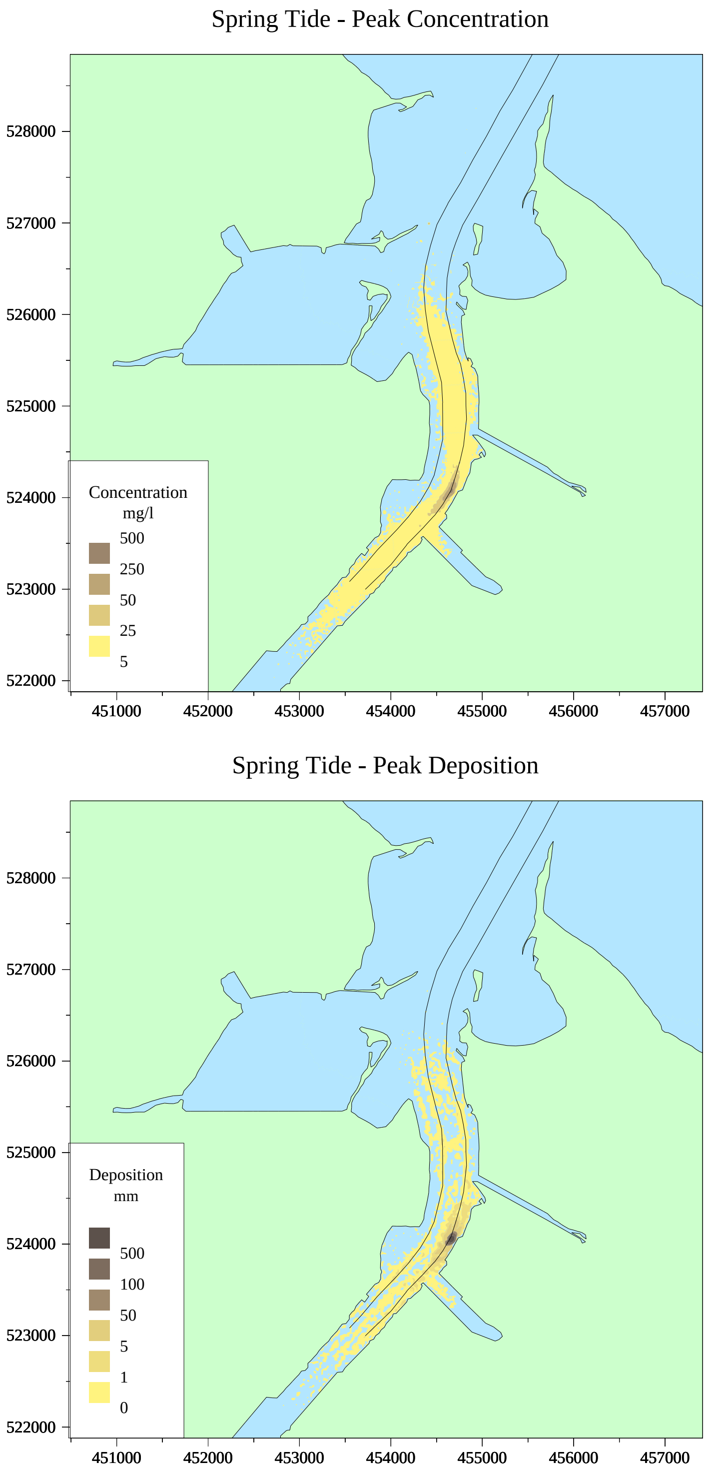


Figure 6.5 Peak concentration and peak deposition for cutter suction dredger at location 2, spring tide, low flow

13. The use of the CSD in the area of the reclamation and Tees Dock turning circle is predicted to increase suspended sediment concentrations by 500mg/l in the immediate vicinity of the barge loading site but beyond this immediate zone, the increase in concentration is predicted to be of the order of 25mg/l or less (see Figures 6.4 and 6.5).

14. Furthermore, peak deposition of material onto the seabed is also very localised to the barge loading site when dredging the Tees Dock turning circle (Figure 6.4). When dredging the area adjacent to the proposed reclamation, peak deposition of material onto the seabed is generally less than 5mm, with greater deposition in the immediate vicinity of the dredging activity (Figure 6.5). It should be noted that much of the material is predicted to deposit within the footprint of the dredging and/or reclamation and as such it would be re-dredged or would deposit within an area which has already been dredged.

15. The use of the CSD loading into barges on one or other side of the main channel limited the cross-channel dispersion of fines and a significant reduction in peak concentrations from one side of the channel to the other was predicted with the most dispersion along the main direction of flow. This would suggest that locations across the channel from the barge loading site would not receive as much sediment as those along the channel.

16. In the CSD scenarios simulated, the dredging of mudstone (with a single CSD) will take about 200 days. The total release of fine material into the estuary will be about 680,000 dry tonnes. The bulk of the released material is expected to accumulate in the subtidal areas of the Tees Estuary (there will be less dispersion on neap tides). Depending on the degree to which the released material consolidates and/or mixes with sandier material the volume of additional material (over and above normal maintenance requirements) arising from this source could be as much as 1,400,000m^3. This material would need to be redredged as part of the capital works or subsequent maintenance dredging and disposed offshore. Some accumulation of this material in the deepened berths adjacent to the channel is to be expected.

Implications of dredging using a trailing suction hopper dredger

17. For spring tide conditions with low freshwater flow, the effect of dredging sandy material with a TSHD in the approach channel and pumping ashore at the reclamation site is shown in Figure 6.6. It can be seen that peak concentrations between 500mg/l and 1000mg/l occur along the dredger track and in the vicinity of the run-off from the reclamation. Increases in suspended sediment concentrations above those occurring with the CSD are predicted. Concentrations of up to 50mg/l are also predicted over parts of Seal Sands and up to 25mg/l in the Seaton Channel. This scenario results in a fraction of a millimetre of deposition on Seal Sands per tide (up to 0.05mm for the three tides simulated) (see Figure 6.7). The effect of dredging in the approach channel on suspended sediment concentrations over Seal Sands and in the Seaton Channel is further illustrated by reference to Figure 6.8 and 6.9.

18. In the scenario simulated, the dredging of sand will take about 30 days. The total release of fine material into the estuary will be about 225,000 dry tonnes. Of this material it is predicted that about 0.2% will accumulate over the approximate 1km^2 of Seal Sands. The SEDPLUME model assumes that the accumulations of material occur with a dry density of 500kg/m^3. Thus if the 0.2% of the released material were distributed uniformly over Seal Sands it would form a deposit about 1mm in thickness.

19. This deposit would form over spring tide periods only and if significant wind wave action occurred it would be expected to be resuspended. A similar proportion of the released fine material is predicted to accumulate in Seaton Channel (approximately 500m^3). The bulk of the released material (80-90%) is expected to accumulate in the subtidal areas of the Tees Estuary. Depending on the degree to which the released material consolidates and/or mixes with sandier material the volume of additional material (over and above normal maintenance requirements) arising form this source could be as much as 400,000m^3. This material would need to be redredged as part of the capital works or subsequent maintenance dredging and disposed offshore. Some accumulation of this material in the deepened berths adjacent to the channel is to be expected.

20. As for the CSD, the use of a TSHD is predicted to have little influence on suspended sediment concentrations and deposition at Bran Sands and North Gare Sands.

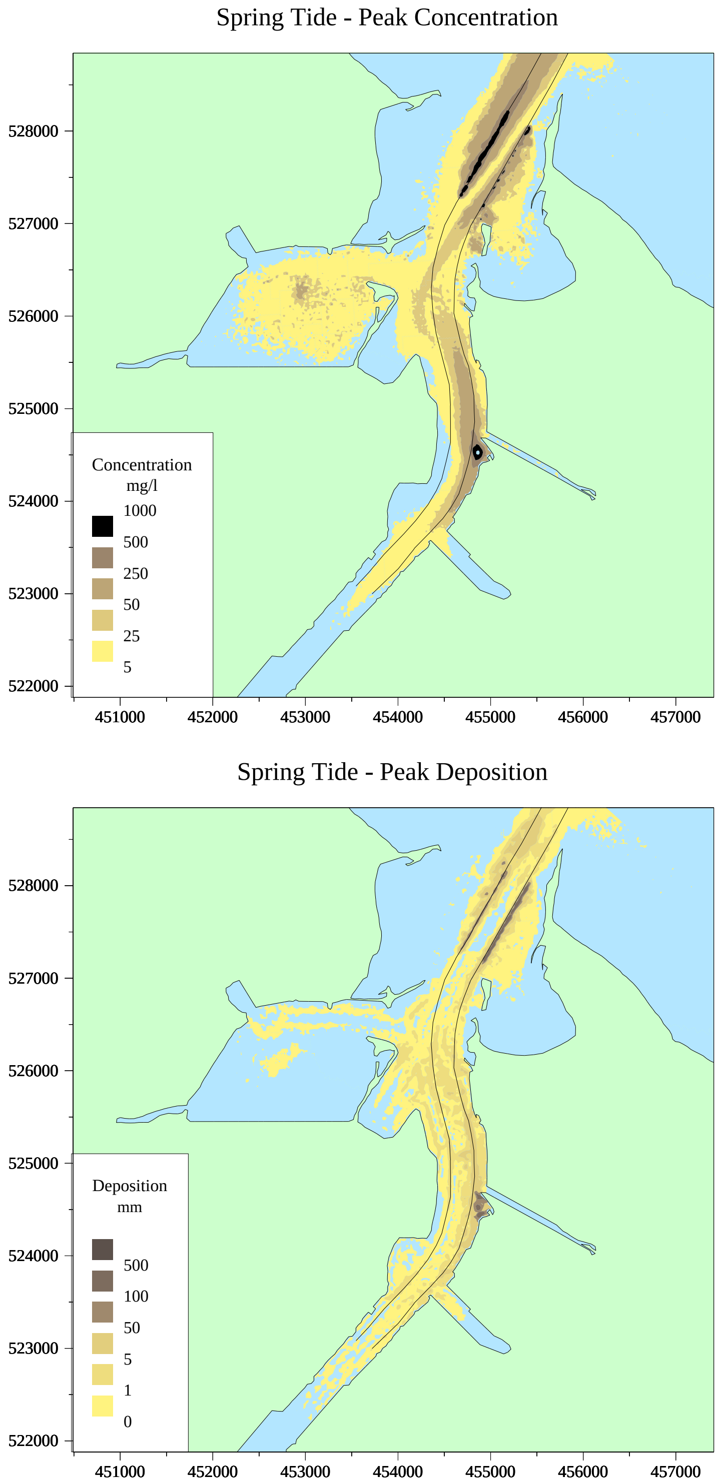


Figure 6.6 Peak concentration and deposition for TSHD dredging sand in the approach channel, spring tide, low flow conditions

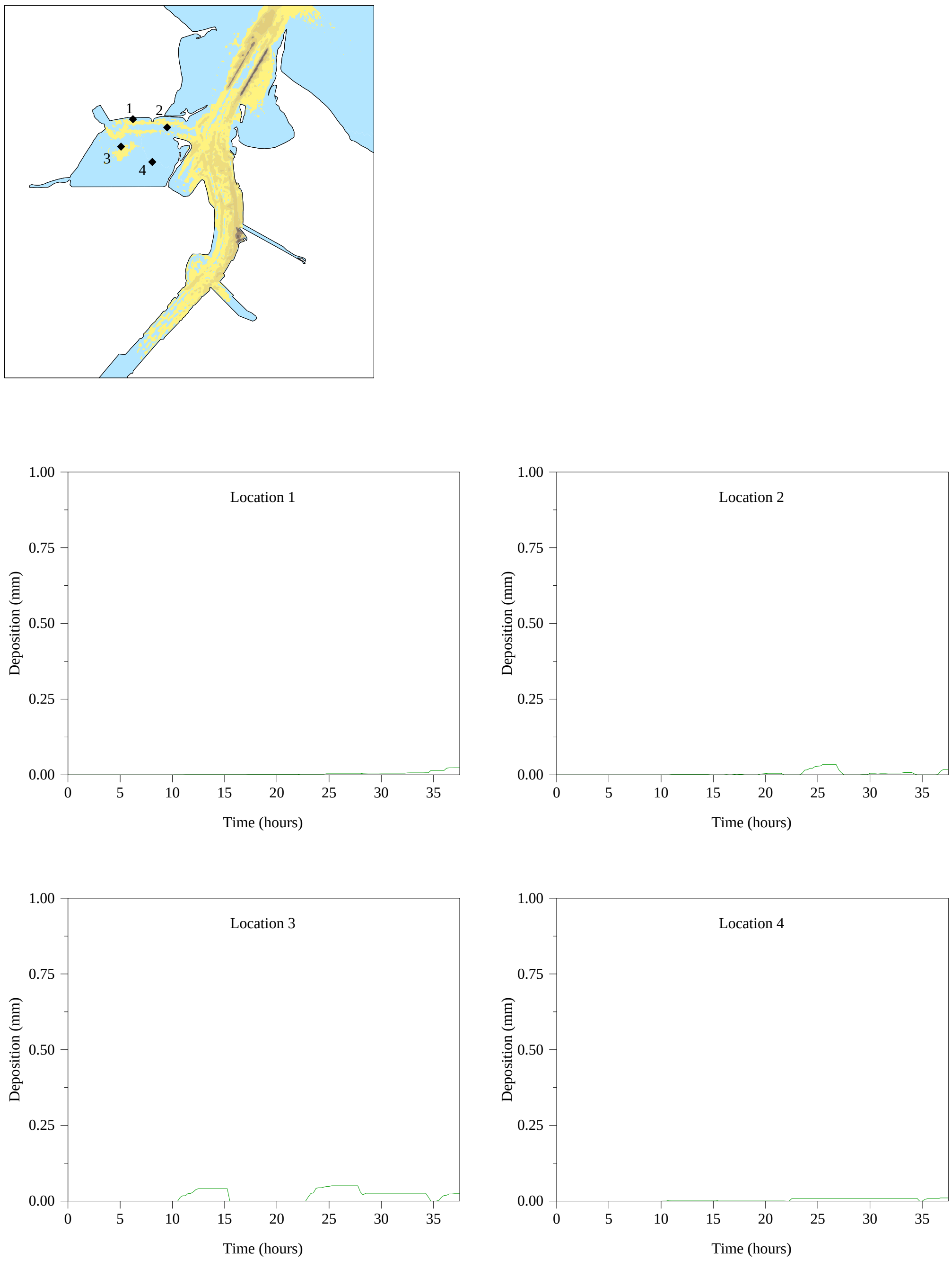
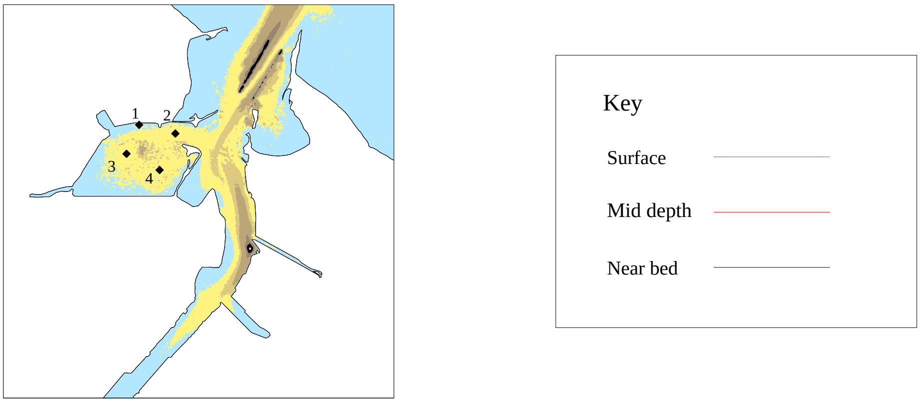


Figure 6.7 **Time histories of deposition in Seaton Channel (Locations 1 and 2) and Seal Sands (Locations 3 and 4) for TSHD dredging sand in the approach channel, spring tide, low flow conditions**



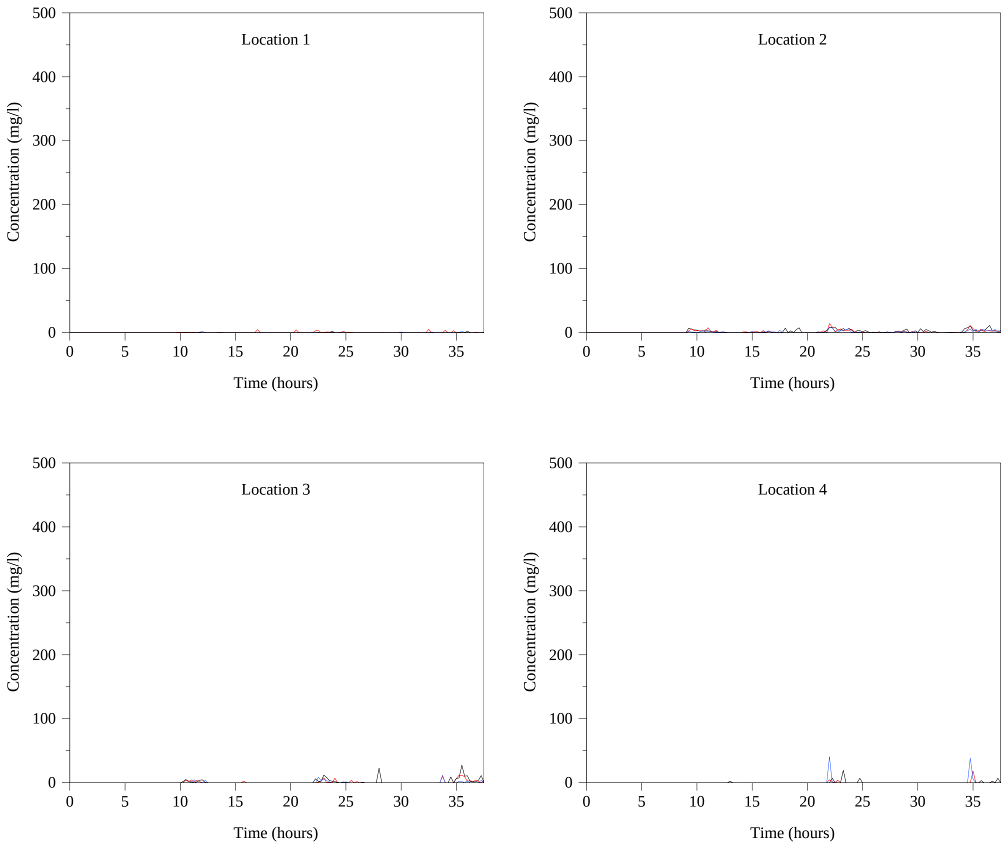


Figure 6.8 **Time histories of concentration in Seaton Channel (Locations 1 and 2) and Seal Sands (Locations 3 and 4) for TSHD dredging sand in the approach channel, spring tide, low flow conditions**

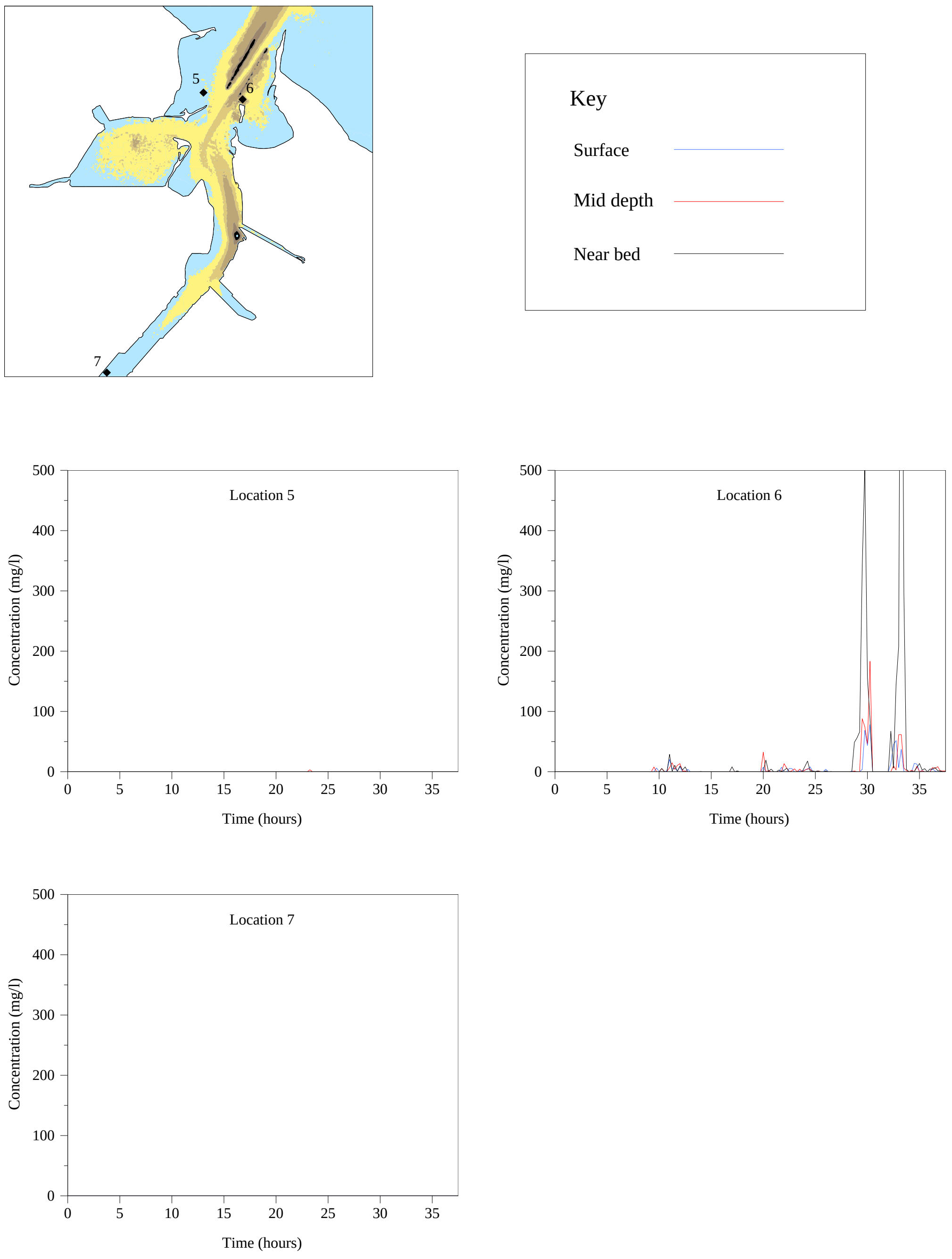


Figure 6.9 Time histories of concentration at Bran and North Gare Sands for TSHD dredging sand in approach channel, spring tide low flow conditions

21. The full results of the simulated scenarios are presented in HR Wallingford (2005) (Accompanying Document 1).

6.4 Prediction of post construction effects

6.4.1 Introduction

1. The proposed development has the potential to influence the hydrodynamic regime of the Tees estuary and its approaches due primarily to the deepening of the approach channel. The deepening has the potential to affect the tidal and gravitationally driven currents with knock on effects for sediment transport and patterns of erosion and deposition.

2. The studies described in this section are covered in more detail in the technical report of the hydrodynamic and sedimentological studies to support the EIA (HR Wallingford, 2005; Accompanying Document 1).

6.4.2 Tidal flow studies

Model establishment

1. A TELEMAC-3D flow model was set up to simulate currents in the Tees Estuary and Tees Bay. TELEMAC-3D is a state-of-the-art finite element flow model, originally developed by LNHE Paris, which uses a completely unstructured grid enabling the accurate simulation of water movement in complex shaped areas. TELEMAC-3D also includes vertical layers, enabling three-dimensional flow structures in the river to be accurately represented. Distribution of salinity, and its evolution, can be modelled. Further details of the TELEMAC-3D model are provided in Malcherek et al (1996).

2. The model's upstream limit is at the Tees Barrage, and extends to 6.5km offshore in Tees Bay, covering an area of approximately 80km^2. The mesh resolution varied from 800m at the seaward model boundary, to 50m over most of the estuary, and 30m in narrow sections. The model domain and detail of the model mesh are shown in Figures 6.10 and 6.11 respectively.

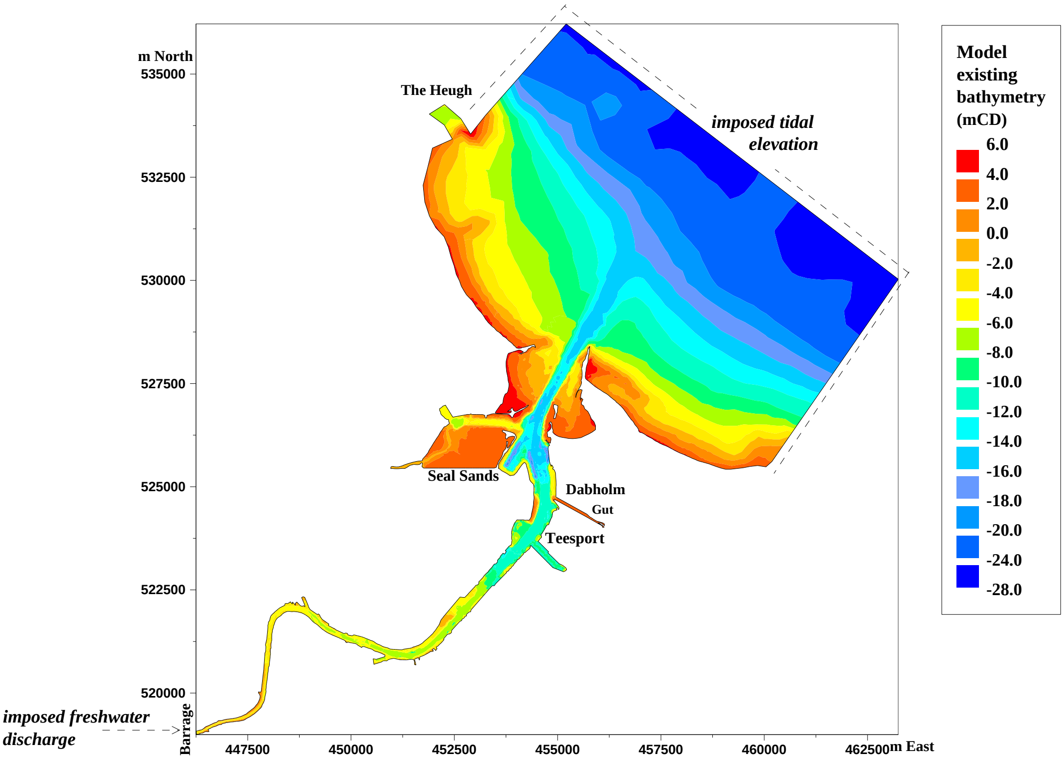


Figure 6.10 Flow model domain

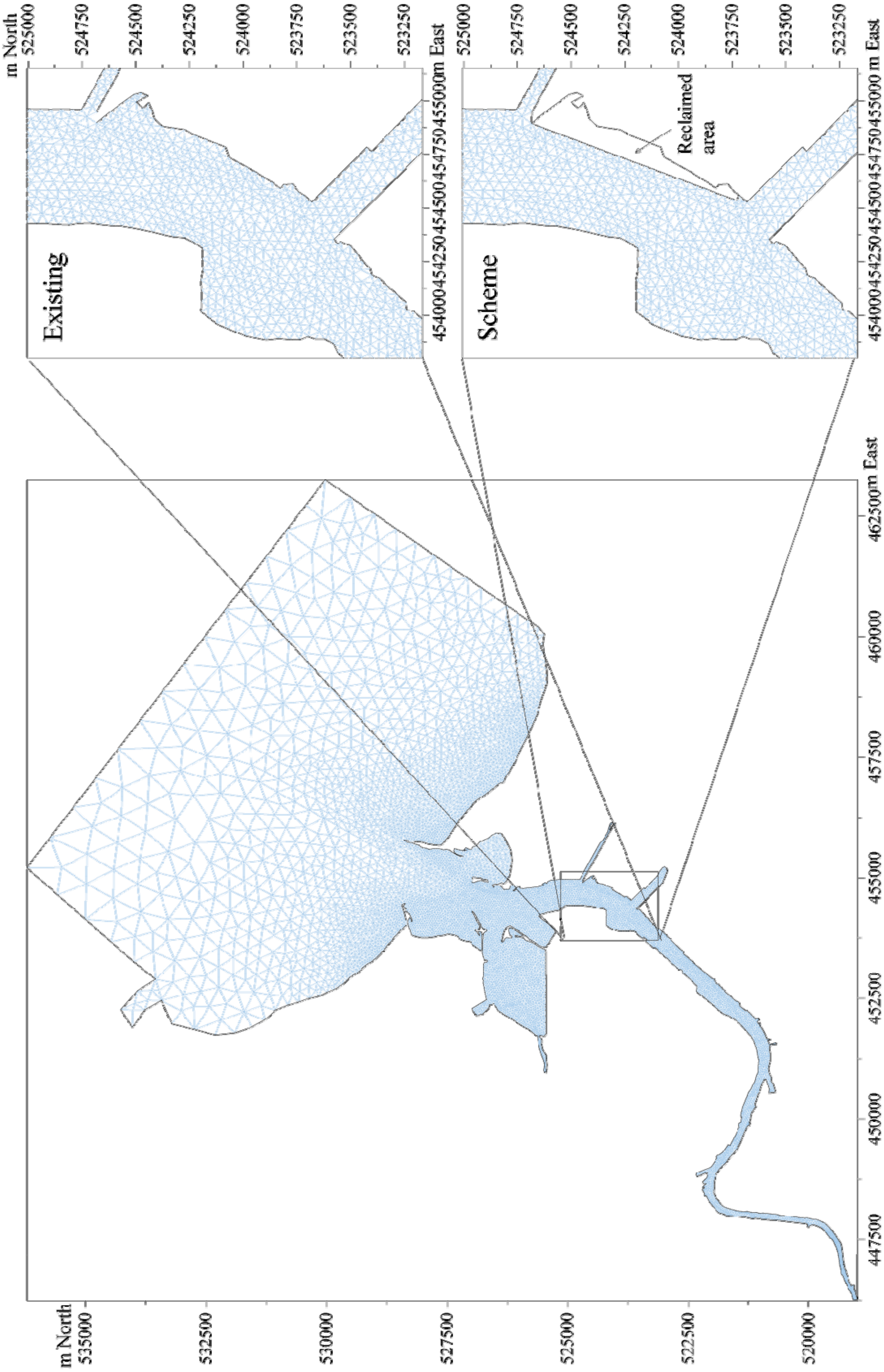


Figure 6.11 Model mesh (existing and with the scheme in place)

3. The credibility of the model is assessed by comparison with observations made in the estuary. The model parameters are adjusted until the closest match between model and observations (i.e. calibration) is achieved. When the model is rerun with the same parameters but for a different set of conditions (e.g. a different tide/freshwater input), and a satisfactory match with corresponding observations is still achieved, the model is considered to be validated.

4. The model was compared to low flow conditions measured by Acoustic Doppler Current Profiler (ADCP) undertaken on 15th and 16th June 1995 (after the construction of the barrage) (see HR Wallingford (1995) for further detail about these observations). The large spring tidal range at the time of the observations was approximately 5.0m (compared to a mean spring tide range of 4.6m). Freshwater discharge at the time was negligible. The model was further compared to high flow conditions measured between 22nd and 30th April 2005, during various tidal and freshwater conditions. Figure 6.12 shows the locations of the eleven ADCP transects, together with seventeen points extracted for time-series comparison with the model.

Figure 6.12 Locations of ADCP transects

5. Table 6.5 describes the dates, tides and freshwater discharges for the days of measurement.

Table 6.5 Details of April 2005 measurement program

Date (April 2005)	Transects	Tidal range (m)	Barrage discharge (cumecs)		
			Min	Max	Mean
22nd	1,2,3,4	3.5m	0.8	23.2	10.8
25th	-	4.5m	0	131.5	36.4
26th	5,6,7	4.6m	0	27.5	7.7
27th	8,9,10	4.5m	0	64.1	11.3
28th	11,1,2,3,4	4.1m	0	37.5	15.9
29th	5,6,7	3.7m	0	41.2	11.6
30th	3,5,7	3.2m	0	41.2	11.6

6. Vectors of depth-averaged observations (Transects 1 to 4, 28th April) are shown with the equivalent model results (mean spring tide, 14 cumecs freshwater) in Figures 6.13 and 6.14 for four hours after and before HW respectively. The model is shown to capture well the qualitative nature of the flow on both the ebb and flood – the strength and direction of currents, and the presence and position of eddies in the depth-mean flow are well represented by the model.

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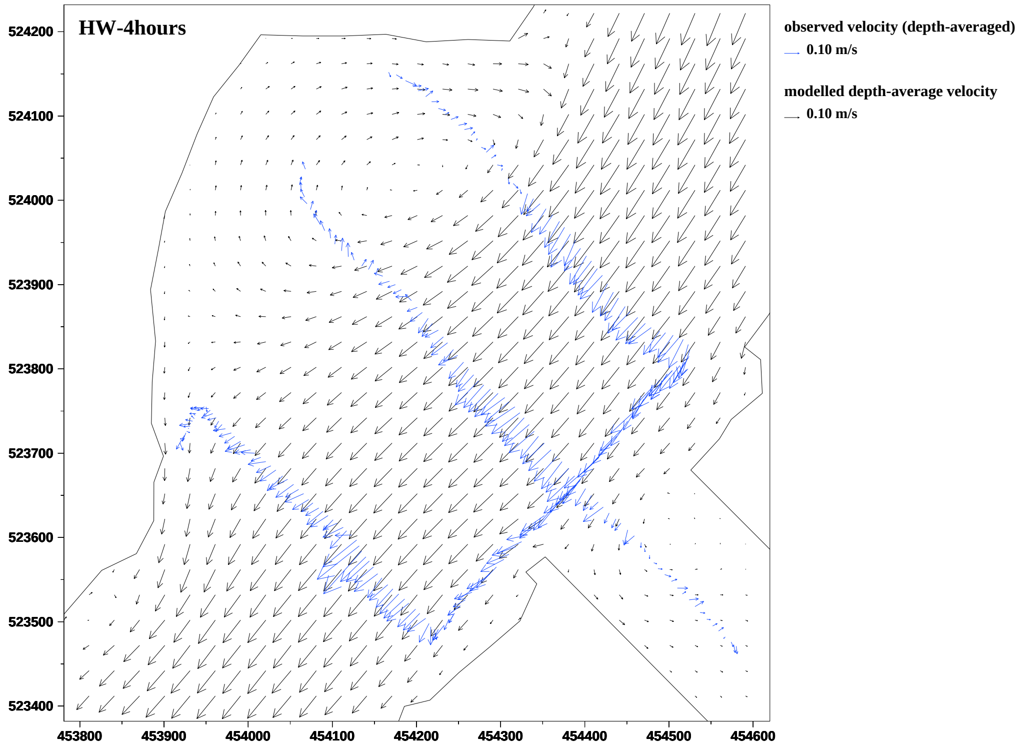

Figure 6.13 Comparison of observed and simulated depth average current at peak flood

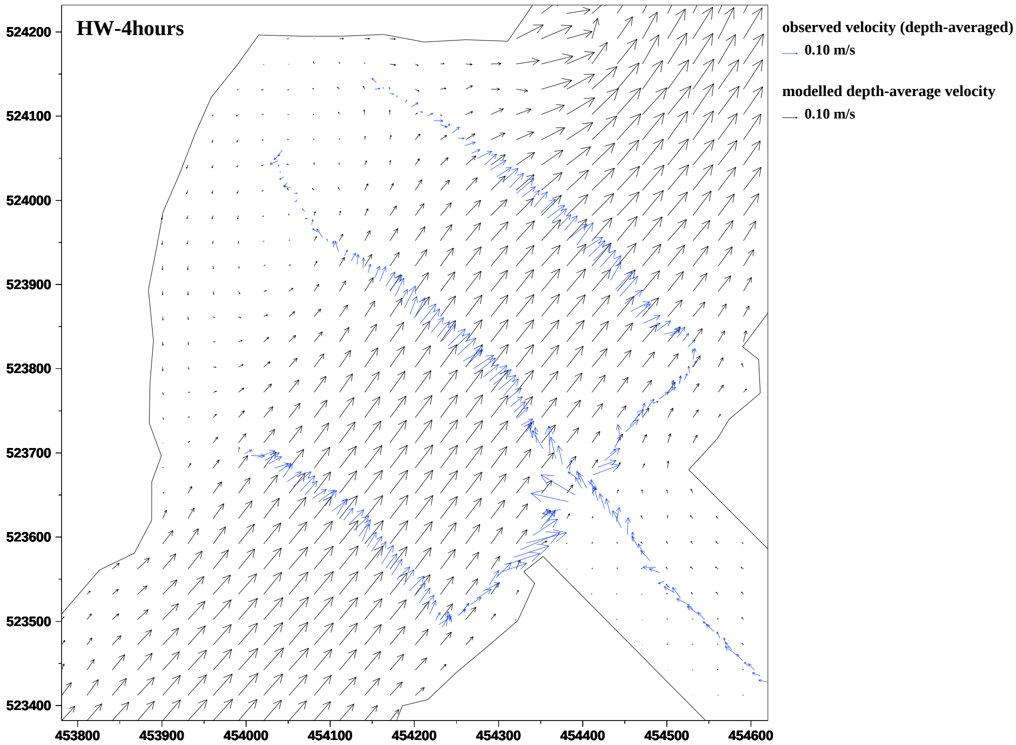

Figure 6.14 Comparison of observed and simulated depth average current at peak ebb

7. Further comparison between the model and measurements can be made by considering time histories of speeds and directions at the selected points. An example of the three-dimensional behaviour of the model is also assessed in Figure 6.15, below, which shows near-surface, mid-depth and near-bed currents

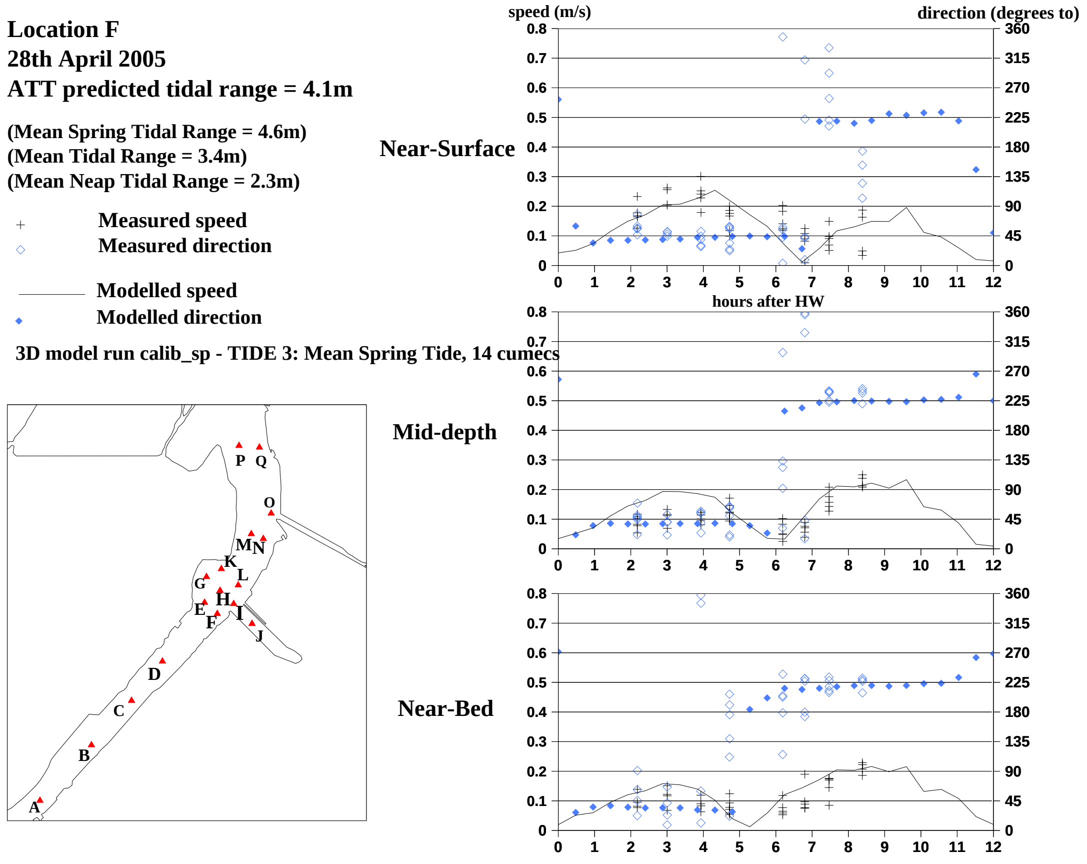

Figure 6.15 Example of model comparison with time series data

8. The vertical structure of the flow is reproduced well by the model. On days where the freshwater has a significant impact on flow, a different vertical structure occurs during the ebb and flood (seen in 27th and 28th April):

- At the surface, ebb flow often exceeds flood flow, since the less dense, downstream-flowing freshwater, enhances the ebb flow whilst opposing the flood.
- At the bed, flood flow often exceeds ebb, since the inflowing denser salty water is confined to the lower part of the water column, and must compensate for the reduced flood flow at the surface.

Predicted effects of the development

9. Having achieved adequate comparison with the observed currents for high and low flow cases for a variety of tide ranges the model was adjusted to include the

presence of the proposed channel dredging and reclamation. The model was then run for spring and neap tides for high and low flow cases.

10. The peak ebb depth average currents with and without the development for low flow spring tide case is shown in Figure 6.16. This gives a general idea of the footprint of direct effect of the proposed development on tidal currents.

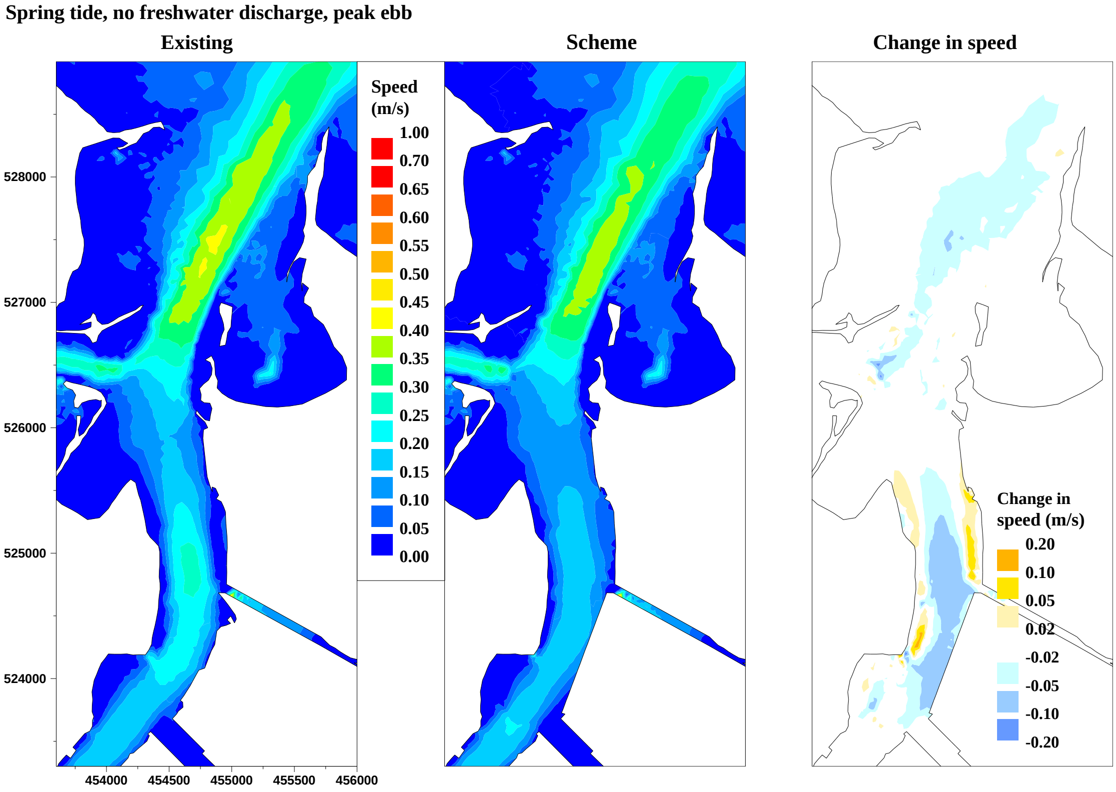

Figure 6.16 Speed magnitude changes from scheme for peak ebb spring tide, low freshwater flow

11. Further results from the tidal flow modelling studies are presented below. The following plots show the effects of the scheme on tidal flow speeds under different conditions. Figure 6.16 shows peak flood depth average currents for the low flow spring tide case. Figures 6.17 and 6.18 show the predicted effects of the proposed scheme on tidal currents for high flow (i.e. 'wet' conditions) on spring tides. Results for neap tide conditions under high and low flow scenarios have also been produced and are presented in Accompanying Document 1. In summary, the results for neap tide conditions show less widespread effects on tidal current speeds than for spring tide conditions.

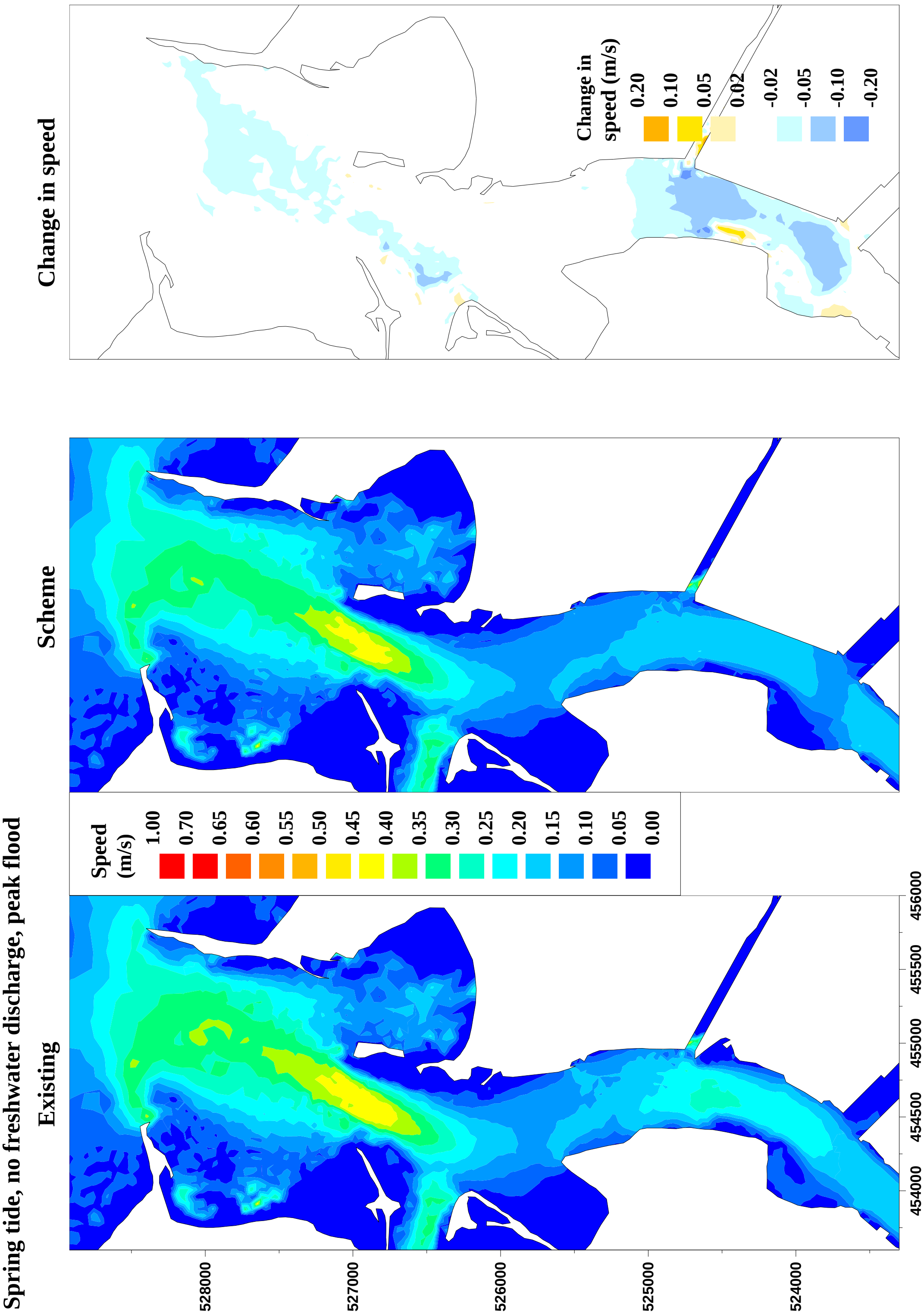

Figure 6.17 Dry spring conditions: depth-mean flood speed (existing, scheme, difference)

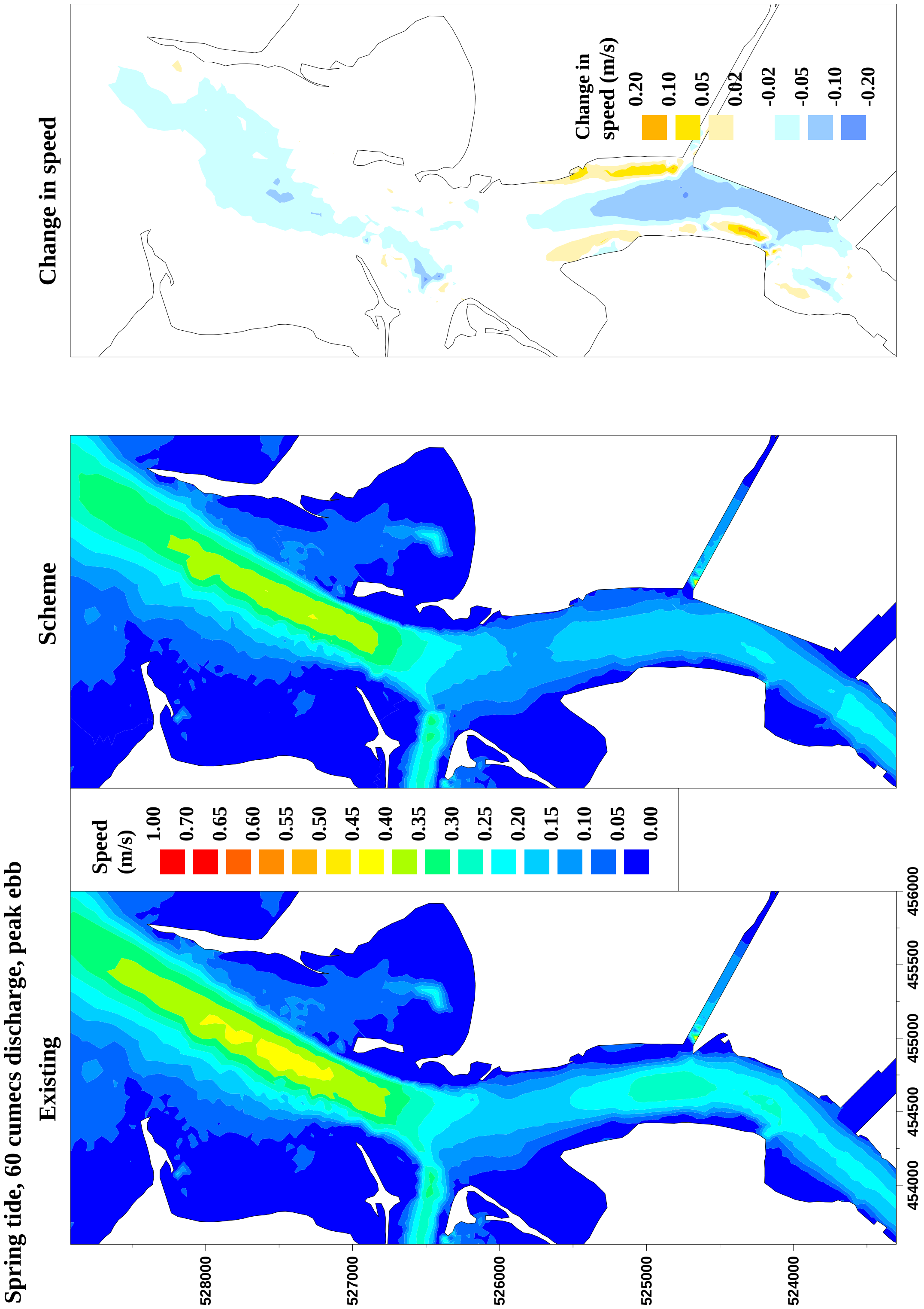

Figure 6.18 Wet spring conditions: depth-mean ebb speed (existing, scheme, difference)

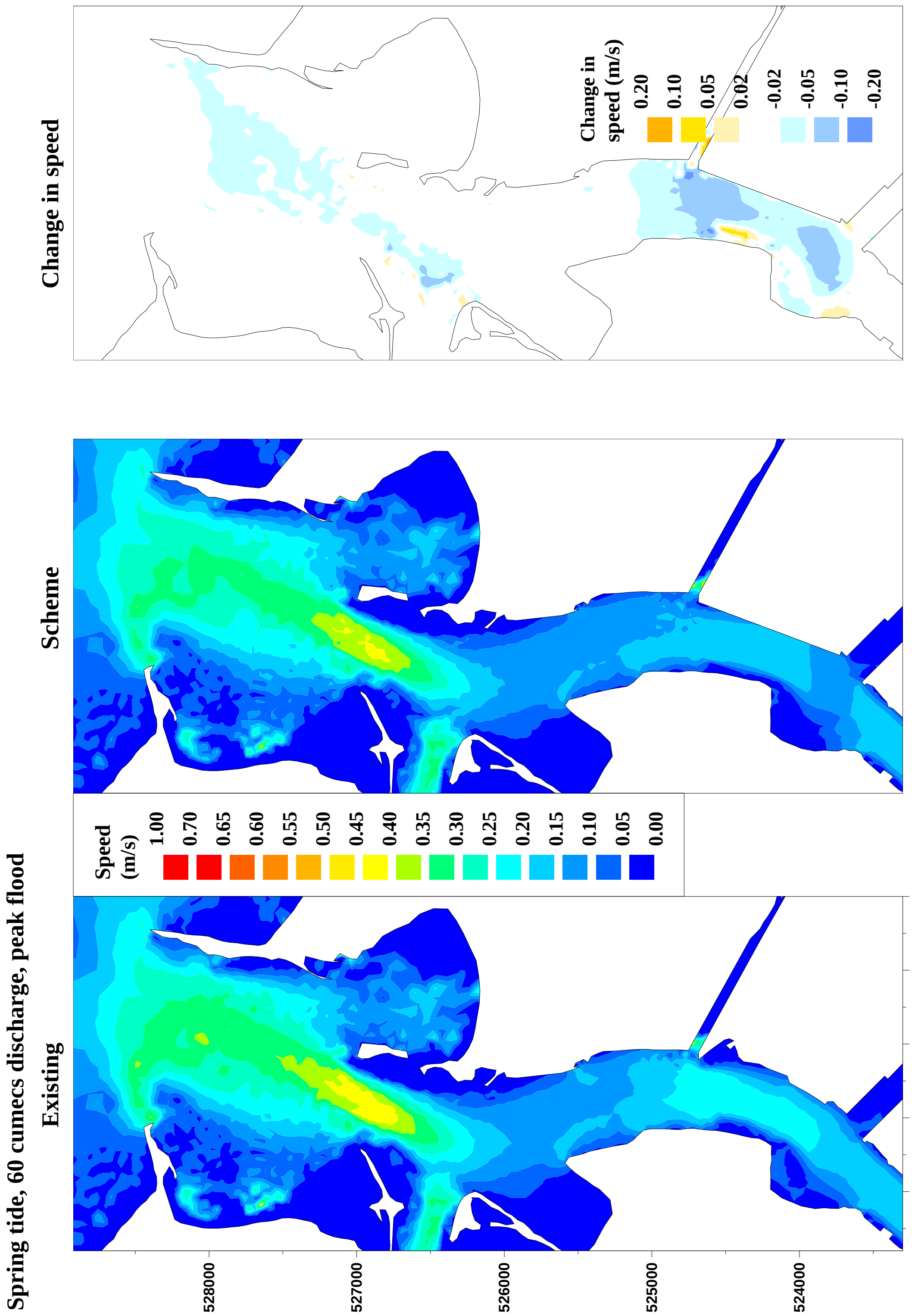

Figure 6.19 Wet spring conditions: depth-mean flood speed (existing, scheme, difference)

12. It can be seen that the pattern of change in tidal current speeds as a consequence of the proposed scheme is not dissimilar for dry (i.e. low flow) and wet (i.e. high flow) conditions. In all cases, changes in current speeds are predicted in the estuary in the vicinity of the proposed development and at the mouth of the estuary. Overall, the predicted effect on current speeds can be described as being of low magnitude.

13. In the vicinity of the proposed development, the general result is for a predicted decrease in current speeds of up to 0.10m/s, with localised decreases of up to 0.20m/s under wet conditions. Increases in current speeds of a similar order of magnitude are predicted for closer to the shores of the estuary. This area (adjacent to the proposed reclamation) experiences the greatest effect on flows.

14. Further downstream at the mouth of the estuary, very little effect on tidal current speeds is predicted. The general prediction here is for decreases in current speeds of the order of 0.05m/s.

15. The patterns of speed change would not be significantly altered by the presence of the proposed dredged side trenches in the area upstream of Redcar.

16. Further detail in assessing the effect of the development on the density driven current is shown by plotting a time series of current for near surface, mid-depth and near bed currents opposite the ConocoPhillips Oil terminal (location 454582mE, 525505mN). Figure 6.20 shows the current for existing and proposed conditions. At this site, where a very distinctive freshwater-induced depth variation in flow is seen, the surface flood tide currents are suppressed by the scheme, whilst the near bed flood current is enhanced. This result would suggest that the deepening will enhance the near bed landward flow for conditions with significant freshwater flow. For low flow cases a more straightforward reduction in tidal currents is predicted at all depths.

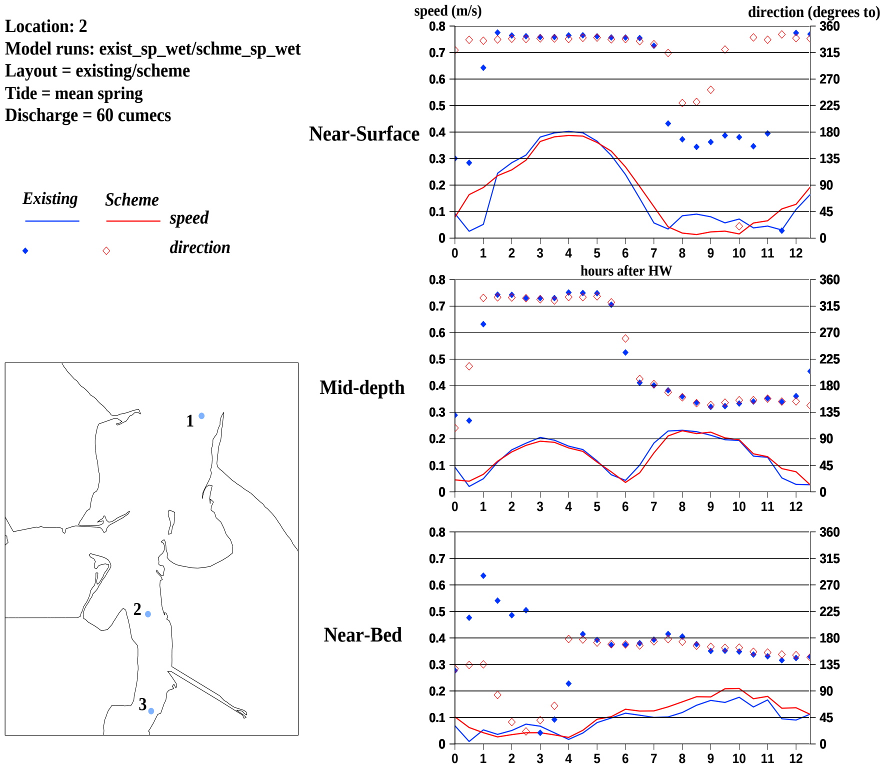

Figure 6.20 Change in time vertical structure of velocity from scheme, spring tide, high flow

17. In the immediate area of the reclamation some changes to current direction are predicted as the overall cross sectional shape of the estuary is changed. This feature is most markedly shown in Figure 6.21 which shows vectors for wet spring ebb flows respectively. A more striking impact is seen on the flow pattern, with fast surface ebb flows favouring a straighter route around the channel bend adjacent to the reclamation, whilst deep ebb flows are slowed over much of the area.

18. The effect of the scheme on three dimensional currents would not be expected to be altered by the presence of the proposed side trenches in the channel upstream of Redcar.

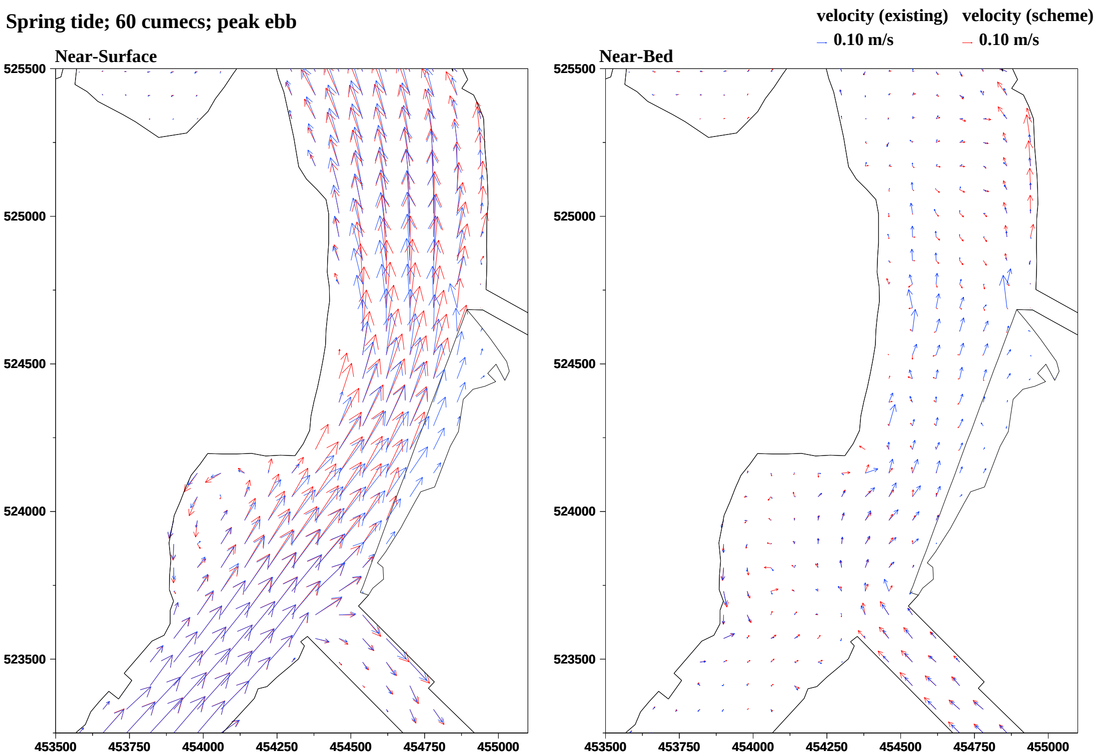

Figure 6.21 **Change in near surface and near bed current pattern from Scheme, spring tide, high flow case**

19. The scheme is predicted to have a very small effect on water levels as shown in Table 6.6. Tidal range is increased by less than 4mm; the tide arrives up to 2 minutes earlier. This effect is not expected to be changed by the presence of dredged trenches at the edges of the channel.

Table 6.6 Impact of scheme on height and timing of high and low waters

	Tees Approach Channel (Location 1)		Adjacent to proposed reclamation (Location 3)		Near barrage	
	Elevation	***Timing***	***Elevation***	***Timing***	***Elevation***	***Timing***
HW	No change	No change	0.001m higher	No change	0.002m higher	2 minutes earlier
LW	No change	No change	0.002m higher	1 minute earlier	0.002m lower	2 minutes earlier

6.4.3 Wave studies

Model establishment

1. As part of the studies, the implications of the proposed scheme on wave conditions in the area have been studied using a third generation wave model (SWAN, acronym for **S**imulating **WA**ves **N**earshore).

2. SWAN includes the effect of reflection from structures, refraction and shoaling, friction, wave breaking and wave-wave interactions. The model also includes wave generation by wind within the model area.

3. The wind and wave conditions tested in the model were derived from the wind and wave climates presented above (Section 6.2.2). These conditions were combined into a series of representative wind-wave combinations covering a range of directions and magnitudes for each.

Predicted effects of the development

4. The effects of the scheme are best illustrated by considering the wind and swell components separately. Wind waves that are generated within the estuary (short period waves) are predicted to be affected by the reflective properties of the container terminal but, as they are short period waves, they are unaffected by the increased depth of the channel. Swell waves (long period waves from offshore) do not penetrate far into the estuary and, therefore, are not affected by the container terminal. Swell waves are, however, affected by the increased depth of the channel in the lower estuary. Predicted changes to the wave climate are described below.

5. The prevailing south-westerly winds run along the Tees estuary and reflect northwards off the south bank of the estuary in the Teesport area. The wind speed applied here (20 m/s) has an exceedence of 1.2%. Figure 6.22 shows the reflection pattern, which extends as far as the North Gare breakwater. However, the change in significant wave height is small, being less than 10cm throughout. Tests with 30m/s south-westerly winds showed stronger waves, with the same pattern of change and a maximum increase in significant wave height of 10cm. This pattern would not be altered by the presence of dredged trenches at the edges of the channel as the water depth in the deepened channel already exceeds the depth at which the short period waves are affected by further increases to the bed depth.

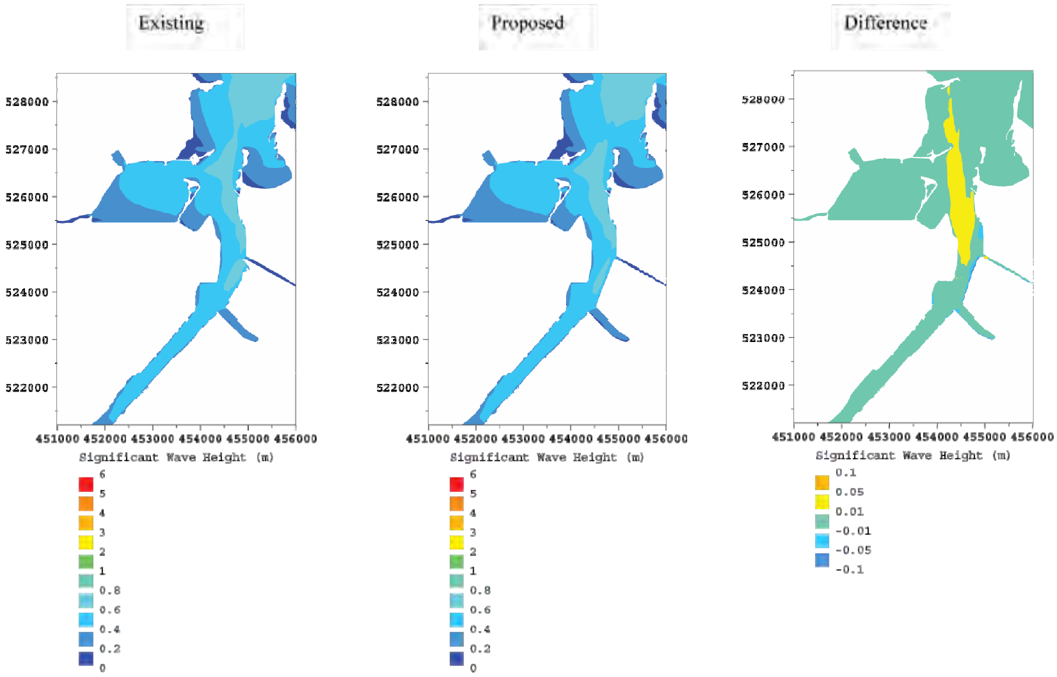

Figure 6.22 Change in wind induced waves for 20 m/s wind from SW

6. Figure 6.23 shows the effect of the proposed scheme on swell from offshore with significant wave height 6m approaching from 30°N. This condition has an estimated return period of 1 year. These long period waves are reflected on the side of the dredged channel and reach the area around the ConocoPhillips Oil Terminal, increasing the significant wave height on the western side of the ConocoPhillips Oil Terminal in ConocoPhillips Dock by up to 30cm. The increased reflection is due to the deepening of the channel (surveyed to be shallower than the stated 14.1m below CD in places) to 14.5m below CD. The increased reflection within the channel leads to a slight decrease in significant wave height for swell waves on North Gare Sands and Bran Sands. The pattern of change was similar for all return periods modelled, with increases of up to 30cm at the ConocoPhillips Oil Terminal for an incident 6m swell wave. This equates to an increase in of approximately 25% in significant wave height over existing conditions for these extreme cases. The direction of the incoming swell had only a slight effect on the changes to significant wave height as a consequence of the channel deepening.

7. The predicted changes to swell have heights would not be significantly changed by the inclusion of dredged side trenches in the channel upstream of Redcar as very little of the swell wave energy penetrates that far into the Estuary.

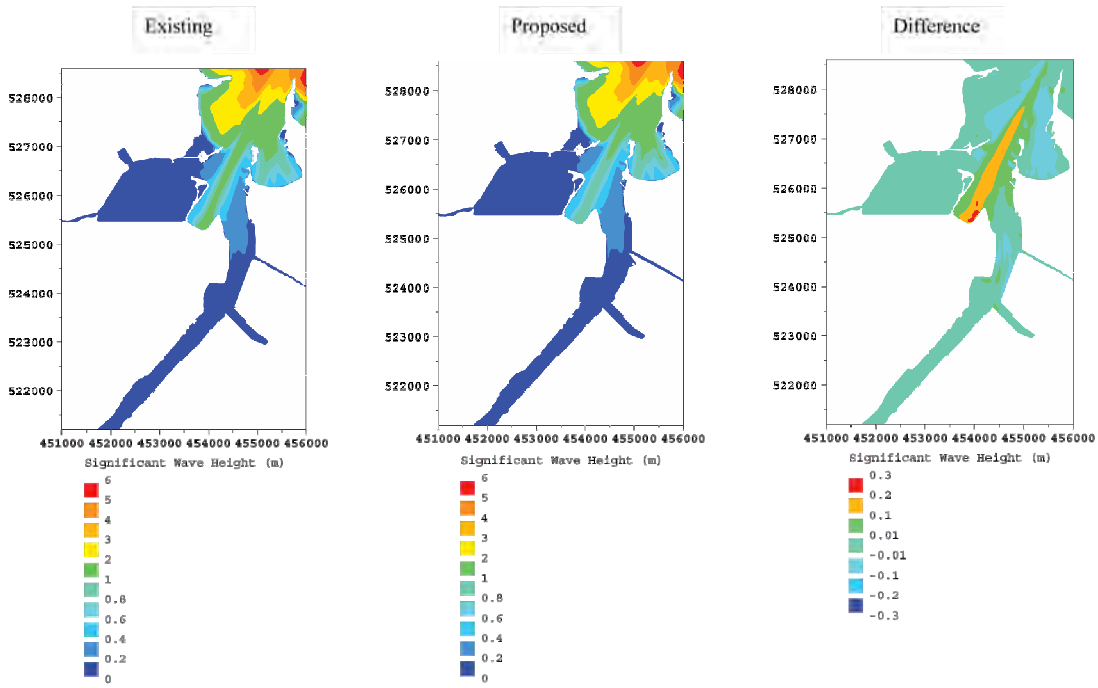

Figure 6.23 Change in swell wave heights for 6m swell wave from 30° N

8. Much of the predicted change in wave conditions at the mouth arises from the fact that there is presently a backlog of maintenance dredging at this location in the channel. A sensitivity test was undertaken to illustrate the effect of reinstating the channel to the presently declared depth of 14.1m below CD. This sensitivity test was run for 6m swell from 15°N. The results showed that about half of the increase in wave height in the channel and reduction of wave height over Bran Sands and North Gare Sands was due to the re-establishment of the channel edges to the declared depth. The implication of this sensitivity test is that the presented changes in the wave climate from changing the channel depth from 14.1 to 14.5m below CD are enhanced because the baseline case included in the model was shallower than 14.1m below CD along the edge of the channel. PD Teesport could dredge to 14.1m below CD at this location at present without consent and would be expected to do so to maintain the current port operation. The effect, therefore, of the proposed scheme on wave heights is in reality half that described above.

6.4.4 Non-cohesive sediment studies

1. Sand transport simulations were performed with the HR Wallingford model, SANDFLOW. SANDFLOW is a dynamic non-cohesive sediment (sand) transport model that simulates the advection and dispersion of suspended sediment due to the effects of both currents and waves. The sediment transport algorithm is based on a formula developed by Soulsby (1997).

2. SANDFLOW was used to simulate the sediment transport patterns throughout the Tees estuary due to tidal conditions alone, and including the effects of wave stirring for typical (representative) waves and for storm waves. The resulting infill in the approach channel was calculated for the existing scenario and

subsequently including the proposed scheme. Comparison with average recorded dredging volumes for the outer areas of the navigation channel (areas 9 to 13) confirmed that the processes responsible for the channel infill are in fact storm-related, whereby the larger storm waves give rise to wave-driven currents which serve to drive sand into the outer channel. Sandy sedimentation rates in the area around the Seaton Turning Circle (Chart 9) are also significantly contributed to by sedimentary events, involving the slippage of sediment that has built up on the side slopes of the maintained areas. The results of the model simulations indicated that there will be only a small change in volume of infill due to tides and wave stirring, so that storm infill will remain the dominant mechanism.

3. Under storm wave conditions a small reduction in wave energy over the adjacent intertidal areas at the estuary mouth is predicted following deepening of the channel, but otherwise the development does not alter the wave dynamics substantially. On this basis it is concluded that the principle mechanism for infill in the dredged areas will be largely unchanged by the development and hence the infill rates in the operational phase will be very similar to the present day. Sand infill in the outer parts of the navigation channel is not, therefore, expected to increase substantially. This is to be expected given the relatively small increase in the channel depth for this area.

6.4.5 Cohesive sediment studies

Model establishment

1. As described in Section 6.2.3 the fines content (silts and clay) of materials dredged are of the order of 20-25% of the total accumulation (PDT, *pers. comm*.).

2. Mud transport modelling has been undertaken to examine the behaviour of the mud fraction following the proposed channel deepening in order to examine the potential for effect on the maintenance dredging requirement in the estuary and potentially, as a consequence, the sediment dynamics of intertidal areas.

3. As described in Section 6.2, the bulk of fine sediment enters the system during the flood tide period having been resuspended from the seabed in Tees Bay (i.e. the main source is offshore). Once within the estuary, fine sediment is pushed further landward by the gravitational circulation present, possibly with additional resuspension and upstream movement as a result of agitation by dredging activities or vessel passage.

4. The chosen model for the study of fine sediment transport was SUBIEF3D which is a post processing transport model within the TELEMAC system. SUBIEF3D uses the hydrodynamics generated by TELEMAC3D to transport fine sediment with allowance for the deposition and erosion of material on the bed. Full details for the software are given in Luck (2002).

5. The selection of conditions simulated was as used for the Tees Barrage study (HR Wallingford 1989a) which divided the year into two periods; 'winter' /

'equinoctial' conditions (October to April) with the high fluvial flow and mud concentrations in Tees Bay of 125, 250 and 600 mg/l and 'summer' conditions with low fluvial flow and mud concentrations in Tees Bay of 125 and 250 mg/l.

6. This combination of conditions was run and a total infill rate of 560,000m^3/year was predicted (100,000m^3 in summer, 380,000m^3 in winter and 80,000m^3 from fluvial sources). This total is of the right order compared to *in situ* dredged volumes (approximately 300,000m^3/year fines) allowing for the use of a single assumed density of deposited material of 500kg/m^3, the modelled assumption of a large freshwater flow into the River Tees over the seven month period and the consequent larger than average gravitational circulation. This simulation suggests approximately 80% of the infill occurs during the seven month winter/equinoctial period (assuming most of the fluvial input is in the winter).

Predicted effects of the development

7. The simulated change in annual accretion of fine material is an increase of 60,000m^3/year; this represents an increase of about 10% over the prediction for the existing situation. The interesting result here is that the summer accretion volumes are predicted to decrease (to 60,000m^3) and the winter/equinoctial periods are predicted to increase (to 480,000m^3). This suggests a balance between two effects: with overall tidal currents reduced in the estuary mouth due to the deepening (leading to a reduction in summer infill) but with enhanced gravitational circulation leading to larger near bed landwards residual flows and an increase in infill during the winter/equinoctial periods.

8. Since the simulations undertaken covered more extreme freshwater flow conditions (60 cumecs for high flow and 0 cumecs for low flow) the predicted impacts (increase in winter period and decrease in summer period) are considered to be at the upper and lower limits of likely changes.

6.4.6 Plume studies of Dabholm Gut outflow

1. The dispersion of suspended solids released into Dabholm Gut through licensed discharges was simulated using the HR Wallingford developed model SEDPLUME-RW(3D). It should be noted that, as a consequence of the construction and operational phases of the proposed development, no additional discharges will be made to Dabholm Gut. The aim of the modelling was to examine whether the proposed development would result in a change to the dispersion characteristics of the discharge and, therefore, whether there was a potential for the development to result in a deterioration in water quality within the Tees estuary. The modelling comprised simulating the dispersion and deposition of particles introduced as a source at the head of Dabholm Gut.

2. The model predictions indicate that the distributions of suspended and deposited particulates from Dabholm Gut will be similar following the proposed development when compared to existing conditions. The main differences are that following the proposed development the core of the plume of suspended particles tends to be closer to the east bank of the Tees estuary than under existing conditions, so that deposition is enhanced near the eastern shore to the

north of Dabholm Gut. For spring tide conditions, deposition in the deepened Tees Dock turning circle is somewhat enhanced for the proposed layout, particularly in winter. However, although more material may deposit in various places compared to the present situation, the footprint of deposition will be unchanged.

6.5 Prediction of morphological change

6.5.1 Estuary-wide assessment of morphological change

1. The preceding sections present the findings of the flow, wave and sediment (mud and sand) transport studies. The effects that are predicted and described have the potential to impact on habitats throughout the estuary system during the operational phase and as such, are of importance for a number of aspects for example, marine ecology and ornithology. The overall effects on estuarine morphology are summarised below, with the implications for other environmental parameters described in the relevant sections of the ES.

2. The changes to the physical processes that have the potential to affect estuary morphology are summarised as follows:

- Reduced large-scale flows in the main deepened channel;
- Increased near bed landward residual flow;
- Slightly increased tidal range towards the Tees Barrage;
- Increased import of fine sediments resuspended in Tees Bay;
- Increased reflection of wind waves within the estuary from the reclamation;
- Increased swell wave heights in the deepened channel; and
- Reduced swell wave heights over the intertidals at the mouth of the estuary.

3. The implications of these predicted changes to the physical processes are described below for various zones within the estuary.

4. It should be noted that in the context of the Tees estuary, the seaward part of the proposed capital dredge introduces only minor changes to the existing bathymetry and consequently the extent of hydrodynamic change is small. However, the orientation of the estuary mouth is sensitive to storm wave direction and minor changes to the slopes of the entrance channel are predicted to result in increased wave penetration into the Phillips Basin and corresponding reductions in wave energy over North Gare and Bran Sands. There is considerable variability in storm wave action and severity from one storm to the next and throughout one year to another. Consequently the significance of the impact on storm waves must be considered against this context.

Subtidal area between the proposed development and the Tees Barrage

5. The tidal range is predicted to increase by a very small amount (4mm for spring tide conditions) and the timing of the tides is expected to be advanced by 2 minutes. No significant change to current speed magnitudes is predicted beyond the immediate area of the deepening. The strengthened gravitational circulation in the deepened area is predicted to have a slight effect directly

upstream of the deepening. However the increased siltation is expected to be restricted within the deepened area, at least partly due to the change in bed level between the deepened area (14.5m below CD) and directly upstream (depths of 10.4m below CD then 8.5m below CD).

6. Slightly more wave energy from swell waves entering the estuary mouth directly from offshore is predicted to reach the upstream channel (approximately 3%).

Intertidal area upstream of the development (North Tees mudflat)

7. The change in tidal high water will not affect the intertidal area as at this stage of the tide the water level will be against the river walls. The predicted increase in low water has the potential to convert about 160m^2 of intertidal to subtidal, assuming approximately 1600m length and a 1:50 intertidal slope. The implications of this change in terms of area available for feeding waterbirds are described in Section 11.2.3.

8. Wind induced waves are predicted to be unchanged for wind speeds up to 20 m/s.

9. Slightly more of the largest swell wave energy may get into the area upstream of the development (e.g. 6m offshore waves from 15^{o}N are predicted to increase Hs to 0.98m (3% increase)). However, this small increase under extreme conditions is not likely to have a significant effect on the morphology of the Estuary in this area.

Tees Dock and turning circle

10. Reduced through-depth flows, but an increase in near bed net landward flows, are predicted to lead to an increase in fine material infill of the order of 10%. A local redistribution of wave energy is predicted, with reductions between the BASF terminal and intertidal area opposite the new quay for wind induced waves. No increase for swell waves entering the system. There is a potential for a slight increase in the proportion of material from Dabholm Gut depositing in the Tees Dock turning circle.

Proposed container terminal

11. Reduced through depth flows, but an increase in near bed net flow, lead to increased infill of fine material of the order of 10%, possibly concentrated towards the proposed berth pocket. Both wind and swell induced waves are predicted to decrease (by 4-8% for tested conditions).

Dabholm Gut

12. The dredging will increase the bed slope outside the entrance to Dabholm Gut and some readjustment of the slope may occur, depending on the nature of the bed material. Current conditions are predicted to decrease at, and upstream of, the entrance to Dabholm Gut with small increases predicted downstream. A very small (mm) predicted raising of high and low waters will change the detail of

the time of inundation and drying of the channel intertidal areas, but it will not be noticeable.

Deepened approach channel

13. Reduced through depth flows are predicted which, combined with the strengthened near bed landward flow, are predicted to result in increased import of fine material with the potential to increase the maintenance dredging requirements by about 10%. The distribution of the infill is expected to broadly reflect the present pattern. No increase in sandy infill is predicted. Some increase of swell wave penetration is predicted, mostly towards the ConocoPhillips Oil Terminal (H_s 20% for 6m Hs waves from 15^o).

14. Increased swell wave energy is predicted seawards from ConocoPhillips Dock along the approach channel for swell waves coming directly from offshore.

Enlarged Seaton Channel turning circle

15. No increase in sand infill is predicted in the Seaton Channel turning circle. However the enlarged turning area will increase the length of slope liable to slumping which will act as an increased (short-term) source of sandy material for Seaton Channel. Reduced storm wave action over North Gare (which would reduce the mobilisation of sand from this location) may counter this affect. Wave conditions for wind induced waves from the south-west are predicted to slightly increase (4%) in the intertidal area to the north of the turning circle which may also change the supply of sand from the side slopes although the wave magnitudes are small (approximately 0.6m for 20 m/s winds). The overall increase in fine material import into the estuary will increase the proportion of fine material removed by maintenance dredging operations from the turning circle.

Seaton Channel

16. No changes to tidal or wave conditions within the channel are predicted. An increased infill rate of fine material of a similar order to the Tees channel is predicted (approximately 10%). No increase in infill from marine sand is predicted. However the enlarged turning area will increase the length of slope liable to slumping acting as an increased source of sandy material in the short-term. The predicted reductions in storm wave action over North Gare may counter this effect reducing the sediment supply from North Gare Sands into the Seaton Channel turning circle.

Seal Sands

17. Analysis of bed sediment shown in HR Wallingford (2002) suggests that in Seaton Channel the bed sediment tends to be finer (>70% particles < 63um) whereas on Seal Sands bed sediments over most of the area comprise sediment of less than 50%, fines, particularly towards the east. Of this amount of fine material, 15-20% was identified as clay with the remaining material being silt. The material showed a pattern with the sandiest sediment occurring at

higher elevations and muddier sediment in gullies and deeper pockets on the top of Seal Sands. The sands in the area are reported as very fine with D85 0.1 – 0.2 mm.

18. Det Norske Veritas (2004) quoted a study by the University of Durham (Donoghue *et al*, 2003) which estimated net accretion of 3.5mm/year over Seal Sands and a general increase in the percentage of fines over the period (1992 - 2003). This conclusion would be in line with evidence that the material removed from the maintained areas of the Tees Channel have become finer, but in contrary to HR Wallingford (2002) which reported that sediment on Seal Sands was getting coarser.

19. A number of reasons for the accretion on Seal Sands were postulated in HR Wallingford (2002). They were broken in to the consideration of changes to the sediment supply and changes to the processes occurring on Seal Sands.

20. Changes to sediment supply:

- Changes in coastal drift, probably due to changes in wave climate;
- Demise of the slag shoal off the North Gare Breakwater;
- Breaches in the slag embankment protecting the Seaton Channel from incursion from North Gare Sands;
- Increased sedimentation in the turning area probably due to a combination of the build up on North Gare Sands and more favourable conditions for sedimentation as an effect of the barrage (more infill leading to more raised concentrations from dredger operations).

21. The main change to the processes on Seal Sand was a general reduction in erosive forces:

- Reduced intertidal area since most of Seal Sands was reclaimed - reduced currents
- Reduced fetch because of reclamation reducing wind generated wave heights. This would reduce erosion;
- The rainfall has generally declined over the relevant period. This would also have the effect of reducing erosion;
- The formation of *Enteromorpha*. The literature gives clear guidance that this is likely to reduce erodability by increasing shear resistance. An increased abundance of *Enteromorpha* over the last decade is also reported in Donoghue (2003).

22. Of these processes, the proposed development is predicted to alter the situation in the following ways:

- Short term deposition during dredging operations (up to 3% of material dredged in outer channel is expected to accumulate on Seal Sands).
- Potential short term increased sand supply to the enlarged Seaton Channel turning area if the new dredged side slopes need to adjust themselves to reach stable gradients – or a potential short term reduction in supply if the enlarged turning area is initially stable and acts as a sink for sand.

- Reduced sand flux across North Gare Sands leading to less long term sand incursion into the turning area.
- No change to tidal currents, tidal range or wave conditions in Seal Sands.
- Increased import (aproximately10%) of fine sediments to Seaton Channel with a proportionate increase in fine sediment supply to Seal Sands.

North Gare and Bran Sands

23. The intertidal areas at the mouth of the estuary are outside any changes in tidal hydrodynamics. Swell wave conditions are predicted to be unchanged or decrease for the conditions tested. No change to the tide range or phasing is predicted.

24. Since no change in sandy infill is predicted for the channel it is expected that the overall volume of the intertidals will be unchanged. However, the changes to the pattern of extreme wave conditions may result in local redistribution of bed material and either an increase in net accumulation or a reduction in net erosion.

25. The deepening of the entrance channel will in places result in changes to the side slopes of the entrance channel adjacent to designated intertidal areas and various training walls in the lower estuary. Although the potential for effect on the stability of training walls and designated intertidal areas in the lower estuary as a result of the proposed channel deepening is low, the design of the lower channel dredging was amended in order to ensure that no adverse effect would arise. These channel design changes are summarised as follows:

- Narrowing the proposed deepened channel by 5m on its southern edge;
- Redesigning the deepened Seaton Channel turning circle to avoid dredging adjacent to intertidal areas.

26. Whilst providing a benefit in terms of removing any potential for effect on designated intertidal areas and the stability of training walls, the proposed design changes are of very small magnitude and are considered negligible in terms of affecting the findings of the numerical modelling. Nevertheless, a sensitivity test was undertaken to verify this conclusion; the findings are presented in Section 6.6.

6.6 Sensitivity test of the implications of changes to the proposed channel design

1. The numerical flow model was amended to include the proposed layout of the capital dredging in the lower channel and run for spring tide conditions under high fluvial flow. These conditions were chosen to demonstrate the effect of the change on the highest typical currents in the area.

2. The model results are shown in Figures 6.24 and 6.25 which show the tidal current magnitudes at times of peak ebb and flood tide and the predicted difference to the results as a consequence of the changes to the proposed dredging in the lower channel (i.e. not the effect of the channel dredging in total; such effects are presented throughout the remainder of Section 6). The

ROYAL HASKONING

differences can be seen to be localised to the areas where changes to channel design are proposed, with the only consistent change being speed reductions in the small deepened areas. Figure 6.26 shows the pattern of depth-averaged tidal currents at the times of peak ebb and flood tide; this figure confirms the small and localised effect of the minor changes to the design of the approach channel.

3. On the basis of the sensitivity test it is concluded that the impacts of the proposed capital dredging are not affected by the proposed minor changes to the design of the approach channel.

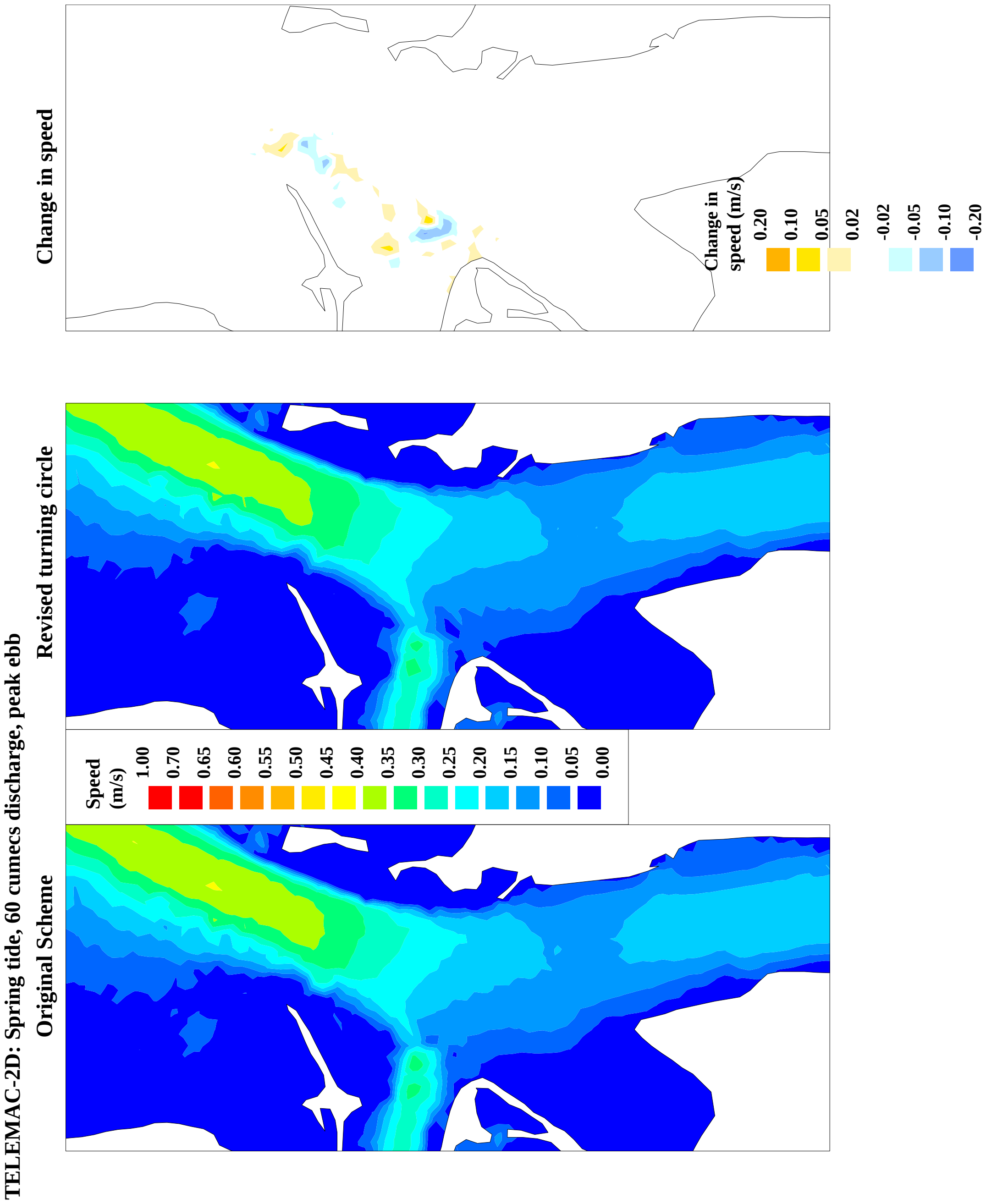

Figure 6.24 The predicted effect of proposed changes to the design of the capital dredging in the lower channel on peak current speeds at peak ebb

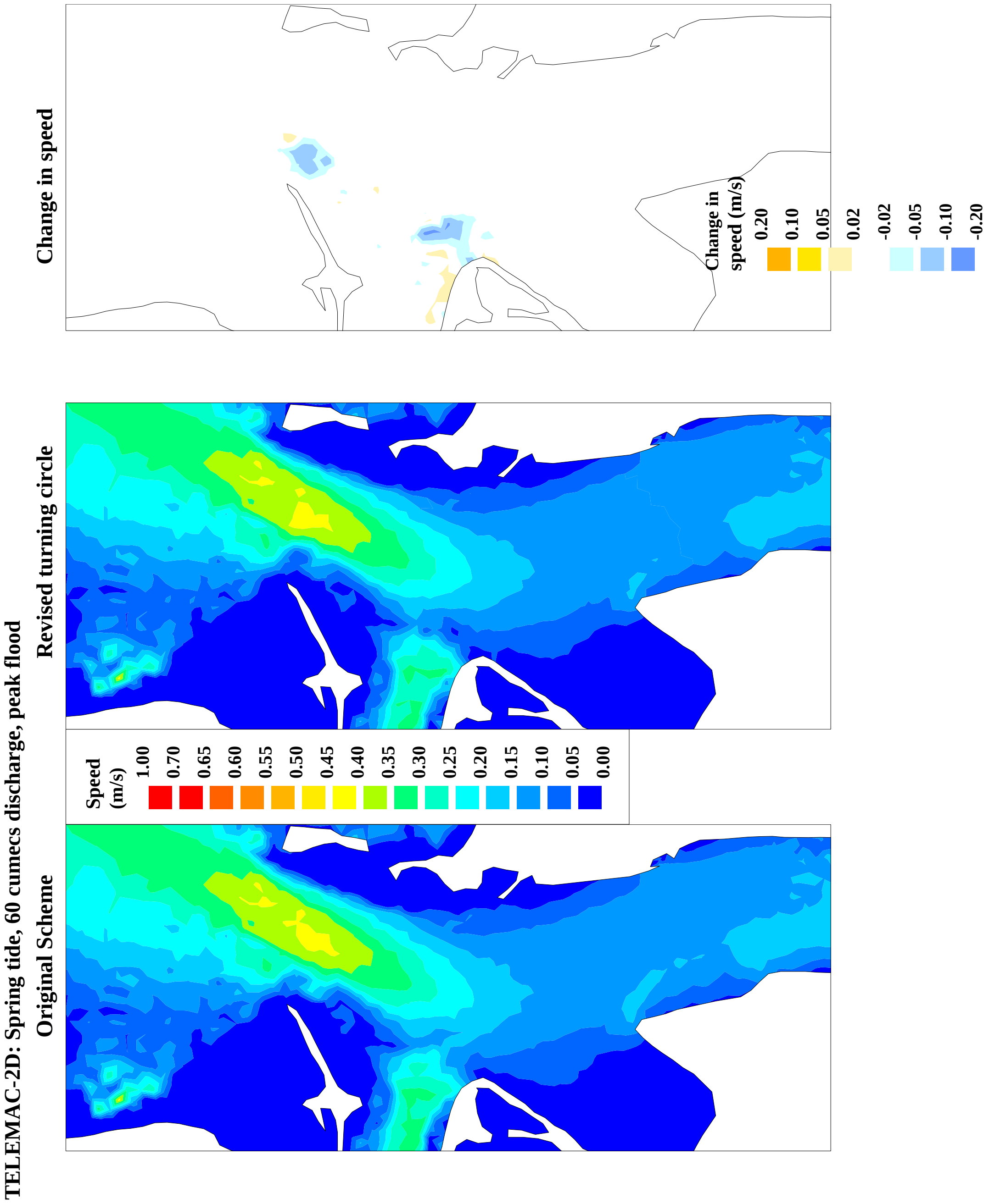

Figure 6.25 **The predicted effect of proposed changes to the design of the capital dredging in the lower channel on peak current speeds at peak flood**

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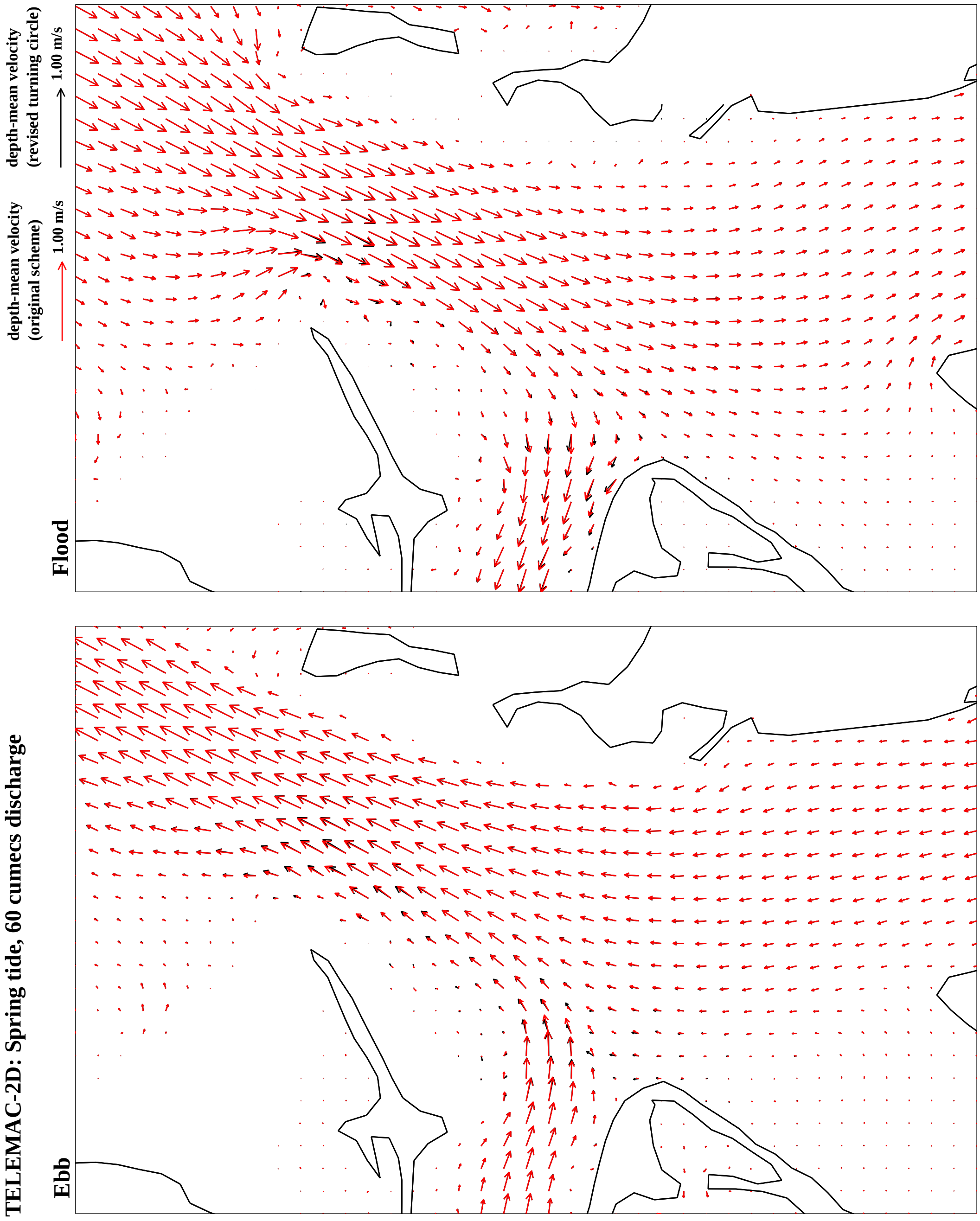


Figure 6.26 **The predicted effect of proposed changes to the design of the capital dredging in the lower channel on depth-averaged tidal currents**

Appendix 7

Benthic ecology and sediment quality sampling plan

Note / Memo

HaskoningDHV UK Ltd.
Industry & Buildings

To:	Marine Management Organisation and Natural England
From:	Steven Rayner
Date:	17 October 2018
Copy:	
Our reference:	I&BPB8270N001F0.1
Classification:	Project related
Subject:	**Northern Gateway Container Terminal - sediment and marine ecology sampling plans**

1. Introduction

PD Teesport (PDT) is proposing to submit a marine licence application to the Marine Management Organisation (MMO) for the Northern Gateway Container Terminal (NGCT) project. This note sets out our proposed approach for both benthic ecological sampling and marine sediment quality sampling that is considered necessary to inform the supporting environmental assessment for the NGCT marine licence application.

In addition to the above, PDT is planning to comply with Condition 5.2.3 of its existing ten-year disposal licence (L/2015/00427/1) for maintenance dredging within the Tees estuary; this condition requires PDT to collect and analyse sediment samples from the dredge area every three years. As well as confirming the sampling requirements for the NGCT marine licence application, this note has been submitted to seek confirmation on the number and location of samples required by the MMO to ensure than PDT complies with Condition 5.2.3 of licence L/2015/00427/1. It is requested that the MMO and Cefas take both elements into account when determining the number and location of sediment samples required.

This document has been issued to both the MMO and Natural England with regard to sediment quality and benthic ecological survey respectively.

2. Background to the NGCT project

PDT applied for a Harbour Revision Order (HRO) for the proposed NGCT under Section 14 of the Harbours Act 1964 in 2006. An application for planning permission under the Town and Country Planning Act 1990 was also submitted to Redcar and Cleveland Borough Council (RCBC) at the same time. In support of these applications, Royal HaskoningDHV carried out an Environmental Impact Assessment (EIA) and produced the NGCT Environmental Statement (ES) in 2006 (Royal Haskoning, 2006) (referred to as the 2006 ES).

The Teesport HRO (referred to as the 2008 HRO) (Statutory Instrument (SI) 2008 No. 1160) was made on 18th April 2008, coming into force on 8th May 2008 for a period of 10 years. The marine elements of the NGCT have not yet been implemented, however the landside elements of the scheme have commenced (and therefore the planning permission granted by RCBC has been implemented). The NGCT development is, therefore, authorised by RCBC under planning permission R/2006/0433/00 and by the Teesport HRO.

As noted above, the 2008 HRO was only granted for a period of 10 years from the 8th May 2008. PDT therefore applied for an extension to the HRO prior to its expiry date, for a further 10 years. The MMO granted the HRO extension on 1st May 2018, with the HRO having a revised expiry date of 7th May 2028.

3. Proposed marine works

In summary, the marine elements of the NGCT scheme will comprise the following:

- Capital dredging within the existing dredged approach channel.
- Realignment of the existing approach channel in the vicinity of the proposed terminal and deepening of the two existing turning circles (Tees Dock turning circle and Seaton Channel turning circle) in the Tees estuary.
- Construction of a 1000m quay with a proposed quay deck level of 9.0m above CD (+6.15m OD).
- Capital dredging of deep water berthing areas alongside the proposed quay face (dredged to 16m bCD).
- Pumping suitable dredged material ashore for use in the reclamation works and for locally raising land levels within the proposed terminal area.
- Disposal of the balance of the capital dredged material at existing offshore disposal grounds in Tees Bay (with the potential for re-use of some of this material as habitat improvement measures within the Tees).
- Relocation of the existing Riverside Ro-Ro facility to accommodate the new container terminal. Although currently dredged to 10.4m bCD, some further highly localised dredging will be required close to the corner with Tees Dock.

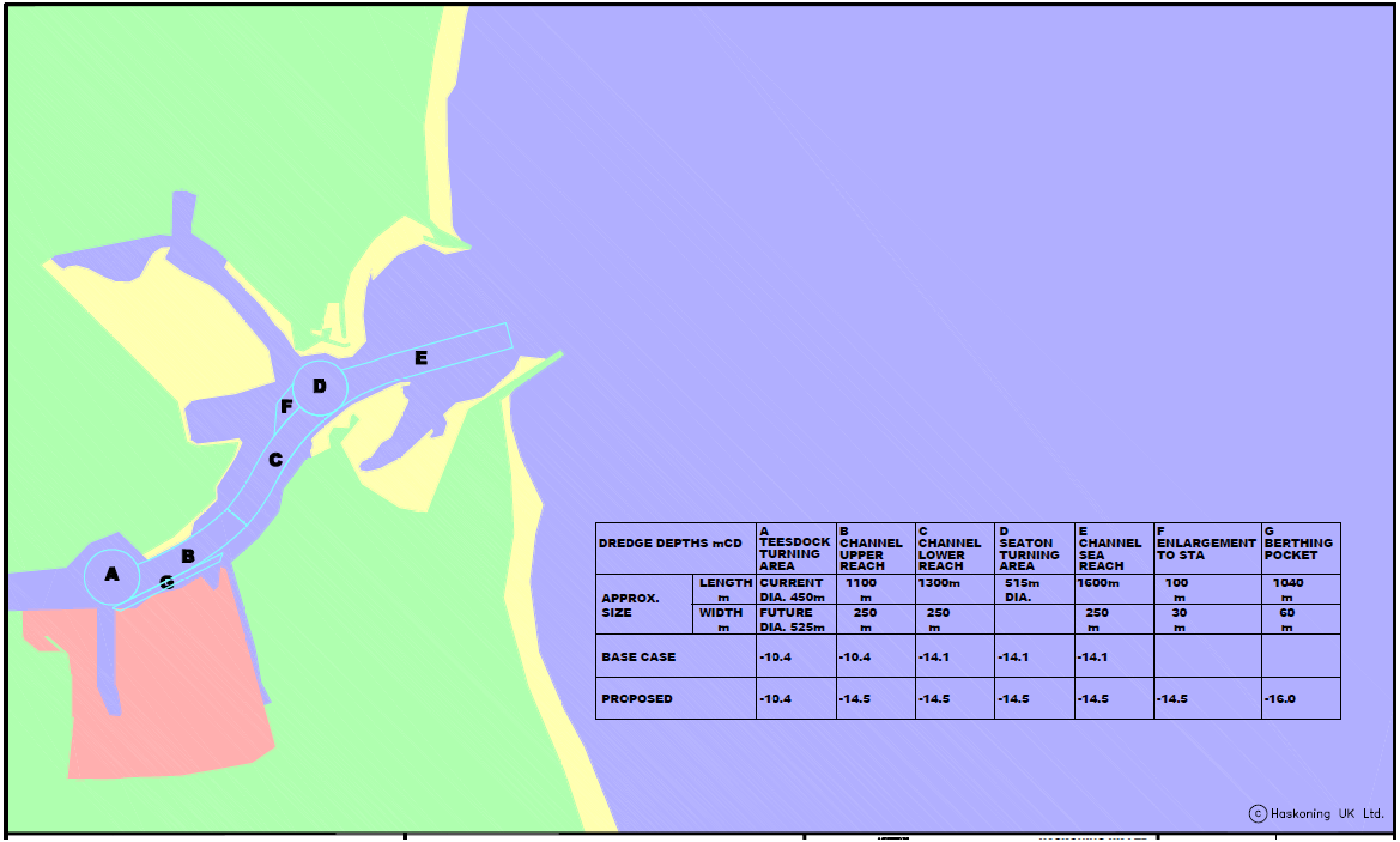
Further detail regarding the dredge, disposal and construction activities is provided below:

3.1. Dredging

Table 1 provides a summary of the current and design dredge depths to be achieved as part of the NGCT. The areas referred to within Table 1 are visually illustrated on Figure 1.

Table 1 Current and design dredge depths for the NGCT

Area	Channel section	Existing declared depth (m bCD)	Proposed declared depth (m bCD)	Volume and material to be dredged (Mm^3)
A	Tees Dock turning circle	10.4	14.5	1.15 (mudstone)
B	Upper channel reach	10.4	14.5	2.06 (mudstone)
C	Lower channel reach	14.1	14.5	0.85 (sand)
D	Seaton channel turning circle	14.1	14.5	0.21 (sand)
E	Channel sea reach	14.1	14.5	Included in the volumes above and below
F	Seaton channel turning area (enlargement)	-	14.5	0.04 (mudstone)
G	Berthing pocket	-	16.0	0.50 (mudstone)



DREDGE DEPTHS mCD		A TEESDOCK TURNING AREA	B CHANNEL UPPER REACH	C CHANNEL LOWER REACH	D SEATON TURNING AREA	E CHANNEL SEA REACH	F ENLARGEMENT TO STA	G BERTHING POCKET
APPROX. SIZE	LENGTH m	CURRENT DIA. 450m	1100 m	1300m	515m DIA.	1600m	100 m	1040 m
	WIDTH m	FUTURE DIA. 525m	250 m	250 m		250 m	30 m	60 m
BASE CASE		-10.4	-10.4	-14.1	-14.1	-14.1		
PROPOSED		-10.4	-14.5	-14.5	-14.5	-14.5	-14.5	-16.0

Figure 1 Dredge areas for the NGCT (the small scale and localised dredging at QEII Berth required for relocation of the Riverside Ro-Ro is not shown on this figure)

The total volume of material that will arise from the capital dredging will be approximately 4.8 million m^3. Based on previous investigations and capital dredging in the estuary, it is expected that, broadly, three material types would be dredged; silts and soft alluvial deposits, Mercia mudstone (boulder clay) and granular material. In Area C and most of Area D only granular material will need to be removed. This is because the channel and Seaton Channel turning circle have previously been dredged to a greater depth than the presently maintained depth of 14.1m below CD. Additionally, there is a backlog of maintenance dredging in this area with some parts of the channel at depths above 14.1m below CD. There is also some overlying granular material to be removed from upstream locations before the mudstone is encountered. The total volume of silts and alluvial deposits to be dredged is expected to be small relative to the overall volume of the dredge given that the channel is already subject to maintenance dredging.

It is anticipated that dredging works will be divided into two phases as follows;

- Phase 1: the removal of granular surficial material in Areas C and D using a trailing suction hopper dredger (TSHD).

- Phase 2: the removal of mudstone using a cutter suction dredger (CSD) loading into hopper barges. As part of this phase, 20m wide, 1m deep trenches would be dredged on the inside of the edge of the dredged channel in the area upstream of Redcar in areas where there is not an existing dredged berth pocket. The purpose of these trenches is to allow maintenance material to accumulate without affecting channel depth.

Due to the high production rates required for the deepening, the vast majority of the dredging would, as identified above, have to be undertaken by either a TSHD or CSD. There may be a requirement to use a backhoe dredger (BD) for small areas of dredging in confined areas, for example, alongside the existing quay wall, to cut trenches for the berthing pockets or for construction of new quays.

Maintenance dredging will be required during the operational. As a result of the NGCT, it is predicted that there will not be a requirement to adjust the maintenance dredging strategy (e.g. the annual volume dredged is not predicted to change significantly beyond the existing variability in maintenance dredging commitment); this has been established and verified through the hydraulic and sedimentary studies that have been undertaken as part of the 2006 EIA.

3.2. Disposal of dredged material

It is anticipated that all the granular material arising from the dredging would be used within the reclamation and to locally raise land levels within the terminal site. Additional granular material may arise from routine maintenance dredging. A total of approximately 1.9 million m^3 of material would be required for the reclamation and land raising. Some mudstone may be used in the reclamation. The material not used in the reclamation (i.e. up to approximately 2.9 million m^3, largely comprised of mudstone) would be disposed of at the offshore disposal sites (Tees Bay A and Tees Bay C).

Opportunities for the beneficial re-use of dredged material (in addition to use in reclamation) will be investigated.

3.3. Quay construction

Quay construction would entail either a mass concrete gravity wall or a piled suspended concrete deck. The form of construction to be adopted will be determined during the detailed design phase. Piling for the suspended concrete deck quay structure would be bored concrete piles formed within steel tubes.

The steel tubes would generally be vibrated down to rock head level without noise associated with a piling hammer.

3.4. Replacement of the riverside Ro-Ro

In order to construct the container terminal, it will be necessary to replace the existing Riverside Ro-Ro facility. It is proposed that this facility is replaced at the Queen Elizabeth II (QE II) Berth located immediately upstream of Tees Dock on the southern side of the river. In order to re-locate the Ro-Ro facility, it will be necessary to demolish the existing QEII jetty structure. The berth at the QEII jetty is currently dredged to 10.4m bCD.

The works required for this facility are:

- Four mooring/berthing dolphins.
- Two pontoons restraint dolphins.
- Bankseat and linkspan bridge.
- Recess in the river embankment for the linkspan bridge.
- Pontoon nominally 40m by 30m.
- Linkspan bridge nominally 60m by 10m.
- Although currently dredged to 10.4m bCD, some further highly localised dredging will be required close to the corner with Tees Dock

4. Previous benthic ecology and sediment quality survey

4.1. Benthic ecology

The following sub-sections present a summary of the benthic ecological survey data recovered from within the Tees estuary as part of previous projects. Sampling positions from previous benthic and epifaunal surveys are shown in Figure 2 and 3 respectively. This information is presented as context and to support the sampling that is proposed for the NGCT project.

2006 NGCT benthic survey
A benthic survey of the lower Tees estuary was undertaken in 2006 to inform the EIA undertaken for the NGCT HRO application. The survey involved retrieving 0.1m^2 Day grab samples from 25 pre-determined sampling stations. At least one sample for biological analysis was taken from each station, with triplicate samples taken at six stations. Sub-samples from each station were taken for analysis of particle size distribution. In addition, a benthic epifaunal survey was conducted. The survey comprised use of an otter trawl with a 20mm mesh and 3mm cod-end at 15 sites within the Tees estuary.

The survey identified that subtidal sediments comprised high silt/clay content in the main approach channel, becoming more sandy at the mouth of the estuary. The invertebrate infauna in the main channel was dominated by polychaetes, with *Chone* sp. and *Ophryotrocha* sp. present. Bivalves, including *Abra alba*, were also present at locations within the dredged channel. The infaunal community in the main channel was dominated by a low number of species suggesting that this assemblage is largely made up of opportunistic species which colonise the area in between maintenance dredging programmes. At near-shore and undredged locations, the opportunistic *Ophryotrocha* sp. and *Capitella capitata* dominated, indicating some level of organic enrichment in these areas. Towards the mouth of the estuary, in the sandy sediments, the infauna was dominated by the polychaetes *Chaetozone christiei* and *Spio decorata*, crustaceans (e.g. *Diastylis bradyi*) and molluscs (e.g. *Abra alba*) were also present.

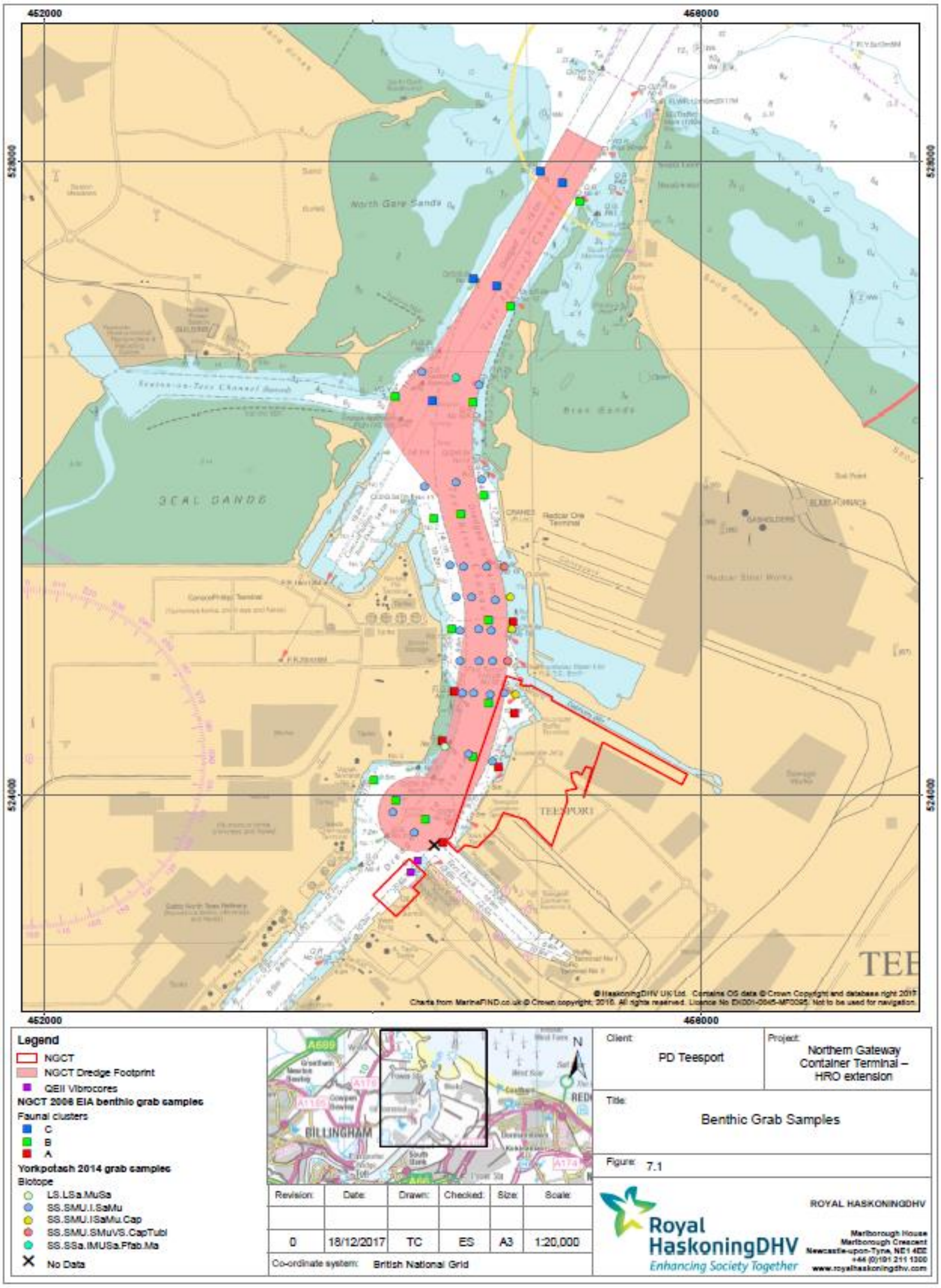


Figure 2 Grab samples recovered during 2006 (NGCT EIA) and 2014 (York Potash Harbour Facilities)

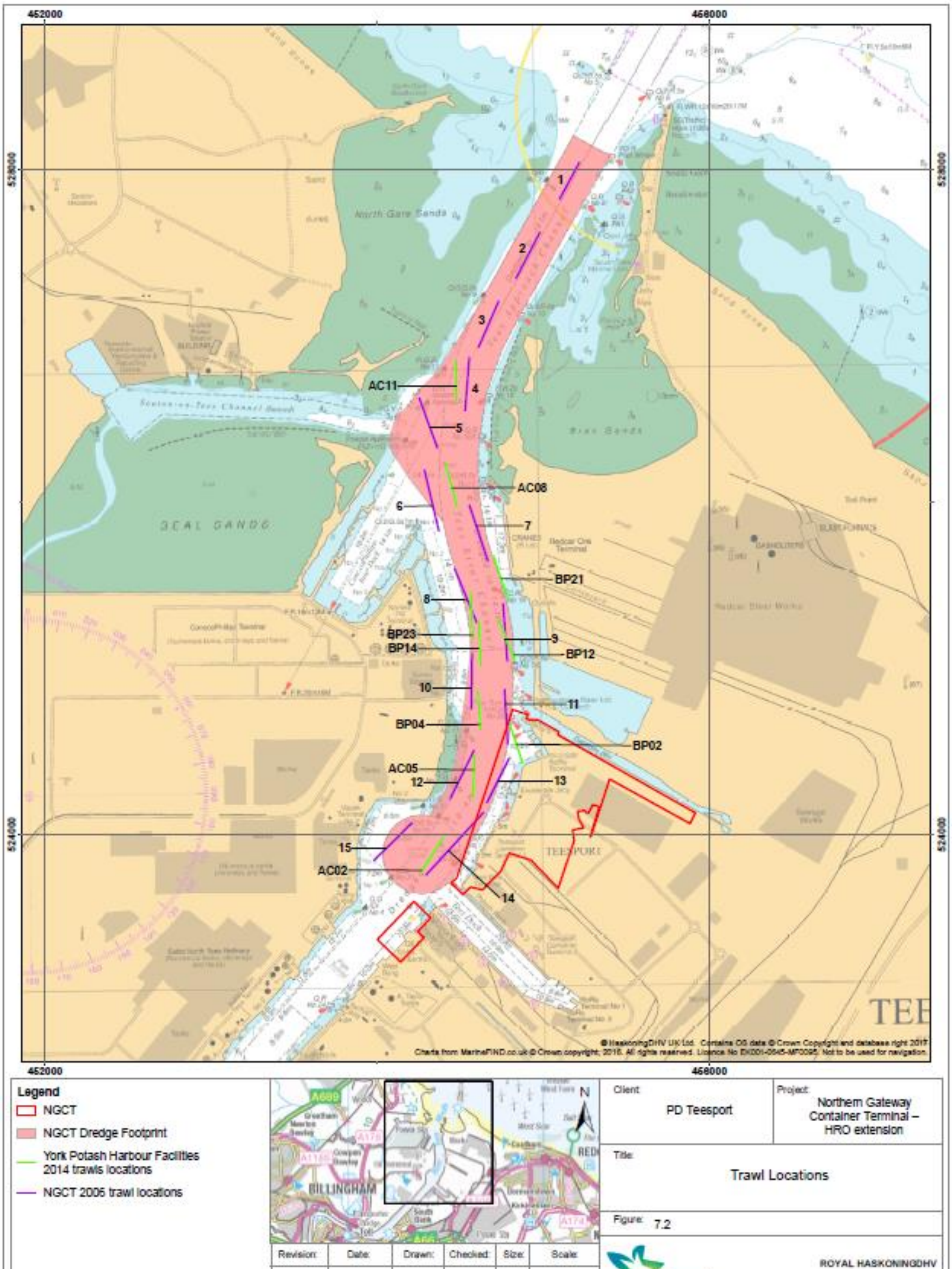


Figure 3 Epifaunal trawls undertaken during 2006 (NGCT EIA) and 2014 (York Potash Harbour Facilities EIA)

Although biotopes were not identified during the NGCT 2006 infaunal survey data analysis, three main groups (A, B, C) were established based on the infaunal species present. The three groups correlated to sediment composition, indicating that the biological community present in each group was influenced by the environment present across the survey site. Group C samples were generally located in sandy sediments (i.e. towards the mouth of the Tees estuary). Group A and Group B were generally present in sediments with a high percentage of fine material (i.e. to the east of Seaton Channel and in the main channel areas), with Group A found in sandy silty sediments and Group B in silty sediments. The 2006 survey undertaken to inform the NGCT EIA identified the presence of Group B in the navigation channel; as noted above, this group contained predominantly polychaetes and common species were *Chone* sp., *Ophryotrocha* sp. and bivalve molluscs *Abra alba*. The benthic survey carried out for the 2006 NGCT ES also described the epifaunal communities in the lower Tees Estuary. In 2006, the most abundant species recorded during the trawl survey was shrimp *Crangon* sp. which was recorded throughout the estuary, followed by shore crab *Carcinus maenas* which was more abundant in the middle section of the estuary adjacent to the proposed NGCT quay. Lower abundances of epifauna were recorded at the mouth of the estuary. Infaunal species were also recorded, the most abundant being A. Alba. The brittle star *Ophiura albida* was also relatively abundant in some trawls.

2008 QEII Berth benthic survey

The benthic infaunal survey undertaken to inform the QEII Berth EIA (undertaken during 2008) consisted of grab samples at two stations within the proposed dredge footprint for QEII. Data from the survey were combined with data from the 25 stations sampled during the infaunal survey undertaken for the NGCT EIA, to enable the samples to be comparatively assessed within a broader context.

Multivariate analysis of the combined data set analysed faunal similarity between samples and found that the NGCT samples broadly fell into three groups reflecting species preference for (1) sandy, (2) silty (muddy), or (3) mixed sediments. The two QEII Berth sample stations comprised of fine sediment and fell into the 2nd group of silty or muddy sediments, indicating that the data conformed to the structure of a typical fine sediment community, containing an unremarkable silty sediment infaunal assemblage typical of these sediment types.

Overall, the QEII Berth samples indicated that the biological communities within the footprint of the QEII Berth were of relatively low diversity, broadly characteristic of chemically or physically disturbed conditions and are very similar in faunal composition to previously surveyed fine sediment locations within the estuary during the 2006 infaunal survey.

2014 York Potash Harbour Facilities benthic survey

The benthic infaunal survey undertaken as part of the York Potash Harbour Facilities EIA consisted of 32 subtidal grab samples. Epifaunal data was also recovered during the 2014 survey using benthic trawls (20mm mesh and 5mm cod end) at 10 locations within the Tees estuary (see Figure 3).

The results of the 2014 York Potash Harbour Facilities benthic infaunal surveys identified a clear distinction between the main channel and the outer channel near the bank of the estuary. The survey identified the dominant biotope complex recorded in the navigation channel was SS.SMU.ISaMu (Infralittoral sandy mud). Similar to Group B (classified during the 2006 NGCT survey), SS.SMU.ISaMu is typically dominated by a rich variety of polychaetes, and a common characterising species of this biotope is *A. alba*.

In 2006, the outer channel adjacent to the proposed NGCT terminal was dominated by Group A samples, which were characterised by *Capitella capitata* and *Ophryotrocha* sp.. This was still the case in 2014 where two biotopes were recorded, namely SS.SMu.ISaMU.Cap (*Capitella capitata* in enriched sublittoral muddy sediments) and SS.SMU.SMuVS.CapTubi (*Capitella capitata* and Tubificoides spp. in reduced salinity infralittoral muddy sediment), where *C. capitata* dominated and was accompanied by large numbers of *Ophryotrocha* sp. These species are characteristic of fine sediments, usually with some level of organic pollution and associated depleted oxygen levels.

In terms of epifauna, the most abundant species recorded was shrimp *Crangon crangon*. C. *maenas* and *A. alba* were also abundant, and the species were three of ten most abundant species present in 2014.

4.2. Sediment quality

4.2.1. Sampling of relevance to the NGCT marine licence application

2006 NGCT sediment quality survey
Sediment samples were collected as part of the EIA for the NGCT during 2006 (Royal Haskoning, 2006) along the approach channel (downstream of the Tees Dock area) and within the area proposed for the container terminal. In total, of the ten sites proposed, eight sites were sampled; two locations could not be sampled due to recent dredging activity over one site and restricted tidal accessibility to the other. Additional samples were also collected at five intertidal 'receptor areas' which could potentially be subject to deposition of sediment that will be disturbed during the capital dredging (giving a total of 13 sampling stations). These receptor areas corresponded with sites that are designated for their nature conservation importance. Samples were collected using a stainless steel grab as part of the marine biological survey. The sampling locations are shown in Figure 4.

Overall, the chemical data from the NGCT study indicated some level of contamination within the samples, particularly heavy metals. However, levels were not deemed high enough to prohibit the material from being disposed of to sea.

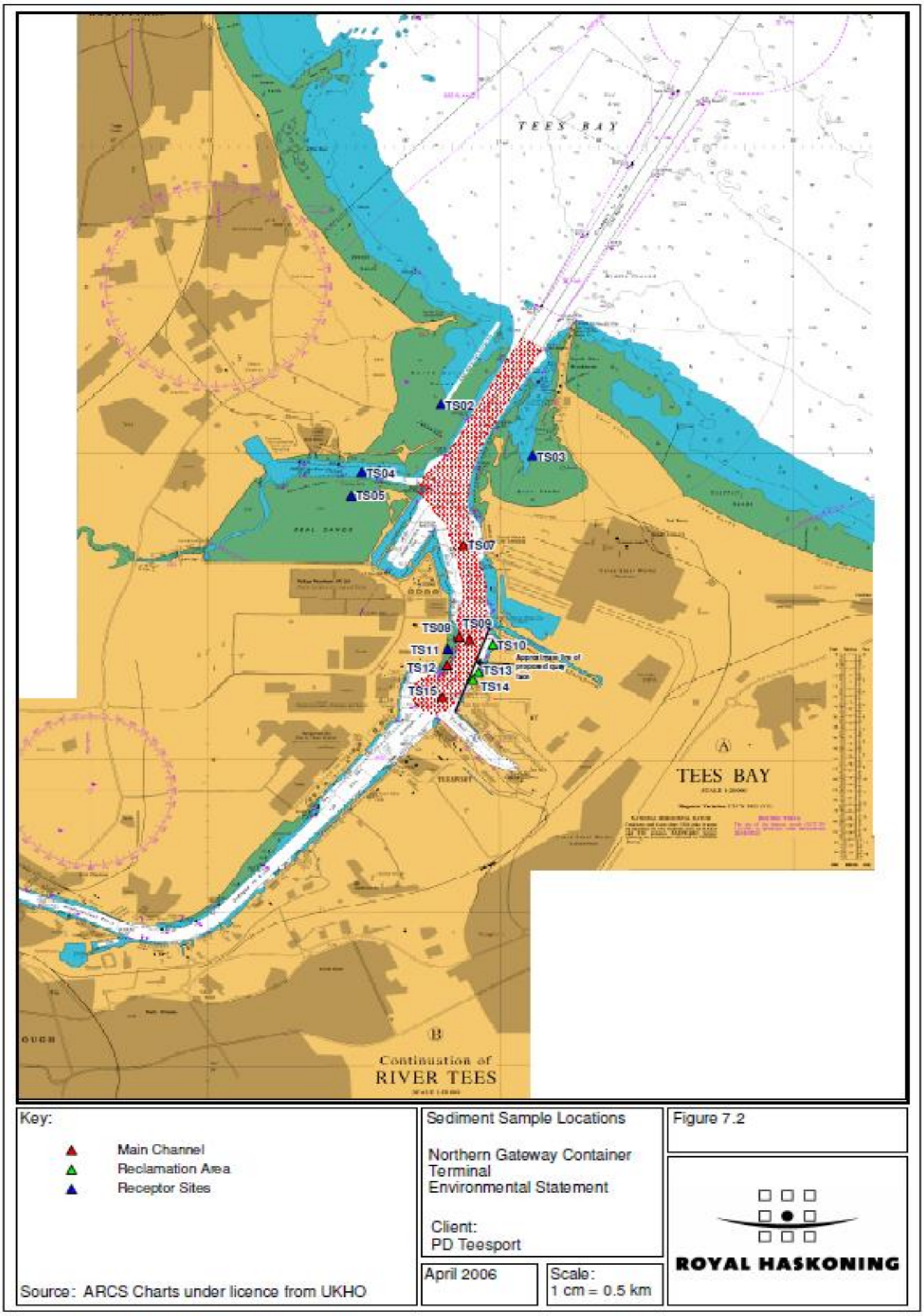
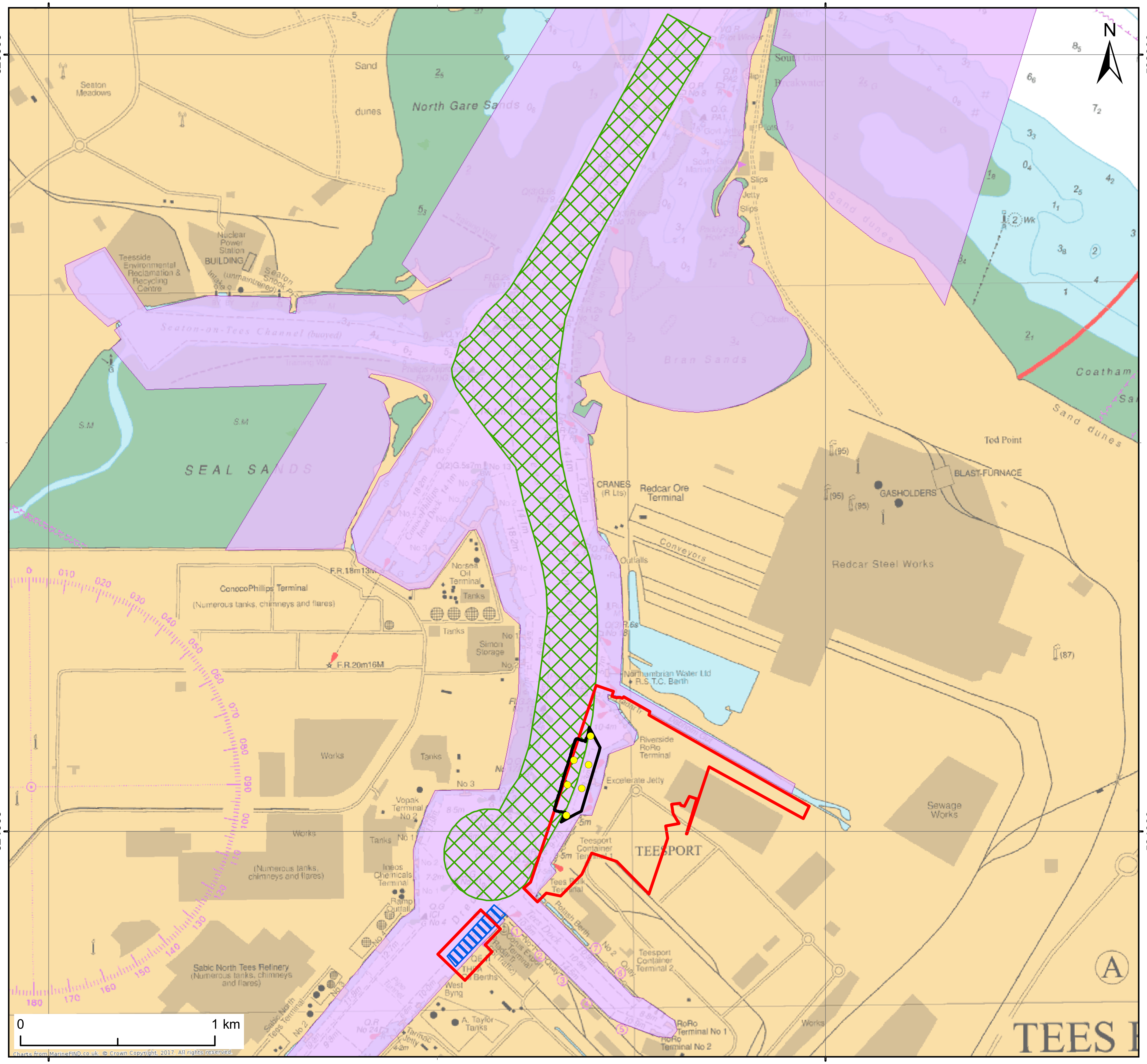


Figure 4 2006 NGCT sediment sample locations



Legend

- Maintenance dredge footprint in the Tees estuary
- NGCT dredge footprint
- NGCT Construction Works Areas
- Indicative dredge footprint for QEII Berth Development
- Trafigura dredge footprint
- Sediment Sample Locations in Trafigura dredge footprint

Client:	Project:
PD Teesport	Northern Gateway Container Terminal - HRO extension

Title: NGCT Sampling Plan

Figure: 5

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	15/10/2018	TC	SR	A3	1:20,000

Co-ordinate system: British National Grid

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2008 QEII Berth sediment quality survey

An additional sediment quality survey was carried out within the Tees estuary in December 2008, in order to characterise the area that was proposed to be dredged as part of the QEII Berth project. Two vibrocores (VC004 and VC001B) sampled sediments to a depth of 4m below Ordnance Datum (OD), or as deep as the core reached.

The results from the vibrocores identified that all metals analysed within the sediments exceeded Action Level 1. Concentrations of DBT and TBT were present below Action Level 1. Concentrations of mercury, cadmium, chromium, copper, lead and zinc exceeded Cefas Action Level 2. Exceedance of the TEL by acenaphthene was also recorded in VC001B. A summary of the data is presented below.

		Core samples				
		V1b			V4	
Analyte	Units	TOP	MID	BOT	TOP	BOT
Mercury	mg/kg	1.22	1.68	2.44	1.61	8.04
Arsenic	mg/kg	26.6	25.8	39.8	22.4	44.0
Cadmium	mg/kg	1.76	12.6	14.6	5.19	13.7
Chromium	mg/kg	85.0	183	201	165	262
Copper	mg/kg	110	231	219	285	315
Lead	mg/kg	229	994	882	415	742
Nickel	mg/kg	38.2	37.6	44.5	38.1	39.9
Zinc	mg/kg	557	3950	2790	1500	2680
Dibutyltin as cation	mg/kg	<0.007	<0.008	<0.007	<0.007	<0.006
Tributyltin as cation	mg/kg	0.04	0.09	0.05	0.06	0.05

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		Core samples				
		V1b			V4	
Contaminant	Units	TOP	MID	BOT	TOP	BOT
Naphthalene	mg kg^{-1}	3.7	32	12	3.9	5.9
Acenaphthene	mg kg^{-1}	0.80	19	27	4.3	5.1
Acenaphthylene	mg kg^{-1}	0.12	0.30	0.58	0.36	0.36
Fluorene	mg kg^{-1}	0.81	9.7	18	3.5	4.4
Phenanthrene	mg kg^{-1}	1.5	9.7	14	3.1	7.8
Anthracene	mg kg^{-1}	0.58	4.4	4.0	1.5	2.6
Fluoranthene	mg kg^{-1}	2.2	15	13	8.3	10
Pyrene	mg kg^{-1}	2.1	10	9.4	6.4	8.5
Benzo(a)anthracene	mg kg^{-1}	0.93	9.3	4.8	4.0	3.9
Chrysene	mg kg^{-1}	1.0	7.2	4.9	3.5	4.3
Benzo(b)fluoranthene	mg kg^{-1}	1.4	10	6.0	4.3	3.0
Benzo(k)fluoranthene	mg kg^{-1}	0.44	4.7	2.7	1.9	1.5
Benzo(b+k)fluoranthene	mg kg^{-1}	1.8	15	8.7	6.1	4.6
Benzo(e)pyrene	mg kg^{-1}	0.68	4.9	3.0	2.6	2.1
Benzo(a)pyrene	mg kg^{-1}	0.68	6.2	3.8	3.2	2.8
Perylene	mg kg^{-1}	0.33	2.0	0.91	0.75	0.78
Indeno(1,2,3cd)pyrene	mg kg^{-1}	0.37	2.5	0.91	0.95	0.82
Benzo(ghi)perylene	mg kg^{-1}	0.29	1.9	1.2	0.98	0.90
Dibenzo[a,h]anthracene	mg kg^{-1}	0.12	0.71	0.29	0.28	0.27
Anthanthrene	mg kg^{-1}	0.27	0.88	0.41	0.46	0.26
Cyclopenta(cd)pyrene	mg kg^{-1}	0.12	2.2	1.0	0.92	0.90

<AL1
>AL1 (exceedance factor <10x)
>AL1 (exceedance factor >10x <100x)
>AL1 (exceedance factor >100x)

Contaminant	Units	Core samples				
		V1b			V4	
		TOP	MID	BOT	TOP	BOT
Naphthalene	mg kg^{-1}	3.7	32	12	3.9	5.9
Acenaphthene	mg kg^{-1}	0.80	19	27	4.3	5.1
Acenaphthylene	mg kg^{-1}	0.12	0.30	0.58	0.36	0.36
Fluorene	mg kg^{-1}	0.81	9.7	18	3.5	4.4
Phenanthrene	mg kg^{-1}	1.5	9.7	14	3.1	7.8
Anthracene	mg kg^{-1}	0.58	4.4	4.0	1.5	2.6
Fluoranthene	mg kg^{-1}	2.2	15	13	8.3	10
Pyrene	mg kg^{-1}	2.1	10	9.4	6.4	8.5
Benzo(a)anthracene	mg kg^{-1}	0.93	9.3	4.8	4.0	3.9
Chrysene	mg kg^{-1}	1.0	7.2	4.9	3.5	4.3
Benzo(b)fluoranthene	mg kg^{-1}	1.4	10	6.0	4.3	3.0
Benzo(k)fluoranthene	mg kg^{-1}	0.44	4.7	2.7	1.9	1.5
Benzo(b+k)fluoranthene	mg kg^{-1}	1.8	15	8.7	6.1	4.6
Benzo(e)pyrene	mg kg^{-1}	0.68	4.9	3.0	2.6	2.1
Benzo(a)pyrene	mg kg^{-1}	0.68	6.2	3.8	3.2	2.8
Perylene	mg kg^{-1}	0.33	2.0	0.91	0.75	0.78
Indeno(1,2,3cd)pyrene	mg kg^{-1}	0.37	2.5	0.91	0.95	0.82
Benzo(ghi)perylene	mg kg^{-1}	0.29	1.9	1.2	0.98	0.90
Dibenzo[a,h]anthracene	mg kg^{-1}	0.12	0.71	0.29	0.28	0.27
Anthanthrene	mg kg^{-1}	0.27	0.88	0.41	0.46	0.26
Cyclopenta(cd)pyrene	mg kg^{-1}	0.12	2.2	1.0	0.92	0.90

<AL1
>AL1 (exceedance factor <10x)
>AL1 (exceedance factor >10x <100x)
>AL1 (exceedance factor >100x)

As well as identifying contaminated sediments, the sediment quality survey also indicated a pattern of increasing contamination with depth. As a result of the contamination levels, the marine licence granted for QEII Berth stated that the fine unconsolidated material was not suitable for disposal to sea and only the Mercia mudstone constituent of the proposed dredge was licensed for offshore disposal. The marine licence states that the unconsolidated deposits need to be dredged using an enclosed grab, loading into a sealed barge to minimise re-suspension of sediment into the water column. No such requirements were specified for the consolidated Mercia mudstone.

2014 York Potash Harbour Facilities sediment quality survey

A site-specific sediment quality survey was undertaken in the Tees estuary during July 2014 to inform the EIA for the York Potash Harbour Facilities project. A total of six vibrocores were taken within the footprint of the berth pocket and port terminal for the York Potash Harbour Facilities, with two vibrocores taken from the adjacent approach channel that will be deepened as part of the NGCT project. Sediment samples were therefore recovered from both at the surface and at depth within the existing approach channel and the berth pocket for the Harbour Facilities project.

The laboratory data illustrated that the concentration of contaminants present in samples from within the approach channel were generally lower than those in the samples recovered from the berth pocket for the York Potash Harbour Facilities project, with no exceedances of Cefas Action Level 1 (and consequently no exceedances of Action Level 2) and considerably fewer exceedances of the PEL (i.e. the concentration of contaminant likely to cause adverse effects in a wide range of organisms). The PEL (and consequently the TEL) was exceeded for selected metals within the samples from the navigation channel, most notably for mercury and lead.

Vibrocore 1 and 2 were positioned within the existing navigation channel in the Tees estuary (which will be subject to dredging for the NGCT). Samples were recovered from a maximum depth of 1.6m below bed level from these two vibrocores. The vibrocore logs reported that the strata within the approach channel comprised soft extremely low strength clay, underlain by gravelly sand at 1.5m depth (VC01) and rock debris at 0.9m depth (VC02). The samples from all strata from VC01 and VC02 did not contain any concentrations of contaminants above Action Level 2. Minor exceedances of Action Level 1 only were identified.

4.2.2. Sampling of relevance to the mid-licence sampling requirement under L/2015/00427/1

Maintenance dredging sampling

As noted in Section 1, as well as requesting confirmation on the sampling requirements for the NGCT, PDT is requesting confirmation on the mid-licence sampling requirements to comply with Condition 5.2.3 of its 10 year licence for disposal of maintenance dredged arisings from the Tees estuary. PDT has recently submitted a sampling plan request for the Hartlepool channel project (capital dredge) and mid-licence sampling for its maintenance dredge source area at Hartlepool (reference SAM/2018/00050). Within its response, the MMO advised that 10 surface samples should be collected from Hartlepool, the results of which would be suitable to inform a future dredge campaign at Hartlepool channel, as well as the mid-licence sampling requirements for L/2015/00427/1. Within SAM/2018/00050, the MMO advised that the sampling at Hartlepool channel would not be sufficient to sign-off the mid-licence sampling requirements for the other dredge areas included in L/2015/00427/1 (i.e. the maintenance areas in the Tees estuary). This issue is therefore being addressed through this note.

During October 2018, PDT recovered six surface samples from the footprint of a proposed dredge for the Teesside GasPort project (see Figure 5). These samples were recovered following consultation with the MMO (SAM/2018/00005). The location of these six samples in relation to the maintenance dredge footprint is shown on Figure 5. The laboratory results from the samples are not yet available, however, it is PDTs intention to utilise the results from these six samples as part of its mid-licence sampling requirement (under L/2015/00427/1).

5. Proposed approach to benthic ecology and sediment quality survey

5.1. Benthic ecology

The Marine Management Organisation (MMO) provided an EIA Scoping Opinion (reference EIA/2017/00041) in December 2017 for the NGCT HRO extension project. The Scoping Opinion stated the following with regard to benthic ecological sampling:

"The decision regarding whether further benthic ecology survey is needed [to inform a future marine licence application for NGCT] *should be based on the suitability of more recent data (e.g. that identified from 2014) t2o allow an appropriate comparison with those acquired during 2006. For example, if the spatial representation of new data is not sufficient or relevant then this would dictate that additional contemporary, fit-for-purpose data should be acquired through targeted survey work."*

As shown on Figure 1 above, the samples recovered during 2014 were recovered from a relatively similar position to those recovered during the 2006 survey. However, it is recognised that the sampling undertaken for the 2014 survey does not extend into the most downstream areas of the NGCT dredge footprint, and therefore there is no known benthic ecological survey data from the downstream stretch of the proposed dredge post 2006. In addition, it is recognised that the most recent benthic ecological survey data from within the dredge footprint was recovered during 2014, and is therefore likely to be approximately five years old at the point of submission of a marine licence application. It is therefore proposed that an additional benthic ecological survey is undertaken, to replicate that undertaken during 2006. It is proposed that samples (and epifaunal trawls) are recovered at the same positions as those from 2006 to provide directly comparable results. Given the proposals to relocate the existing Riverside Ro-Ro to the QEII Berth, we also propose to recover three additional benthic grabs from within the proposed relocation area at QEII Berth. A total of 28 benthic grabs are therefore proposed from within the Tees estuary.

In addition to the above, it is proposed that benthic grabs are recovered from within and adjacent to the footprint of the Tees Bay A and Tees Bay C offshore disposal sites. This information would be used to determine the significance of potential smothering impacts associated with the offshore disposal of dredged material. We propose to recover four grab samples from within and four grabs around each of the two offshore disposal sites (16 grabs in total from the offshore disposal sites).

For the purposes of establishing the baseline environment, one sample will be taken at each of the 44 sampling stations. The position of all sample stations will be programmed into the vessel dGPS system and will be confirmed on site. The position of actual sampling will be recorded. A 0.1m^2 Day grab will be used for subtidal sampling from 44 samples stations located throughout the NGCT footprint. On retrieval, the sample will be released onto a 0.5mm mesh stainless steel sieve and be examined for suitability and photographed to determine sample volume, visual characteristics of the sediment and the presence of anoxia and epifauna. All samples will be transported to a suitable laboratory that adopts the procedures set out in the UK National Marine Biological Analytical Quality Control scheme.

A sub-sample of the sediment will be retained for Particle Size Analysis (PSA) to enable any sediment community associations to be determined. A cut-off 100ml syringe would be used to remove sediment from the undisturbed surface of the Day grab sample for PSA analysis. This sub-sampling will be done following 'acceptance' of the sample (i.e. by measuring the depth of bite following retrieval and ensuring the sample exceeds 10cm depth). The remainder of the sample will then be placed onto the sieve with a photograph taken and other information taken (i.e. description of the sample) before being collected in a storage vessel where it will be preserved in formalin prior to further sieving and analysis in the laboratory.

As per the 2006 survey, a total of 15 benthic trawls will be deployed across the survey area to cover the location of the proposed terminal, the berthing pocket and area that is proposed to be dredged within the approach channel. Given the proposals to relocate the Riverside Ro-Ro to the QEII Berth, we propose to include an additional benthic trawl at the QEII Berth (resulting in 16 benthic trawls in total). The trawls will be positioned as per those carried out during 2006 (supplemented with the additional trawl at QEII Berth), and a 20mm mesh with 5mm cod end (as per the 2006 trawls) will be used with specimens counted.

Macrofauna

Identification of infaunal specimens will be undertaken in the laboratory following the methodology below:

- Samples will be re-sieved over 0.5mm mesh and transferred to 70% alcohol;
- Fauna will be extracted from the sample, identified to species level and enumerated;
- Results will be entered into an Excel spreadsheet for later analysis;
- A reference collection of species identified will be retained;
- Any encrusting or epifauna within the samples will be identified, presence/absence noted and this data also recorded on the spreadsheet;
- A full species list will be produced; and,
- Individuals per species and ash free dry weight biomass will be reported.

Statistical analysis of the data will be undertaken using accepted tools for uni- and multivariate analysis, such as PRIMER and SPSS following guidance by Boyd (2002) and Davies et al (2001). In addition indicator species for contaminated sediment will be noted.

Particle size analysis

Sampling of sediments for PSA is an essential accompaniment to macrofaunal surveys. Small-scale heterogeneity at the seabed dictates that a PSA sediment sub-sample should be collected from the same sample as that collected for the benthic fauna. This allows the macrofaunal data to be accurately referenced against variations in particle size characteristics.

Sub-sampling for PSA is described above. If cobbles (>63 mm) are present in the sample, they will not be included as part of the PSA subsample. Cobbles will be measured across their smallest axes so that they can be included in later data analyses.

The full particle size distribution (at 0.5 phi intervals) will be reported for each sample. Statistics will be calculated as follows:

- Full particle size distribution;
- Mean particle size;
- Sorting coefficient;
- Skewness;
- Modal size; and
- Kurtosis.

5.2. Sediment quality

5.2.1. NGCT

As noted above, the MMO provided an EIA Scoping Opinion (reference EIA/2017/00041) in December 2017 for the NGCT HRO extension project. The Scoping Opinion stated the following with regard to sediment sampling:

“Disposal at sea will be subject to a marine licence and new samples and analysis of the dredge material may be required to assess the suitability of the material for disposal at sea. Sampling for a disposal licence should be designed through consultation with the MMO (and Cefas) via the pre-application licencing process. A regime of sediment sampling will be required to support a marine licence application for at sea disposal of the dredged material.”

Although the advice provided from the MMO (repeated above) is variable in its recommendations for sediment quality sampling, it is proposed that additional sediment quality samples are recovered throughout the proposed dredge footprint and from within the proposed relocation area for the Riverside Ro-Ro at QEII Berth.

As noted in Section 4.2, sampling in 2006 for the original NGCT HRO application identified that the sediments within the dredge footprint were suitable for offshore disposal. Sampling in 2008 for the QEII Berth project (which was undertaken in significant depths of unconsolidated material which had not been subject to previous maintenance dredging (i.e. a significantly different setting to that within the proposed dredge footprint in the main channel)) confirmed contaminants within the unconsolidated sediments which prevented offshore disposal (i.e. above Action Level 2). However the underlying Mercia mudstone deposits were considered suitable for offshore disposal. As outlined on the marine licence for QEII Berth (L/2013/00404/5), there is a mechanism in place for appropriately dredging the contaminated unconsolidated deposits; this involves use of an enclosed grab and loading into a sealed barge to minimise the resuspension of sediment into the water column.

The 2014 sampling undertaken for the York Potash Harbour facilities confirmed that the sediments within the existing navigation channel contained marginal exceedances of Action Level 1 only, both at the surface and at depth.

Based on the above, in addition to the fact that the vast majority of sediments to be dredged comprise granular deposits and Mercia mudstone within the existing navigation channel (which is subject to regular maintenance dredging), it is proposed that samples from the surface only will be collected. It is considered that there is sufficient sediment quality data from previous studies within the Tees estuary (specifically the 2008 and 2014 surveys), which confirm that the sediments **to be dredged at depth within the navigation channel for the NGCT** do not contain contaminants in exceedance of Action Level 2. It is recognised that there is also a requirement to undertake local dredging at QEII Berth, and previous sampling of unconsolidated deposits at this location in 2008 has identified Action Level 2 exceedances at depth. However, as we already have chemical data from samples of unconsolidated deposits at depth at this location (and there is already an agreed mechanism for managing any dredging of unconsolidated deposits at QEII Berth outlined on the marine licence for the QEII Berth development, including precluding disposal at sea and a means of minimising sediment loss to the water column through dredging technique), it is concluded that additional sampling at depth would provide no additional benefit. We therefore do not propose to undertake any additional sampling at depth within the proposed dredge footprint.

Based on the OSPAR Guidelines for the Management of Dredged Material (as revised and adopted in 2014), the number of samples required is determined on the quantity of sediment to be dredged. The total volume of material to be removed for the NGCT scheme equates to 4.8 million m^3, recognising that the vast majority of this material comprises Mercia mudstone and gravelly deposits, which based on previous survey results is highly likely to contain contaminants below Action Level 2 and therefore would be suitable for offshore disposal. It is also noted that a significant proportion of the material is proposed to be used for reclamation and land raising.

Based on the OSPAR guidance, a dredge volume of 4.8 million m^3 would equate to 44 – 58 surface sediment samples (this is a guide only) collected at evenly distributed locations across the dredge footprint. It is requested that MMO confirms the required number of surface samples based on the information presented above (including understanding from previous surveys).

Sediment samples will be analysed by a laboratory validated by the MMO. The laboratory data will be compared to two sets of standards that are available to inform the environmental assessment, namely:

- Cefas Guideline Action Levels for the disposal of dredged material (Cefas, undated);
- Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (CCME, 2002).

5.2.2. Mid-licence sampling for L/2015/00427/1

It is requested that the MMO confirms the number of surface samples required to inform the mid-licence sampling condition (Condition 5.2.3) of the 10 year licence held by PDT, for disposal of maintenance dredged material from the Tees estuary (taking into account the fact that an agreement has already been reached with the MMO for mid-licence sampling at Hartlepool, and the location of the six surface samples recovered within the dredge footprint for the proposed Teesside GasPort).

It is PDT's intention, where possible, to utilise the results of the surface samples recovered from within the NGCT dredge footprint to inform the mid-licence sampling requirements for its maintenance dredge activities in the Tees estuary (L/2015/00427/1).

6. Consultation

We would appreciate your comments on the above proposed sampling strategies in order that PDT can proceed with the surveys to an agreed strategy.

Yours sincerely
On behalf of HaskoningDHV UK Ltd

Steven Rayner
Senior Consultant

Appendix 8

MMO sediment quality sampling plan

Marine Management Organisation

Marine Licensing
Lancaster House
Hampshire Court
Newcastle upon Tyne
NE4 7YH

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Mr Mark Pearson
PDTeesport
Craft Depot Vulcan Street
Middlesbrough
TS2 1LX

Our reference: SAM/2018/00069

By email only

12/07/2019

Dear Mr Mark Pearson,

SAMPLE PLAN ADVICE FOR NORTHERN GATEWAY CONTAINER TERMINAL.

Thank you for your request to the Marine Management Organisation (MMO) for a sample plan to inform a marine licence application for the proposed Northern Gateway Container Terminal (NGCT) project. Please see our response below and any attachments, which has been compiled following consultation with our technical advisors The Centre for Environment, Fisheries and Aquaculture Science (Cefas).

Your feedback

We are committed to providing excellent customer service and continually improving our standards and we would be delighted to know what you thought of the service you have received from us. Please help us by taking a few minutes to complete the following short survey (https://www.surveymonkey.com/r/MMOMLcustomer).

If you require any further information please do not hesitate to contact me using the details provided below.

Yours Sincerely,

Luella Williamson
Marine Case Officer
D 0208 026 8618
E luella.williamson@marinemanagement.org.uk

Enclosed:
Appendix 1 – MMO Sampling Plan
Appendix 2 – Supporting Figures

Marine
Management
Organisation

Description of the project

This advice relates to sample analysis to support a marine licence application for the disposal of material from the proposed Northern Gateway Container Terminal (NGCT) project which comprises a capital dredge of 4.8 million m^3 (the proposed dredge depths vary over the seven dredge areas). The sampling advice relates to the disposal of 2.9 million m^3 at disposal sites: Tees Bay A (TY160) and Tees Bay C (TY162), and the disposal of 1.9 million m^3 for land reclamation around the Tees area, thus comprising beneficial use.

The proposed NGCT scheme comprises of the following:

- Capital dredging within the existing dredged approach channel.
- Realignment of the existing approach channel in the vicinity of the proposed terminal and deepening of the two existing turning circles (Tees Dock turning circle and Seaton Channel turning circle) in the Tees estuary.
- Construction of a 1000m quay with a proposed quay deck level of 9.0m above CD (+6.15m OD).
- Capital dredging of deep water berthing areas alongside the proposed quay face (dredged to 16m bCD).
- Pumping suitable dredged material ashore for use in the reclamation works and for locally raising land levels within the proposed terminal area.
- Disposal of the balance of the capital dredged material at existing offshore disposal grounds in Tees Bay (with the potential for re-use of some of this material as habitat improvement measures within the Tees).
- Relocation of the existing Riverside Ro-Ro facility to accommodate the new container terminal. Although currently dredged to 10.4m bCD, some further highly localised dredging will be required close to the corner with Tees Dock.

Table 1. Proposed dredge depths and quantities per dredge area

Dredge Area	Existing depth (mBCD)	Proposed depth (mBCD)	Dredge depth	Proposed dredge quantity (m³)
A	10.4	14.5	4.1m	1,150,000
B	10.4	14.5	4.1m	2,060,000
C	14.1	14.5	0.4m	850,000
D	14.1	14.5	0.4m	210,000
E	-	14.5	Unknown	*included in other areas
F	-	14.5	Unknown	40,000
G	-	16	Unknown	500,000

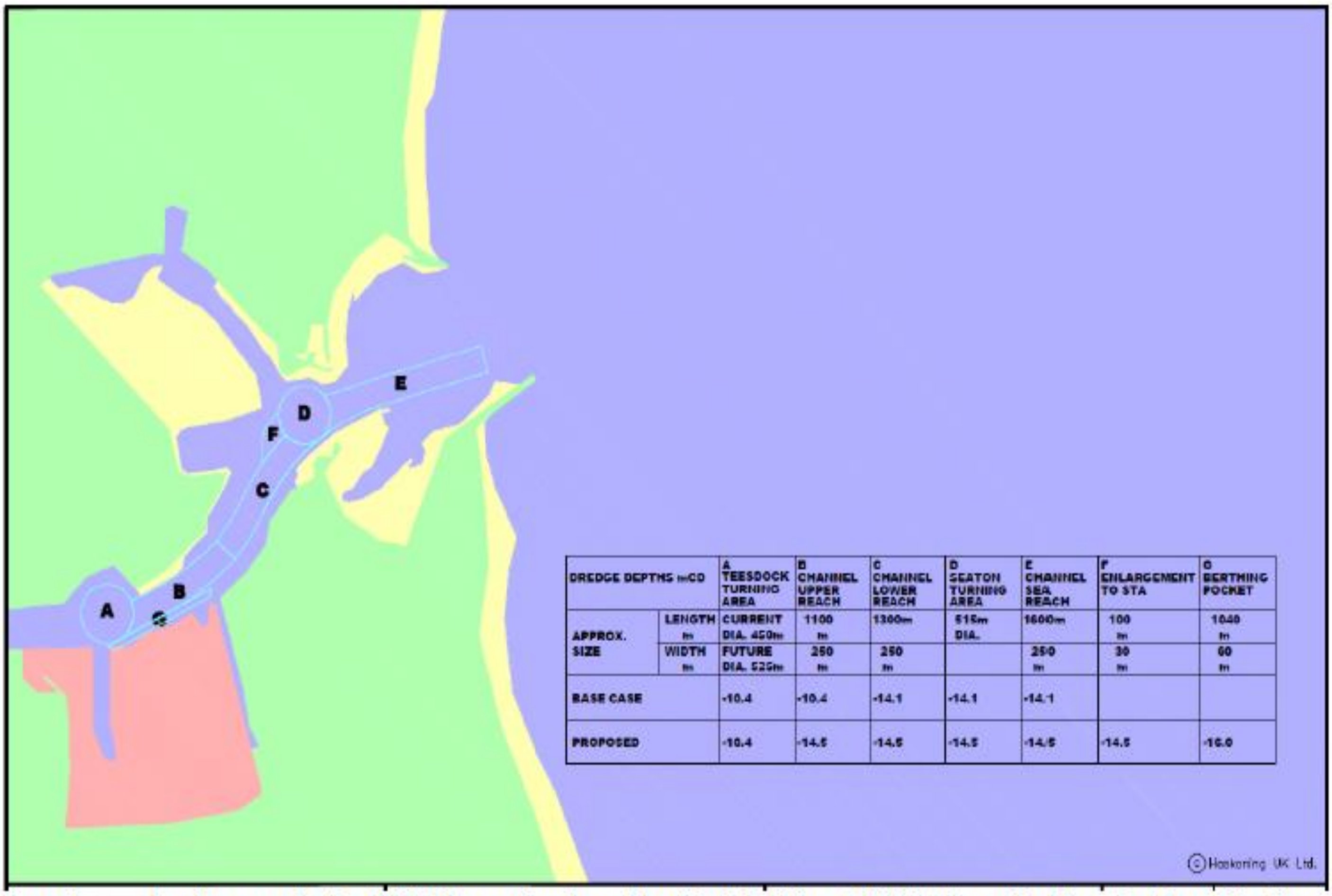

Figure 1 Dredge areas for the NGCT (the small scale and localised dredging at QEII Berth required for relocation of the Riverside Ro-Ro is not shown on this figure)

Sampling required

In accordance with the recommendations of the OSPAR Guidelines for the Management of Dredged Material, samples should be taken to provide a good representation of the volume of material to be dredged. The distribution and depth of sampling should reflect the size and depth of the area to be dredged, the amount to be dredged and the expected variability in the horizontal and vertical distribution of contaminants. The MMO also uses the OSPAR guidelines to inform our advice on sampling requirements for other activities which are likely to lead to the mobilisation of sediments. Based on the information submitted (as described above), the following sampling and analysis is required.

In consideration of the volume details of the proposed dredge, the MMO advises that **37 samples** should be taken from 37 samples stations within the footprint of the proposed dredge area to provide adequate spatial coverage (see Table 2). This is in line with the minimum guidelines set by OSPAR, which recommends between 16 and 30 stations for dredges between 500,000 and 2,000,000m^3, and 10 additional stations for each 1,000,000 extra, thus comprising an estimated 55 – 60 sample stations. Due to sample data currently being processed for SAM/2018/00005 (Trafigura) (6 sample stations) close to dredge area C in this project, it has been determined that a reduced sampling effort within this area can be undertaken.

Table 2. Recommended sample stations for each dredge area (*Provided dredging does not exceed 1 metre below the sediment surface)

Dredge Area	Proposed dredge quantity (m^3)	Recommended sample stations	Depth samples (required for subsurface activities)	Total number of samples
A	1,150,000	4	Surface only	4
B	2,060,000	6	Surface only	6
C	850,000	12	Surface only	12
D	210,000	3	Surface only	3
E	Unknown	5*	Surface only	5
F	40,000	1	**Surface only	1
G	500,000	6 (8 without Trafigura)	**Surface only	6

*no dredge volume has been provided so a nominal 5 samples have been suggested.
**no dredge depth provided. Where dredging is greater than 1 m, core samples at 1 m intervals are recommended.

The following information must be included with any samples (irrespective of the laboratory to be used for analysis):

- Clearly labelled samples;
- Completed sample position sheet, including the latitude and longitude (decimal degrees and the projection i.e. WGS84) of each location
- Details of the method of sampling;
- A map/chart detailing the sample locations.

Surface samples should be taken from the upper layer of in-situ sediment using a non-metallic / stainless steel scoop. To maintain the integrity of the samples please ensure that they are frozen and remain in the freezer until they can be dispatched. Please ensure the samples are dispatched in a cool box - the cool box should not be placed in any other packaging.

Analysis Required

In light of the information provided and knowledge of the past industrial land usage of this site analysis is, on this occasion, required for:

- Trace Metals and Arsenic (As)
- Organotins
- Total Hydrocarbons (THC)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Polychlorinated Biphenyls (PCBs)
- Polybrominated Diphenyl Ethers (PBDEs)
- Organochlorines (OCs)
- Particle Size Analysis (PSA)

The full suite of analyse testing is not required for the geological mudstone. However, the unconsolidated material over the whole NGCT are has not been sampled recently enough to preclude the testing for certain analytes, and in particular the wider Tees area has not been recently characterised for PCBs and PDBEs. Given the scale of the proposed dredging a full suite of contaminants is a prudent and proportionate measure. Where sediment data are lacking or not appropriate for their intended use, we apply the precautionary principle to determine the level of risk of contamination to the marine environment. If the unconsolidated material is relatively thin in the NGCT area, few (if any) depth samples will be required.

Further details can be found on the attached sample plan form in Appendix 1.

To ensure consistency between laboratories it is expected that all analysis required will be undertaken from the same sample container.

Laboratories

You have now obtained an approved sample plan from the MMO. Should you now require sample analysis for chemical, physical and biological determinands in support of a regulatory approval such as a marine licence, you have a choice between using a provider of your choice listed at the link below: https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans

This list indicates the laboratories which have been validated to undertake sediment analysis, as well as the specific determinands which they are validated to analyse. The MMO will not accept results from laboratories which have not been validated.

Irrespective of which validated laboratory is used to undertake sediment analysis, results accompanying a marine licence application must be submitted to the MMO on the correct results template (approved templates are available via the link in 4.1 above).

If the analysis is to be undertaken by a laboratory other than those validated by the MMO, that laboratory must meet the qualifying criteria as set out in the MMO guidance and become a validated laboratory (https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans).

It is your responsibility to ensure that appropriate analysis is commissioned and supplied in support of a regulatory approval. However, if you have any queries about the process or would like clarity on this, please do not hesitate to contact the MMO by emailing: marineconsents@marinemanagement.org.uk

Conclusion

This advice is based solely on the information provided in the sample plan request, and the sampling and analysis described will be adequate to inform a licence application that mirrors the information in this pre-application request, providing that no further issues come to light and an application is submitted in a suitable time-frame. The MMO will take a pragmatic approach to the requirement of repeat samples in relation to projects where works have not commenced. Samples taken at depth will remain a valid consideration for decision-making from the time they are taken. However, due to the dynamic nature of the marine environment and the potential for changes in the quantity and quality of sediments, there may be a need for surface sediments to be re-sampled and analysed if the project has not commenced within two years of the time of sampling.

Where long term licences for maintenance dredging will be applied for, additional sampling and analysis will need to be undertaken throughout the duration of the proposed longer licence term in order to comply with the OSPAR guidelines.

MMO reserves the right to request further sampling/analysis should any submitted Marine Licence application differ from that information submitted in this pre-application request. Any future application or return must clearly state this pre-application reference number.

Appendix 1

Sample Plan

Sample	Station	Metals	Organotins	THC	PAHs	PCBs	PDBEs	OCs	PSA
A1 – A4	**Dredge Area A (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
B1 – B6	**Dredge Area B (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
C1 – C12	**Dredge Area C (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
D1 – D3	**Dredge Area D (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
E1 – E5	**Dredge Area E (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
F1	**Dredge Area F (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
G1 – G6	**Dredge Area G (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
		☐	☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐	☐
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		☐	☐	☐	☐	☐	☐	☐	☐

Comments:

Stations should be evenly distributed across the dredge areas, depth samples are no longer required due to evidence presented by core samples.

Total samples to be taken:
Dredge Area A – 4 stations at 0m
Dredge Area B – 6 stations at 0m
Dredge Area C – 12 stations at 0m
Dredge Area D – 3 stations at 0m
Dredge Area E – 5 stations at 0m
Dredge Area F – 1 Station at 0m
Dredge Area G – 6 stations at 0m

Appendix 2

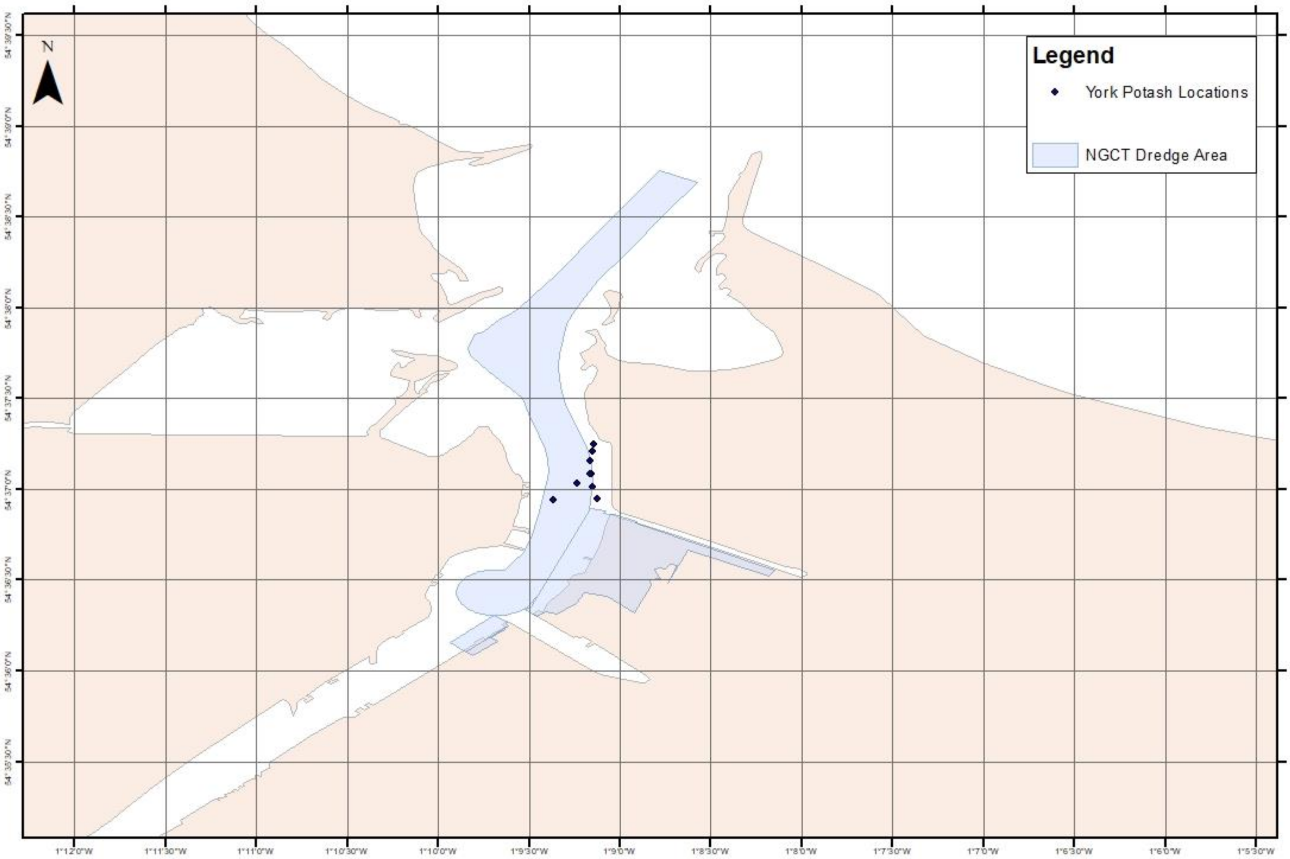

Figure 2: Map of the Tees Estuary and approach channel detailing the overlap between York Potash (DCO/2014/00002) and Northern Gateway (SAM/2018/00069)

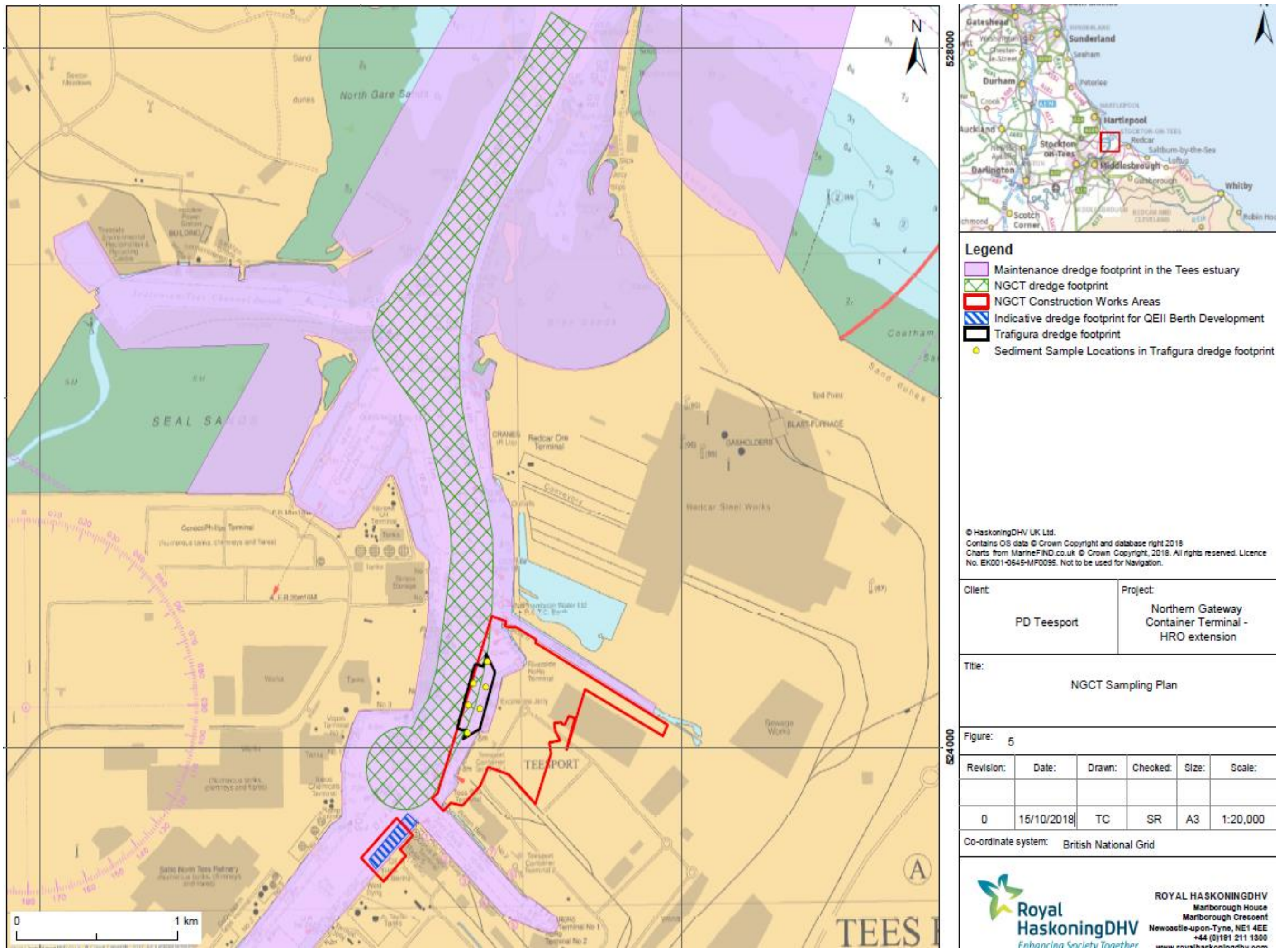

Figure 3. Map detailing the various developments in the vicinity of NGCT.

LSN	Sample No.	Location	Dredge Area no.	Excluded	TS%	AS	CD	CR	CU	HG	NI	PB	ZN	DBT	TBT
2014/17019	1+5	VC03A+4, 0m	Area i		45.55	26.88	0.76	58.39	92.43	0.9	33.81	136.9	249.91	**0.021**	**<LOD**
2014/17020	2+6	VC03A+4, 1m	Area i		55.211	20.82	0.83	75.65	230.72	2.19	33	121.66	246.23	**0.050**	**0.038**
2014/17021	4	VC03A, 1.79m	Area i		81.242	4.43	0.03	60.51	20.06	0.03	53.72	9.25	87.11	**<LOD**	**<LOD**
2014/17022	7	VC4, 2m	Area i		48.795	16.34	2.46	322.11	1503.7	13.19	54.74	127.64	518.6	**0.056**	**0.082**
2014/17023	8	VC4, 3m	Area i		46.644	16.12	3.01	456.54	1795.9	29.11	52.93	131.32	635.74	**0.108**	**0.074**
2014/17024	9	VC4, 4m	Area i		46.463	26.04	2.75	462.9	3070.7	41.78	34.94	140.09	540.49	**0.012**	**0.036**
2014/17025	10	VC4, 4.53m	Area i		81.19	6.08	0.07	19.47	13.14	0.16	16.73	21.04	51.81	**<LOD**	**<LOD**
2014/17026	11+28	VC6+VC5, 0m	Area i		45.197	29.69	0.6	57.61	64.05	0.62	33.11	133.03	240.6	**0.014**	**<LOD**
2014/17027	12	VC6, 1m	Area i		55.699	29.91	0.48	59.06	68.41	0.59	33.73	111.42	204.74	**0.046**	**0.025**
2014/17028	13	VC6, 2m	Area i		58.938	27.32	0.86	82.44	167.9	1.13	38.2	124.65	278.65	**0.017**	**0.026**
2014/17029	14	VC6, 3m	Area i		51.5	13.56	2.13	288.87	1077.1	2.63	67.01	136.29	550.03	**0.047**	**0.066**
2014/17030	15	VC6, 4.53m	Area i		51.816	19.2	2.56	352.1	1424.2	4.78	65.01	156.1	615.12	**0.121**	**0.076**
2014/17031	20	VC02A, 0m	Area ii		49.931	36.73	0.5	51.85	57.48	0.54	32.63	129.39	207.21	**0.009**	**0.008**
2014/17032	21	VC02A, 0.86m	Area ii		63.265	27.56	0.59	63.12	99.43	0.73	32.74	121.41	202.54	**0.012**	**0.016**
2014/17033	22+36	VC08A+VC7, 0m	Area ii		47.419	30.83	0.89	61.12	99.92	0.89	33.18	140.78	281.29	**0.027**	**0.010**
2014/17034	23+37	VC08A+VC7, 1m	Area ii		43.725	13.71	2.25	268.59	1007.7	1.11	55.96	132.68	505.46	**0.039**	**0.083**
2014/17035	24	VC08A, 2m	Area ii		39.241	34.86	7.33	601.39	1531.4	45.03	34.31	211.42	873.74	**0.156**	**0.082**
2014/17036	25+39	VC08A+VC7, 3m	Area ii		43.756	36.42	3.59	516.02	2570.9	22.79	38.42	178.23	717.78	**0.071**	**0.129**
2014/17037	26	VC08A, 4m	Area ii		76.21	14.19	1.64	38.26	895.43	4.93	13.37	53.38	141.58	**<LOD**	**<LOD**
2014/17038	29	VC5, 1m	Area ii		43.872	31.07	0.88	65.3	107.98	0.91	40.13	155.56	343.68	**0.072**	**0.023**
2014/17039	30	VC5, 2m	Area ii		52.381	16.15	1.3	91.22	250.82	0.69	47.32	134.23	368.99	**0.007**	**0.042**
2014/17040	31	VC5, 3m	Area ii		45.567	38.24	5.34	488.34	1111.9	45.34	39.07	309.68	1066.4	**0.114**	**0.024**
2014/17041	32	VC5, 3.48m	Area ii		41.637	63.46	5.26	624.7	2062.9	59.23	35.35	265.9	1065.5	**0.089**	**0.054**
2014/17042	33	VC01A, 0m	Area ii		51.542	35.94	0.32	39.49	46.55	0.59	26.93	116.9	165.91	**<LOD**	**0.007**
2014/17043	34	VC01A, 1m	Area ii		55.136	38.69	0.48	57.03	60.08	0.58	34.55	159.67	220.28	0.008	0.017
		Mean			52.88	26.17	1.88	210.48	777.24	11.22	39.24	138.34	415.17	0.052	0.046
		AL1 (ppm dry)				20	0.4	40	40	0.3	20	50	130	0.1	0.1
		AL2 (ppm dry)				100	5.0	400	400	3.00	200	500	800	1	1
		Limits of Detection				0.15	0.05	0.15	0.06	0.03	0.15	0.08	0.15	0.002	0.002

Figure 4. DCO/2014/00002 York Potash - Sediment Composition Analysis for Trace metals and Arsenic (As), and organotins

LSN	Sample No.	Location	Dredge Area no.	Excluded	TS (%)	23BA	ACENAPH	ACENAPT	ANTHRAC	BAA	BAP	BBF	BENZGHI	BEP	BKF	C1N	C1PHEN
2014/17019	1+5	VC03A+4, 0m	Area i		46		0.214	0.815	0.548	0.975	0.889	1.338	0.809	0.967	0.510	11.135	5.403
2014/17020	2+6	VC03A+4, 1m	Area i		55		0.274	0.562	0.584	0.888	0.701	0.914	0.490	0.549	0.345	8.567	3.962
2014/17021	4	VC03A, 1.79m	Area i		81		0.007	0.014	0.014	0.021	0.017	0.025	0.012	0.013	0.009	0.169	0.124
2014/17022	7	VC4, 2m	Area i		49		2.587	11.954	3.859	2.781	1.177	1.331	0.511	0.803	0.445	125.348	20.183
2014/17023	8	VC4, 3m	Area i		47		4.046	18.871	5.703	3.712	1.480	1.228	0.454	0.901	0.456	231.193	26.558
2014/17024	9	VC4, 4m	Area i		46		5.661	24.129	7.784	4.879	2.108	1.921	0.743	1.483	0.574	327.377	29.317
2014/17025	10	VC4, 4.53m	Area i		81		0.036	0.211	0.077	0.117	0.082	0.080	0.083	0.088	0.036	5.552	1.322
2014/17026	11+28	VC6+VC5, 0m	Area i		45		0.091	0.366	0.335	0.805	0.791	0.968	0.707	0.715	0.464	7.166	4.121
2014/17027	12	VC6, 1m	Area i		56		0.079	0.396	0.371	0.926	0.950	1.254	0.806	0.834	0.520	9.461	4.513
2014/17028	13	VC6, 2m	Area i		59		0.170	0.893	0.534	0.968	0.750	0.970	0.578	0.641	0.387	13.020	5.084
2014/17029	14	VC6, 3m	Area i		52		1.564	7.284	2.339	2.171	1.163	1.295	0.667	0.775	0.509	77.227	13.384
2014/17030	15	VC6, 4.53m	Area i		52		2.088	12.302	3.302	2.520	1.240	1.168	0.538	0.785	0.506	101.795	15.954
2014/17031	20	VC02A, 0m	Area ii		50		0.053	0.326	0.305	0.904	0.909	1.233	0.738	0.803	0.493	8.853	4.044
2014/17032	21	VC02A, 0.86m	Area ii		63		0.095	0.510	0.437	0.943	0.824	0.928	0.736	0.744	0.410	12.486	4.800
2014/17033	22+36	VC08A+VC7, 0m	Area ii		47		0.124	0.456	0.403	0.937	0.901	1.135	0.760	0.812	0.493	9.459	4.440
2014/17034	23+37	VC08A+VC7, 1m	Area ii		44		2.160	11.032	3.537	3.185	1.887	1.870	0.890	1.095	0.756	93.965	18.565
2014/17035	24	VC08A, 2m	Area ii		39		3.501	20.987	7.676	5.953	3.346	3.406	1.476	2.486	1.046	271.461	30.923
2014/17036	25+39	VC08A+VC7, 3m	Area ii		44		1.980	8.522	3.669	2.813	1.557	1.809	0.907	1.369	0.584	82.593	18.718
2014/17037	26	VC08A, 4m	Area ii		76		0.190	0.739	0.367	0.365	0.240	0.272	0.211	0.255	0.109	9.774	3.679
2014/17038	29	VC5, 1m	Area ii		44		0.112	0.427	0.502	1.196	1.364	1.816	1.119	1.104	0.760	9.161	4.534
2014/17039	30	VC5, 2m	Area ii		52		0.292	1.362	0.735	1.153	0.872	1.137	0.662	0.715	0.451	17.568	6.511
2014/17040	31	VC5, 3m	Area ii		46		1.769	6.682	3.696	3.314	1.861	2.140	1.050	1.643	0.725	105.639	19.509
		Mean				#DIV/0!	1.231	5.856	2.126	1.888	1.141	1.284	0.679	0.890	0.481	69.953	11.166
	AL1 (ppm dry)					0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Figure 5. DCO/2014/00002 York Potash - Sediment Composition Analysis for Polycyclic Aromatic Hydrocarbons

Advice on request to preclude at depth sampling and PDBE analysis.

MARINE AND COASTAL ACCESS ACT (2009) PART 4

FORMAL REQUEST FOR PRE-APPLICATION SAMPLING ADVICE FOR THE NORTHERN GATEWAY CONTAINER TERMINAL PROJECT BY PD TEESPORT AT TEESPORT, TEESSIDE.
REF: SAM/2018/00069

From: Joe Perry
Cefas, Lowestoft Laboratory
Date: 13th June 2019
Tel: 01502 524564
Email:
Regulatory_Assessment@cefas.co.uk

To: Luella Williamson - MMO (by MCMS)

1. With reference to your request for advice regarding pre-application sampling and analysis for the Northern Gateway Container Terminal project, please find my advice below and a sample plan form in appendix 1.

2. Cefas provide advice to MMO on sampling plans for marine licence applications to ensure that there is sufficient evidence on sediment quality to undertake an assessment of potential impacts on the marine environment prior to issuing a Marine Licence. This may include characterisation of dredge areas or of areas where other activities are likely to lead to the mobilisation of sediments. To enable us to provide that advice, and to fulfil the UK's obligations under International Conventions in respect of disposal at sea, and the requirements of the Marine and Coastal Access Act where applicable, we require sediment samples to be provided for analysis.

Description of the project

3. PD Teesport are seeking a joint sediment sampling plan to inform a marine licence application for the proposed Northern Gateway Container Terminal and to support the discharge of Condition 5.2.3 of the existing 10-year maintenance dredge disposal licence (L/2015/00427/1). Sampling advice was initially provided by Cefas in 2018 (Joe Perry, 12th November 18) and subsequently amended in December (Andrew Griffith, 18th December 18) following additional clarification provided by the applicant. The sampling advice recommended that 37 samples be recovered from the various dredge areas according to their proposed volumes.

4. It was noted by the applicant that significant proportions of areas A, B, F and G were likely to comprise inert glacial deposits (mudstone). To confirm the extent of this, and ultimately to confirm the eventual sampling activity, as mudstone does not require contaminant analysis, it was recommended by Cefas that four core samples (representing one core per area) should be recovered. The applicant has conducted this sampling and presented the results for consideration. It is the applicant's view that sub surface sampling is no longer required in areas A, B, F and G, as the cores show the mudstone to be within 1 metre of the riverbed surface.

5. The applicant has also provided sampling results for the maintenance licence for (L/2015/00427/1). These results were collected in line with Cefas sampling advice provided in December 2018, where ten samples outside of the NGCT dredge area were deemed to be necessary to support mid-licence sampling requirements. The applicant argues that these results preclude the need to test for Polybrominated Diphenyl Ethers (PBDE), for which all samples have been recommended for analysis throughout the NGT dredge areas.

Request to preclude subsurface sampling

6. The core sample data collected by the applicant appears to be in response to the Cefas comment from previous advice, which stated: *"The applicant has not detailed the depth of the unconsolidated material [mudstone] and therefore we have advised that samples at 1m intervals to the mudstone layer be taken. Should information on the depth of the unconsolidated material become available it*

can be submitted with the marine licence application as supporting evidence." The following table details the findings from the applicant's core sample analysis:

*Table 3. Table showing depths of the core samples, all units = metres below Lowest Astronomical Tide; * = metres below Chart Datum. Depth of refusal indicates penetration of consolidated material.*

Area	Surface depth	Depth of refusal	Core depth	Dredge depth m BCD*
A	10.5	10.9	0.4	14.5
B	10.8	11.02	0.22	14.5
F	12.5	13	0.5	14.5
G	9.8	10.3	0.5	16

7. As all core depth values are less than 1 metre, it can be deduced that undisturbed consolidated material is likely present within 1 metre of the riverbed surface. Considering these results, I would agree with the applicant's stipulation that subsurface sediment samples are neither necessary nor practical.

Request to preclude PBDE sampling

8. The applicant intends to use the mid-licence sampling results presented for L/2015/00427/1 (the maintenance area upstream) to show that PBDE analysis is not necessary within the NGCT dredge area. They argue that the samples taken are sufficiently representative of the NGCT dredge area and do not raise cause for concern. I note that determination of whether these sample results discharge the mid-licence sampling condition of L/2015/00427/1 will be conducted through a separate consultation.

9. PBDEs are a type of organic compound used as flame retardants. PBDE individual congeners vary widely, with up to 209 different combinations. They are considered an OSPAR contaminant of concern due to their toxicity, longevity and hydrophobicity in the marine environment. The distribution and concentrations of PBDE congeners in the marine environment are highly variable, and whilst named as a Chemical for Priority Action, there are no formal OSPAR assessment values developed with which to assess status[1]. As such, I have consulted with internal Cefas experts to assess the validity of the applicant's arguments. Advice constructed for this request will take a precautionary approach, but will note practicality and cost concerns raised by the applicant.

10. The results provided for this consultation (L/2015/00427/1) indicate a PBDE range of 0.05 – 2.64 ppb (not including BDE 209 [µg/kg]). This is a highly variable range, but follows, to some extent, levels expected in the marine environment for each BDE congener. BDE congener 209 is generally expected to be found in much higher concentrations in the marine environment, with localised hotspots often depicting even higher concentrations. Cefas internal advice state that the levels of BDE 209 depicted in the data [247 – 912 µg/kg can be considered "very high", and similar to those levels found at localised hotspots around the UK.

Major comment

11. Whilst the applicant has stated that these data prove that there is no need to continue PBDE analysis of the proposed dredge area, it is my opinion that this has not been adequately justified, nor is it adequately supported by the data presented. Based on expert chemistry advice, and the data presented, I do not see any valid reason to preclude PBDE analysis from the sample plan SAM/2018/00069 with regards to the NGCT area. If the applicant can provide further justification and/or evidence which indicate that the PBDE results are similar to previously observed levels in the area, then this advice could be reviewed again however, as the application currently stands, the applicant's conclusions are not supported by the evidence presented.

12. In summary, the requirement for sub-surface samples is no longer required, however, I do not consider there to be sufficient evidence to reduce or amend the regime for PBDE sampling.

[1] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/pressures-human-activities/contaminants/pbde-sediment/

13. Please see an amended sampling plan based on this consultation inserted as an annex to this advice.

Joe Perry
Advisor (Sustainable Marine Management)

Quality Check	***Date***
Andrew Griffith	17/06/2019

Appendix 1
Amended Sample Plan

Sample	Station	Metals	Organotins	THC	PAHs	PCBs	PDBEs	OCs	PSA
A1 – A4	**Dredge Area A (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
B1 – B6	**Dredge Area B (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
C1 – C12	**Dredge Area C (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
D1 – D3	**Dredge Area D (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
E1 – E5	**Dredge Area E (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
F1	**Dredge Area F (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
G1 – G6	**Dredge Area G (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
***M1-10**	**Maintenance Area (0m)**	☒	☒	☒	☒	☒	☒	☒	☒
		☐	☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐	☐
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		☐	☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐	☐

Comments:
Stations should be evenly distributed across the dredge areas, depth samples are no longer required due to evidence presented by core samples.

Total samples to be taken:
Dredge Area A – 4 stations at 0m
Dredge Area B – 6 stations at 0m
Dredge Area C – 12 stations at 0m
Dredge Area D – 3 stations at 0m
Dredge Area E – 5 stations at 0m
Dredge Area F – 1 Station at 0m
Dredge Area G – 6 stations at 0m
***Maintenance Area – 10 samples** 0m – This sampling activity has already been conducted and is so included for reference only

Appendix 9

Historic sediment quality data

Royal HaskoningDHV

Summary of historic sediment quality surveys in the Tees estuary

2006 NGCT sediment quality survey

Sediment samples were collected as part of the EIA for the NGCT during 2006 (Royal Haskoning, 2006) along the approach channel (downstream of the Tees Dock area) and within the area proposed for the container terminal. In total, of the ten sites proposed, eight sites were sampled; two locations could not be sampled due to recent dredging activity over one site and restricted tidal accessibility to the other. Additional samples were also collected at five intertidal 'receptor areas' which could potentially be subject to deposition of sediment that will be disturbed during the capital dredging (giving a total of 13 sampling stations). These receptor areas corresponded with sites that are designated for their nature conservation importance. Samples were collected using a stainless steel grab as part of the marine biological survey. The samples were analysed for:

- Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc) and other metals (aluminium, boron, iron, manganese, selenium, silver and vanadium);
- Organotins (Tributyl tin (TBT) and dibutyl tin (DBT);
- Total petroleum hydrocarbons (TPH);
- PAHs (USEPA 16);
- PCBs including 25 congeners;
- Organochlorine pesticides (hexachlorohexanes (HCHs), drins, dichlorodiphenyltrichloroethane and derivatives (DDTs));
- Ammonia;
- Sulphide;
- Brominated flame retardants (at five randomly selected sites only); and,
- Nonalyphenols (Endocrine Disruptors).

Overall, the chemical data from the NGCT study indicated some level of contamination within the samples, particularly heavy metals. However, levels were not deemed high enough to prohibit the material from being disposed of to sea. A summary of the 2006 data (screened against the Action Levels and the CSGQ's is presented in **Table 1** below.

Table 1 Summary of sediment quality data for metals and organotins from samples recovered during 2006 from within the proposed dredge envelope

Contaminant	Min conc. (mg/kg) dry weight)	Max conc. (mg/kg) dry weight	Action Level 1 exceedance (number of samples)	Action Level 2 exceedance (number of samples)	TEL exceedance (number of samples)	PEL exceedance (number of samples)
Arsenic	4.7	30	Yes (7)	No	Yes (11)	No
Cadmium	0.57	1.1	Yes (4)	No	Yes (2)	No
Chromium	7.5	91	Yes (6)	No	Yes (4)	No
Copper	4.300	150.000	Yes (6)	No	Yes (6)	Yes (1)
Mercury	<0.200	1.300	Yes (9)	No	Yes (9)	Yes (4)
Nickel	2.600	34.000	Yes (7)	No	-	-
Lead	24.000	200.000	Yes (9)	No	Yes (9)	Yes (5)
Zinc	34.000	310.000	Yes (8)	No	Yes (8)	Yes (1)
DBT	<0.020	<0.020	No	No	-	-
TBT	<0.020	<0.020	No	No	-	-
OCPs	<0.050	<0.050	-	-	-	-
PCBs	<0.010	<0.010	-	-	-	-
Naphthalene	0.068	2.500	Yes (12)	-	Yes (13)	Yes (10)
Acenaphthylene	0.012	0.790	Yes (8)	-	Yes (13)	Yes (7)
Acenaphthene	0.018	0.420	Yes (8)	-	Yes (13)	Yes (8)
Fluorene	0.027	0.720	Yes (9)	-	Yes (13)	Yes (9)
Phenanthrene	0.054	2.900	Yes (10)	-	Yes (11)	Yes (9)
Anthracene	0.015	0.970	Yes (9)	-	Yes (11)	Yes (7)
Fluoranthene	0.038	3.200	Yes (10)	-	Yes (11)	Yes (4)
Pyrene	0.033	2.900	Yes (10)	-	Yes (10)	Yes (4)
Benzo(a)anthracene	0.014	1.500	Yes (10)	-	Yes (10)	Yes (4)
Chrysene	0.018	1.700	Yes (10)	-	Yes (10)	Yes (4)
Cyclopenta(cd)pyrene	<0.010	0.440	-	-	-	-
Benzo(b)fluoranthene	0.022	1.600	-	-	-	-
Benzo(k)fluoranthene	<0.010	1.100	-	-	-	-
Benzo(e)pyrene	<0.010	0.950	-	-	-	-
Benzo(a)pyrene	<0.010	1.200	Yes (10)	-	Yes (10)	Yes (3)
Dibenzo(ah)anthracene	<0.010	0.220	Yes (5)	-	Yes (12)	Yes (4)
Benzo(ghi)perylene	<0.010	0.840	-	-	-	-
Indeno(123cd)pyrene	<0.010	1.000	-	-	-	-
Anthanthrene	<0.010	0.380	-	-	-	-
PAH (Total)	0.410	25.000	-	-	-	-

Contaminant	Min conc. (mg/kg) dry weight)	Max conc. (mg/kg) dry weight	Action Level 1 exceedance (number of samples)	Action Level 2 exceedance (number of samples)	TEL exceedance (number of samples)	PEL exceedance (number of samples)
Faecal Enterococci**	<10.000	20.000	-	-	-	-
Total coliforms**	<10.000	<10.000	-	-	-	-
TribromoDPE #17*	<0.010	1.400	-	-	-	-
TribromoDPE #28*	<0.010	1.200	-	-	-	-
TetrabromoDPE #47*	<0.010	8.700	-	-	-	-
TetrabromoDPE #49*	<0.010	5.600	-	-	-	-
TetrabromoDPE #66*	<0.010	1.600	-	-	-	-
TetrabromoDPE #71*	<0.010	3.800	-	-	-	-
TetrabromoDPE #77*	<0.010	0.000	-	-	-	-
PentabromoDPE #85*	<0.010	0.300	-	-	-	-
PentabromoDPE #99*	<0.010	12.000	-	-	-	-
PentabromoDPE #100*	<0.010	1.000	-	-	-	-
PentabromoDPE #119*	<0.010	0.500	-	-	-	-
HexabromoDPE #138*	<0.010	0.100	-	-	-	-
HexabromoDPE #153*	<0.010	2.200	-	-	-	-
HexabromoDPE #154*	<0.010	0.800	-	-	-	-
HexabromoDPE #156*	<0.010	0.000	-	-	-	-
HeptabromoDPE #183*	<0.010	0.700	-	-	-	-
HeptabromoDPE #184*	<0.010	0.000	-	-	-	-
HeptabromoDPE #191*	<0.010	0.000	-	-	-	-
OctabromoDPE #196*	<0.010	0.000	-	-	-	-
OctabromoDPE #197*	<0.010	0.000	-	-	-	-
NonabromoDPE #206*	<0.010	8.000	-	-	-	-
NonabromoDPE #207*	<0.050	1.400	-	-	-	-
NonabromoDPE #209	13	340	-	-	-	-

- - = No level available for comparison; * = µg/kg; ** = cfu/g

Royal HaskoningDHV

2008 QEII Berth sediment quality survey

A sediment quality survey was carried out in the Tees estuary in December 2008 to characterise the area to be dredged as part of the QEII Berth project. Two vibrocores (VC004 and VC001B) sampled sediments to a depth of 4m below Ordnance Datum (OD), or as deep as the corer reached.

The results from the vibrocores identified that all metals analysed within the sediments exceeded AL1. Concentrations of DBT and TBT were present below AL1. Concentrations of mercury, cadmium, chromium, copper, lead and zinc exceeded AL2. Exceedance of the TEL by acenaphthene was also recorded in VC001B.

As well as identifying contaminated sediments, the sediment quality survey also indicated a pattern of increasing contamination with depth. As a result of the contamination levels, the marine licence granted for QEII Berth project stated that the fine unconsolidated material was not suitable for disposal to sea and only the Mercia mudstone constituent was licensed for offshore disposal. The marine licence states that the unconsolidated deposits need to be dredged using an enclosed grab, loading into a sealed barge to minimise re-suspension of sediment into the water column. No such requirements were specified for the consolidated Mercia mudstone.

2012 sediment sampling from Tees Dock No.1 Quay

Royal HaskoningDHV carried out an EIA on behalf of PDT in 2012 for proposed strengthening of the existing No.1 Quay at Tees Dock, and also the widening and deepening of the existing berth and adjacent areas within Tees Dock. Prior to submission of the EIA, Royal HaskoningDHV produced a Technical Note (Royal Haskoning, 2011) which presented the available sediment quality data from Tees Dock, and provided justification for taking no further sediment quality samples prior to submission of the marine licence application.

In 2011, the most recent sediment quality data from the Tees Dock were requested from Cefas. The data was originally submitted to Cefas in support of a maintenance dredge disposal licence held by PDT (and therefore the data was specifically in relation to sediment samples recovered from the surface of Tees Dock only). This data was screened against ALs, which identified concentrations of metals, PAH and PCBs above AL1. No elevations of AL2 were identified. Though showing signs of minor contamination, it was determined that the ‘soft’ sediments within ‘Tees Dock Water Area’ (identified in marine licence 34396) were suitable for offshore disposal.

The 2011 Technical Note (Royal Haskoning, 2011) stated that the areas which were proposed for capital dredging within Tees Dock had previously been dredged to bedrock (i.e. Mercia mudstone). The note concluded that the bedrock deposits are highly likely to be uncontaminated (due to the physical properties of the material) and would be deemed suitable for offshore disposal within the licensed sites in Tees Bay. It was also concluded that the sediment chemistry of the unconsolidated sediments present, and which required removal as part of the proposed scheme, would be expected to contain similar levels of contamination to those sediments sampled in support of existing maintenance dredge disposal licences in place at the time.

The MMO granted a marine licence for the works in 2013, which permitted the disposal of all dredged material arising from the Tees Dock No.1 Quay scheme at Tees Bay C.

2014 York Potash Harbour Facilities sediment quality survey

A sediment quality survey was undertaken in the Tees estuary during July 2014 to inform the EIA for the York Potash Harbour Facilities project. A total of six vibrocores were taken within the footprint of the berth pocket and port terminal for the York Potash Harbour Facilities, with two vibrocores taken from the adjacent approach channel (that will be deepened as part of the NGCT project and the results are therefore directly applicable to the NGCT scheme). Sediment samples were therefore recovered from at the surface and at depth within the existing approach channel and the berth pocket for the Harbour Facilities project. Further detail is provided in **Table 2.**

Table 2 Vibrocores recovered from the berth pocket and port terminal for the York Potash Harbour Facilities

Vibrocore number	Vibrocore penetration (m)	Depth at which samples were recovered and analysed (m)	Location
1A	1.6	0, 1, 1.6	Tees estuary approach channel (which would also be subject to dredging from the NGCT scheme)
2A	1.0	0, 0.86m	
3A	1.94	0, 0.7, 1.24, 1.79	Berth pocket and port terminal for York Potash Harbour facility (outside of the NGCT dredge footprint)
4	4.53	0, 1, 2, 3, 4, 4.53	
5A	3.78	0, 1, 2, 3, 3.48, 3.78	
6	4.18	0, 1, 2, 3, 4.18	
7	4.87	0, 1, 2, 3, 4, 4.87	
8A	4.68	0, 1, 2, 3, 4, 4.68	

Vibrocore 1A and 2A were positioned within the existing navigation channel in the Tees estuary (which will be subject to dredging for the NGCT). All other samples recovered were from vibrocores located in areas outside of the NGCT dredge footprint.

Samples were recovered from a maximum depth of 1.6m below bed level from vibrocores 1A and 2A. The vibrocore logs reported that the strata within the approach channel comprised soft extremely low strength clay, underlain by gravelly sand at 1.5m depth (VC1A) and rock debris at 0.9m depth (VC2A). The samples from all strata from VC1A and VC2A did not contain any concentrations of contaminants above AL2. Minor exceedances of AL1 only were identified.

Appendix 10

Net gain study report

Northern Gateway Container Terminal

Application of the ‘net gain’ biodiversity metric

Client: PD Ports

Reference: PB8270-RHD-ZZ-XX-RP-0003

Status: 01/S0

Date: 07 February 2020

Royal HaskoningDHV
Enhancing Society Together

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Document title:	Northern Gateway Container Terminal
Reference:	PB8270-RHD-ZZ-XX-RP-0003
Status:	01/S0
Date:	07 February 2020
Project name:	Northern Gateway Container Terminal
Project number:	9Y0989
Author(s):	Matt Simpson
Drafted by:	Matt Simpson
Checked by:	Steve Rayner
Date / initials:	5 November 2019
Approved by:	Steve Rayner
Date / initials:	12 November 2019

Classification
Restricted

Table of Contents

1 INTRODUCTION

1.1 Aim of this report

This report sets out the findings of the application of the methodology to define the biodiversity net gain requirement for the predicted impact of the proposed Northern Gateway Container Terminal (NGCT) on intertidal habitat. The methodology is currently being developed by Natural England; version 3.2 (Natural England, 2019) has been released to Royal HaskoningDHV.

Natural England (2019) note that a key element of the 'net gain' approach is the development of a metric, which is a tool that allows biodiversity losses and compensation to be measured. The metric allows the biodiversity impact of a development to be quantified so that the offset requirement, and the value of the compensatory action, can be clearly defined.

The key principles for using the metric are as follows (reproduced from Natural England, 2019):

- **The metric does not change the protection afforded to biodiversity**: existing levels of protection afforded to protected species and to habitats are not affected by the use of this metric.
- **The metric sits within a decision framework based on the mitigation hierarchy**: it informs decision-making where application of the mitigation hierarchy and good practice principles has concluded that compensation for habitat losses is justified.
- **The metric is a proxy for biodiversity**: while it is underpinned by ecological evidence the metric is only a proxy for biodiversity and to be of practical use has been kept deliberately simple.
- **The metric focuses on widespread species and typical habitats**: it is a suitable proxy for widespread species found in typical examples of different habitats. Scarce and protected species are likely to need separate consideration to the biodiversity metric.
- **The metric recognises the importance of place and connectivity**: it seeks to enhance biodiversity in the locality of impacts so far as possible as well as contributing to England's ecological network by creating more, bigger, better and joined areas for biodiversity.
- **The metric informs decisions**: Decisions and management interventions need to take account of expert ecological advice and not just the biodiversity unit outputs of the metric. The historic or landscape significance of a habitat, and relevant planning policies, are also relevant.

1.2 Predicted impact of the proposed NGCT on intertidal habitat

The calculation of the biodiversity metric has been informed by a marine ecological survey (included as Appendix 12 to the Environmental Impact Assessment (EIA) Report (Royal HaskoningDHV, 2019)) which describes the nature of the intertidal habitat potentially impacted by the proposed NGCT.

The predicted impact of the proposed NGCT on intertidal habitat is described in Section 9 of the EIA Report. The EIA Report concludes that the proposed NGCT would result in the direct loss of intertidal habitat due to the reclamation. The area of intertidal loss is calculated to be 1.19ha. Further definition of this area (habitat type, distinctiveness and condition) is provided in Section 2, which applies the biodiversity net gain metric methodology.

2 APPLICATION OF THE BIODIVERSITY NET GAIN METRIC TO CALCULATE THE IMPACT OF THE PROPOSED NGCT

2.1 Introduction

This section documents the approach taken to the application of the methodology set out in Natural England (2019) to calculate the biodiversity impact of the proposed NGCT.

Natural England (2019) notes that a habitat obtains 'biodiversity units' according to its area, biodiversity value and condition. Factors like strategic significance and connectivity (relationship of the habitat to the surrounding area) are also considered.

Box 1 sets out how the metric is applied. Natural England (2019) states that net gain will be attained when the post-intervention units (i.e. taking into account the predicted impact of the NGCT plus the effect of any proposed intervention) are at least 10% higher than the original (pre-intervention) habitat biodiversity units. It should be noted that the methodology in Box 1 relates to the location where actions are proposed to enhance biodiversity value and does not include consideration of the impact on the area where development is proposed (in this case, the NGCT). Natural England has clarified that prior to applying the methodology set out in Box 1, the biodiversity baseline units will need to be calculated within the development site to identify how many units will be lost due to the development (as reported in this section).

Box 1 Summary of the biodiversity net gain metric (Natural England, 2019)

BIODIVERSITY UNITS PRE-INTERVENTION = Area x Distinctiveness x Condition x (Strategic significance x Connectivity)

BIODIVERSITY UNITS of PROPOSED ACTION = Area x Distinctiveness x Condition x (Strategic significance x Connectivity) x RISKS [Difficulty x temporal x location]

Net Gain = proposed action biodiversity units - pre-intervention biodiversity units

If net gain cannot be achieved, a second site needs to be identified and the same process described above applied to see if the overall result, across the two sites, achieves a 10% gain in total.

The biodiversity net gain metric is not designed to be used in designated sites or for irreplaceable habitats, as these are non-tradable. Natural England (2019) states that truly irreplaceable habitats will be those based on peat, chalk or clay in the marine environment. Although the proposed NGCT lies within designated sites (namely the Teesmouth and Cleveland Coast potential Special Protection Area (pSPA) and Ramsar site, and the Teesmouth and Cleveland Coast Site of Special Scientific Interest (SSSI)), the application of the biodiversity metric in this case is not intended to inform decisions regarding potential impact on designated sites. These considerations are dealt with in the EIA Report (with respect to SSSIs) and the Habitats Regulations Assessment (HRA) (with respect to European sites).

2.2 Habitat definition

The marine ecology survey report (Appendix 12 of the EIA Report) describes the key biotopes assigned to the intertidal area within the footprint of the proposed NGCT. The biotopes are described according to the

EUNIS codes (as advocated by Natural England, 2019) and are summarised in Table 2.1 (including area covered by each biotope).

Table 2.1 Intertidal habitats within the footprint of the proposed NGCT

Habitat	EUNIS code	EUNIS description	Area (ha)
A1 – Littoral rock and other hard substrata	A1.32	Fucoids in variable salinity	0.40
	A1.33	Red algal turf in lower eulittoral, sheltered from wave action	0.13
	A1.45	Ephemeral green or red seaweeds (freshwater or sand-influenced) on non-mobile substrate	0.42
A2 – Littoral Sediment	A2.12	Estuarine coarse sediment shores	0.05
	A1.33/A2.12	See above descriptions	0.19
TOTAL			**1.19**

2.3 Habitat area

The total area of intertidal habitat within the footprint of the proposed NGCT is calculated as 1.19ha (refer to Table 2.1 for breakdown between the various intertidal biotopes).

2.4 Habitat distinctiveness

Natural England (2019) states that all naturally occurring coastal/intertidal habitats that could be covered by the net gain approach are considered of nature conservation value, whether or not they occur within the boundary of a protected site. Natural England proposes that all coastal and intertidal habitats are of high distinctiveness (score of 6), with some (i.e. intertidal habitats based on peat or clay) considered as irreplaceable due to their slow recoverability and low resilience.

Natural England (2019) acknowledges that there are habitats that are man-made and these need to be distinguished from the naturally occurring versions of those habitats. The methodology proposes that these man-made habitats will be added to the metric as a distinctiveness category of 'low' (score of 2) to represent their origin. It should be noted that the 'condition' parameter (Section 2.5 of this report) may increase their overall biodiversity value in the metric in cases where the habitat is performing an important natural function.

The results of the marine ecological survey (intertidal) have been analysed to assess the appropriate distinctiveness category. Typical photographs of the habitats classified as A1 (littoral rock) are shown below (Plates 2.1 to 2.3).

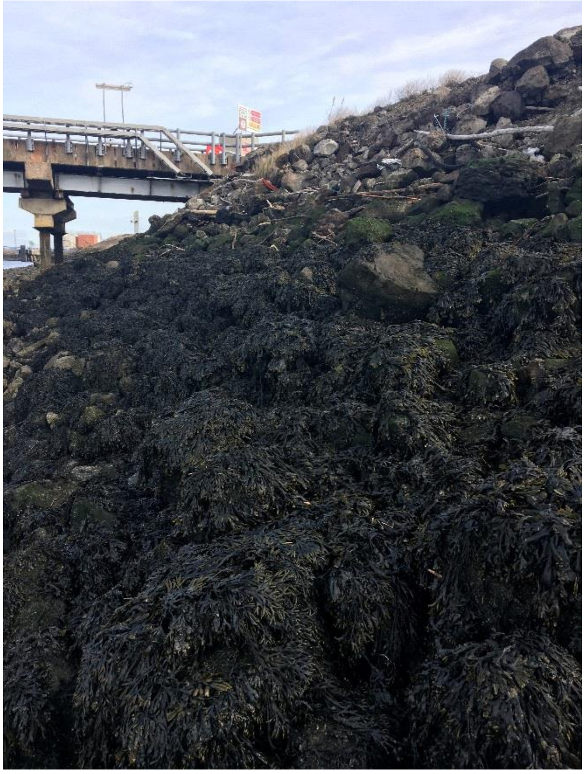

Plate 2.1 Typical habitat classified as A1.32 (Fucoids in variable salinity)

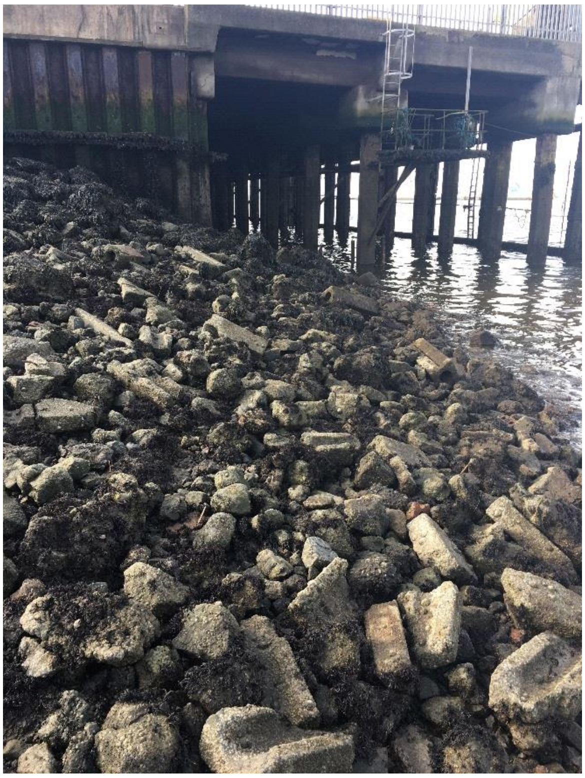

Plate 2.2 Typical habitat classified as A1.33 (Red algal turf in lower eulittoral, sheltered from wave action)

Plate 2.3 Typical habitat classified as A1.45 (Ephemeral green or red seaweeds (freshwater or sand-influenced) on non-mobile substrate)

The rocky shore/hard substrata is present as a result of historic reclamation with a variety of materials of anthropogenic origin being present (rubble, bricks, slag). These habitats are, therefore, judged to not be 'naturally occurring' as they are present as a direct result of anthropogenic activity and much of the material is not naturally-occurring rock.

A typical photograph of the habitat classified as A2 (littoral sediment) is shown below (Plate 2.4).

The littoral sediment habitat is considered to be naturally occurring as the sediment has accumulated in this location as a result of coastal processes. While these processes are likely to be influenced by anthropogenic activity (e.g. dredging, structures within the estuary), the habitat itself cannot be considered man-made. Areas that are classified as a mixture of littoral rock and sediment are, however, considered man-made as opposed to naturally occurring.

Given the above, a distinction has been made between littoral rock and littoral sediments in terms of habitat distinctiveness (Table 2.2).

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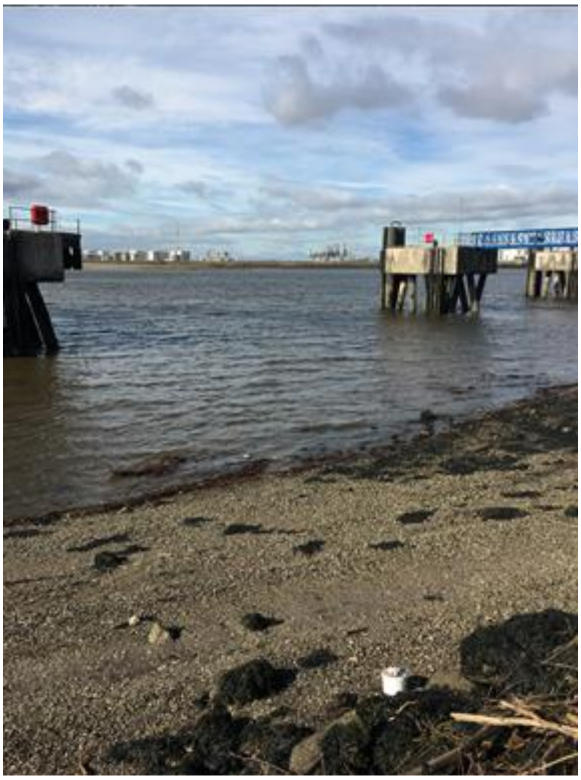


Plate 2.4 Typical habitat classified as A2.12 (Estuarine coarse sediment shores)

Table 2.2 Habitat distinctiveness (distinctiveness categories, score and habitat type from Natural England, 2019)

Distinctiveness category	Score	Habitat type	Habitat present within NGCT footprint	Area (ha)
Irreplaceable	N/A	Habitats based on clay or peat	N/A	0
High	6	All natural coastal intertidal habitats	A2.12 (Estuarine coarse sediment shores)	0.05
Low	2	All man-made habitats, their ecological value will be given by their habitat condition	A1.32 (Fucoids in variable salinity) A1.33 (Red algal turf in lower eulittoral, sheltered from wave action) A1.45 (Ephemeral green or red seaweeds (freshwater or sand-influenced) on non-mobile substrate)	1.14

2.5 Habitat condition

The condition of intertidal/coastal habitats are assigned at EUNIS level 2/3 (Natural England, 2019); the habitats of relevance to this assessment are A1 (littoral rock) and A2 (intertidal sediments) (see Table 2.1).

Appendix A to Natural England (2019) lists a series of criteria against which habitat condition can be assessed and a score is assigned on the basis of these criteria.

While the intertidal ecological survey did not specifically collect all the information required to assess against the criteria in Appendix A (because the Natural England (2019) methodology was not available at the time of survey), for the intertidal sediment habitat, it is judged that the habitat condition should be classified as 'moderate' (attracting a score of 2). There are several indicators that support this judgement, such as presence of filamentous algae, very poor species richness of core samples, presence of structures which impede the natural movement of sediments, poor transition of habitats and the fact that the ecological status of the overlying water body is classified under the Water Framework Directive (WFD) as Moderate.

For the rocky shore habitat, it is judged that the habitat condition can be classified as 'fairly good' (attracting a score of 2.5). The assessment criteria for this condition category are:

- Only discrete and very localised pollution.
- Macroalgae Tool suggests water quality is 'Good'.
- One or more non-native species are present at no more than the 'Occasional' level on the SACFOR scale. Non-native seaweeds should occupy no more than 1-9% of the rocky shore. No high risk undesirable species present.
- Rocky shore communities/biotopes are as expected for that stretch.

2.6 Calculation of biodiversity units impacted by the proposed NGCT (i.e. baseline)

Table 2.3 summarises the outcome of the baseline assessment and calculates the biodiversity units predicted to be impacted by the proposed NGCT.

Table 2.3 Calculation of biodiversity units impacted by the proposed NGCT

Habitat type	Area (ha)	Distinctiveness	Condition	Biodiversity units impacted by NGCT (baseline) (area x distinctiveness / condition)
All natural coastal intertidal habitats (intertidal sediments)	0.05	6	2	0.6
All man-made habitats (rocky shore)	1.14	2	2.5	5.7
TOTAL				**6.3**

3 BIODIVERSITY EFFECT OF PROPOSED INTERVENTION

3.1 Overview of the proposed intervention

PD Teesport (PDT) has investigated the potential to implement habitat improvement measures (referred to as 'interventions' to align with the terminology used by Natural England (2019)) in light of the predicted biodiversity impact of the proposed NGCT. Given the nature of the impact of the proposed NGCT as described in Section 2, the focus of the investigation was on the potential to improve intertidal habitat. With this focus in mind, PDT held discussions with the Tees Rivers Trust regarding its 'Tees Estuary Edge Softening Project', which is currently at the feasibility and early design stage.

The Tees Rivers Trust is investigating the potential to improve intertidal habitat along a stretch of the eastern bank of the Tees downstream of the A1032 (Newport Bridge). The feasibility and design report (JBA, 2019) describes options for habitat improvement within five areas (referred to as Areas 1 to 5; see Annex A).

PDT proposes to work in partnership with the Tees Rivers Trust to deliver the habitat improvement measures in Area 1 (shown on Figure 3.1). The options for habitat improvement include reprofiling the river wall (where there is an historic failure), placement of a rock roll or geo bag along the lower intertidal margin and recharging the intertidal area with silt arising from maintenance dredging to create an area of enhanced, soft sediment, intertidal habitat.

The following sections assess the biodiversity units currently present within Area 1 (Section 3.2) and the predicted post-intervention biodiversity units (Section 3.3).

3.2 Habitat area

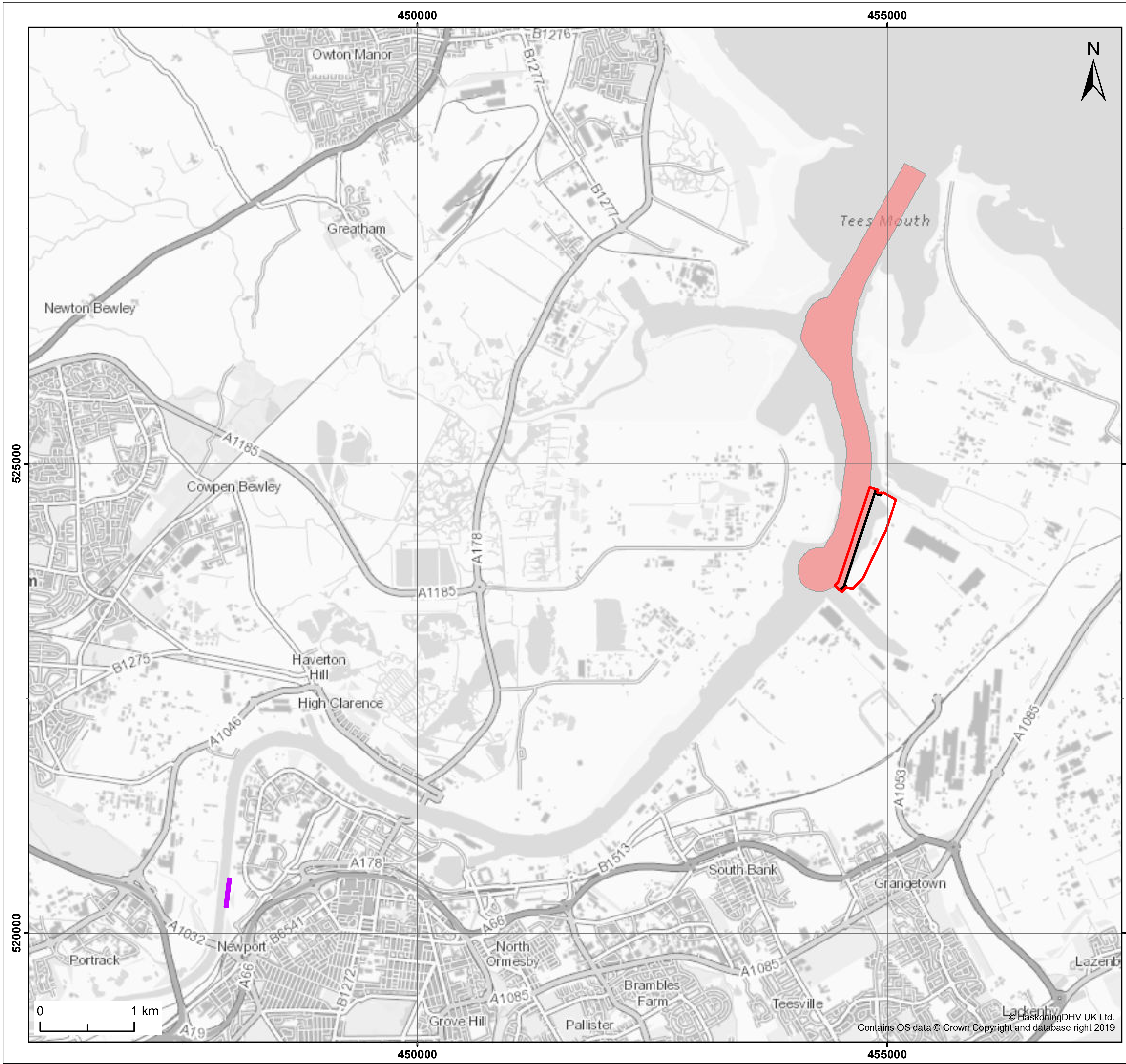
The habitat improvement measures for Area 1 would deliver 5,350m^2 (approximately 0.54ha) of intertidal habitat.

3.3 Habitat distinctiveness

The habitat currently (pre-intervention) within Area 1 consists of rocky shore/hard substrata and, as is the case for this habitat type within the NGCT footprint, is present as a result of historic reclamation and is comprised of rubble, bricks and slag. The habitats are, therefore, judged to not be 'naturally occurring' as they are present as a direct result of anthropogenic activity. The intertidal area is backed by a revetment and there are no areas of sedimentary habitat present in this area. The current habitat is, therefore, categorised in the 'low' distinctiveness category.

The intention of the proposed intervention is to create intertidal sedimentary habitat (mudflat) using maintenance dredged material. This habitat is assigned to the 'high' distinctiveness category. While this material would be placed and retained within Area 1, the application of the 'high' distinctiveness category is considered appropriate given that the material is naturally occurring and is not considered equivalent (in terms of distinctiveness) to artificial hard substrata.

Table 3.1 provides a summary of the habitat distinctiveness within Area 1 for pre- and post- intervention conditions.



Legend

- Intervention Works Area 1
- Limit of deviation for Works No. 1 (as defined in the 2008 HRO)
- Proposed quay face
- Proposed dredge footprint

Client:	Project:
PD Teesport	NGCT net gain study

Title: Proposed location of intervention works in the context of the proposed NGCT

Figure: 1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	07/11/2019	TC	SR	A3	1:40,000

Co-ordinate system: British National Grid

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Table 3.1 Habitat distinctiveness (distinctiveness categories, score and habitat type from Natural England, 2019)

	Distinctiveness category	Score	Habitat type	Habitat present within Area 1 (with EUNIS code)	Area (ha)
Pre-intervention	Low	2	All man-made habitats, their ecological value will be given by their habitat condition	Rocky intertidal (A1)	0.54
Post-intervention	High	6	All natural coastal intertidal habitats	Intertidal sediments (A2)	0.54

3.4 Habitat condition

Appendix A to Natural England (2019) lists a series of criteria against which habitat condition can be assessed and a score is assigned on the basis of these criteria.

The Tees Rivers Trust has gathered some baseline data for the Area 1 (benthic and fish surveys have not yet been undertaken) to define the current habitat condition. Bird surveys of the foreshore only recorded magpies on several occasions and there is a low percentage cover (approximately 10%) of a very limited range of seaweed species (bladder wrack *Fucus vesiculosus* and spiral wrack *Fucus spiralis*). No seals have been recorded specifically using Area 1.

A walkover survey of Area 1 identified evidence of localised pollution of the intertidal, including litter and oily residues in locations.

On the basis of current information, the pre-intervention condition of the rocky intertidal habitat within Area 1 is considered 'Poor' (equating to a score of 1).

The proposed habitat improvement (creation of intertidal sediment) is considered to have good potential to result in a marked improvement in habitat condition. Based on a review of the criteria in Appendix A to Natural England (2019), it is (conservatively) judged that the habitat condition should be classified as 'moderate'. While the intertidal sediment would be expected to support the development of a benthic invertebrate community and provide a feeding resource for waterbirds, there are several known indicators that support a 'moderate' classification, such as presence of structures which impede the natural movement of sediments, poor transition of habitats and the fact that the ecological status of the overlying water body is classified under the Water Framework Directive (WFD) as Moderate.

On this basis, a condition score of 2 is assigned to the habitat condition of the intertidal sediment (post-intervention).

3.5 Strategic significance

The strategic significance parameter of the metric gives extra value to habitats that are located in optimum locations for biodiversity and other environmental objectives; it recognises that there is a risk for biodiversity from a change in location of a habitat (Natural England, 2019). Table 3.2 presents the multipliers that should be applied based on strategic significance.

Table 3.2 Multipliers to be applied based on strategic significance

Strategic significance	Multiplier
Within area identified in Local Policy/Plans Nature Recovery Areas	1.15
Location ecologically desirable identified in related studies (e.g. MMO01135 or REMEMARE)	1.1
Area of compensation/development not identified in local plans or related projects	1

The Tees Rivers Trust and the Environment Agency commissioned the Institute of Estuarine and Coastal Studies (IECS) to undertake a feasibility study to identify areas along the Tees estuary where habitat improvement techniques could be applied (reported in the *Tees Estuary Edges Enhancement Study* (IECS, 2018)). IECS (2018) identified that habitat improvement techniques could be applied within the reach of the estuary downstream of Newport Bridge and recommended this reach as a pilot site; this study informed the direction of the feasibility and design work being undertaken by the Tees Rivers Trust.

The habitat improvement projects being investigated by the Tees Rivers Trust form part of the IMMERSE (IMplementing MEasures for Sustainable Estuaries) project, an INTERREG-funded project that runs from October 2018-October 2021. The Tees Rivers Trust acts as the IMMERSE liaison to the Tees Estuary Partnership, which is currently developing an estuary strategy and action plan and investigating measures to increase connectivity and synergy between marine and fresh water habitat in the Tees.

IECS (2018) indicates how the potential habitat improvement measures met policy and biodiversity requirements and notes that reprofiling existing foreshore levels (as a technique for habitat improvement) aligns with the Habitats Directive, Wild Birds Directive, Natural England's Site Improvement Plan for the Teesmouth and Cleveland Coast SPA (Natural England, 2014), the Biodiversity Action Plan and the South Tees Regeneration Master Plan (South Tees Development Corporation, 2019).

Of particular relevance to the proposed habitat improvement measures in Area 1, Natural England's Site Improvement Plan identifies 'physical modification' as a pressure or threat and identifies that measures could be taken to create/restore intertidal habitat rich in soft sediments. A specific action related to this pressure is to develop a 'beneficial use' of maintenance dredgings programme to retain fine sediments within the estuary.

Given the above context, the strategic significance is considered high and the habitat improvement measures proposed align with various policy drivers and aspirations for the Tees estuary. A multiplier of 1.15 is considered appropriate.

3.6 Connectivity

Natural England (2019) states that *"the focus of connectivity in the metric is the relationship of a particular habitat patch to other surrounding similar or related semi-natural habitats facilitating flows of species and ecosystem services. In short, this is a way of rating actions that will actually provide a like for like or similar net gain with connection to the area where impact is happening."* Natural England (2019) proposes that the connectivity scores shown in Table 3.3 are applied in the metric.

Table 3.3 Multipliers to be applied in the biodiversity metric to reflect connectivity

Score	Definition	Multiplier
Low connectivity	≥20km distance from action	1
Medium connectivity	10-20km distance from action	1.1
High connectivity	≤10km distance from action	1.5

The distance between the location of the proposed NGCT and the location of the proposed habitat improvement (intervention) is less than 10km. This equates to a high connectivity score and, therefore, a multiplier of 1.5 is applied.

3.7 Risks

Three risks (related to location, time and difficulty) are reflected in the metric to account for the uncertainties and risk of failure in any net gain action.

3.7.1 Location risk

The location risk reflects the fact that habitat created at a great distance from the site of habitat losses carries a risk of depleting local areas of natural habitats (Natural England, 2019). This risk is related with the strategic significance element of the metric; risk multipliers are chosen based on actions happening within the same local authority area or a neighbouring local authority area and identified as a location that is ecologically desirable in related studies. Natural England (2019) identifies three categories and associated multipliers for this risk (Table 3.4).

Table 3.4 Multipliers to be applied in the biodiversity metric to reflect location risk

Category	Multiplier
Compensation inside [the same] local authority area, or deemed to be sufficiently local to the site of biodiversity loss	1
Compensation outside the local authority [to the impacted area] but within neighbouring local authority area and identified by related studies as suitable areas	0.75
Compensation outside the local authority area and beyond areas in neighbouring local authority area and identified by related studies as suitable areas	0.5

The biodiversity impact of the NGCT would occur within the Redcar and Cleveland local authority area, with the proposed habitat improvement measures delivered in the neighbouring Middlesbrough local authority area. However, given that the habitat improvement measures are in the same estuary system to the impacted area, they are considered 'sufficiently local' and a multiplier of 1 has been applied. This approach is sensible in an ecological context.

3.7.2 Temporal risk

Subject to the marine licence being granted for the proposed NGCT, PDT intends to implement the habitat improvement measures in advance of the development of the NGCT. However, as the habitat improvement measures would be a joint initiative with the Tees Rivers Trust, a precautionary approach has been applied and it is assumed that the measures are implemented in the same year as the loss of habitat occurring due to the development of the NGCT. The temporal risk therefore reflects the time lag between the implementation of the habitat improvement measures and the development of the habitat to its target condition (referred to as 'time to target condition' by Natural England (2019)).

Natural England (2019) states that, for the purposes of creating a metric, an average figure for 'time to target condition' needs to be used, accepting that there will be variation from this central estimation depending on site-specific circumstances. Table 3.5 presents Natural England's advice on the average time taken for improvement of littoral sediment (i.e. the relevant habitat in this case).

Table 3.5 Time to target condition for littoral sediment (summarised from Natural England, 2019)

Habitat	Years to poor condition habitat	Years to medium condition habitat	Years to good condition habitat
Littoral sediment	1	5	10

Based on a target condition of 'moderate'[1] for the intertidal habitat at the improvement area (see Section 3.4), which according to Table 3.5 would take 5 years, a multiplier of 0.837 should be applied (according to Natural England, 2019).

3.7.3 Difficulty of creation and restoration

Natural England (2019) recognises that there is a risk associated with the delivery of habitat creation or enhancement measures due to the uncertainty in the effectiveness of management techniques used to restore or create habitat. A distinction is made between 're-creation' and 'restoration'; for littoral sediment, re-creation is considered to be 'medium' difficulty and restoration is considered to be 'low' difficulty.

The proposed habitat improvement measures are considered to be 'restoration' measures because the area is currently intertidal (i.e. there is no requirement to recreate intertidal through, for example, management realignment of coastal defences). A difficulty category of 'low' is therefore assigned, which equates to a multiplier of 1.

3.8 Calculation of biodiversity units pre- and post- intervention

Table 3.6 summarises the calculation of biodiversity units pre- and post-intervention. It can be seen the pre-intervention biodiversity units are calculated at 2.4, with the post-intervention units calculated at 12.2.

[1] 'Moderate' is one of the categories for littoral sediment defined in the condition tables included in Appendix A of Natural England (2019). It is assumed that this is equivalent to the 'medium' condition category referred to in Table 3.5.

Table 3.6 **Calculation of pre- and post-intervention biodiversity units**

Stage	-	A	B	C	D	E	-	-	-	A*B*C*(D*E)
Pre-intervention	*Habitat present within Area 1 (with EUNIS code)*	*Area (ha)*	*Distinctiveness*	*Condition*	*Strategic significance*	*Connectivity*	-	-	-	*Biodiversity units*
	Rocky intertidal (A1)	0.54	2	1 (Poor)	1.5	1.5	-	-	-	2.4
Stage	-	A	B	C	D	E	F	G	H	A*B*C*(D*E)*(F*G*H)
Post-intervention	*Habitat present within Area 1 (with EUNIS code)*	*Area (ha)*	*Distinctiveness*	*Condition*	*Strategic significance*	*Connectivity*	*Location risk*	*Temporal risk*	*Difficulty risk*	*Biodiversity units*
	Intertidal sediments (A2)	0.54	6	2 (Moderate)	1.5	1.5	1	0.837	1	12.2

4 CONCLUSION

The proposed NGCT is predicted to result in an impact on (i.e. loss of) 6.3 biodiversity units. The proposed habitat improvement measures (or interventions) would enhance an area of intertidal habitat in the Tees estuary, resulting in a change from an existing 2.4 biodiversity units to 12.2 biodiversity units.

Given that the post-intervention biodiversity units (12.2) are approximately 40% higher than the sum of the biodiversity units impacted by the proposed NGCT and the pre-intervention units (6.3 + 2.4 = 8.7), it is concluded that net gain is attained.

5 REFERENCES

JBA (2019). Feasibility and Design – Tees Estuary Edge Softening Project: Design Report. Prepared for the Tees Rivers Trust, March 2019.

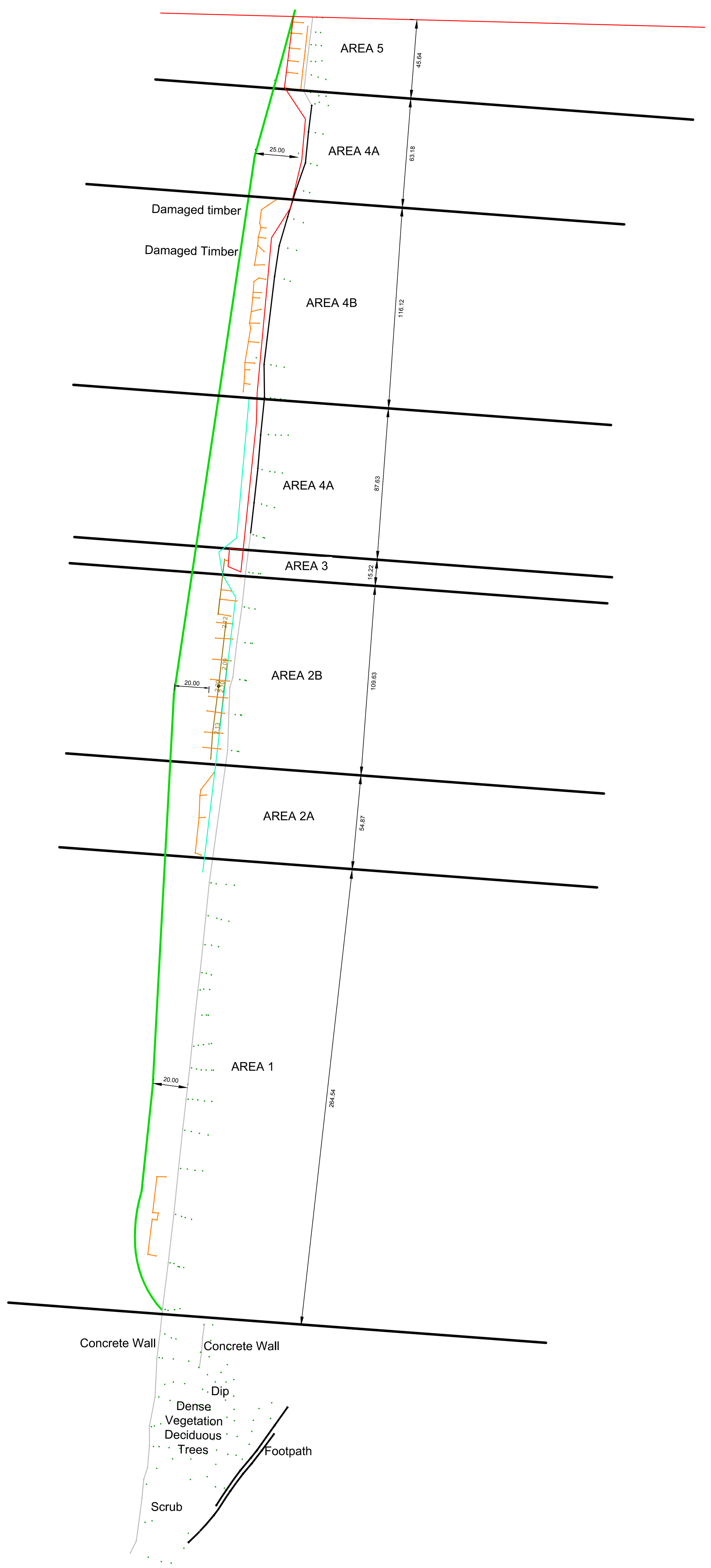
Natural England (2014). Site Improvement Plan: Teesmouth & Cleveland Coast.

Natural England (2019). Net Gain for intertidal environments. Version 3.2, 13 May 2019.

South Tees Development Corporation (2019). South Tees Regeneration Master Plan.

Annex A

Areas being investigated for habitat improvement by the Tees Rivers Trust



PLAN

General Notes

1. All dimensions shown are in metres unless otherwise stated and levels in metres to Ordnance Datum.(OSTN15/OSGM15)
2. Do not scale from this drawing. All dimensions must be checked/verified on site.
3. Any discrepancies noted on site are to be reported to the Engineer immediately.
4. All works in watercourses will be carried out with care to minimise the risk of pollution adhering to Pollution Prevention Guidelines.
5. All works affecting flood defences, main watercourses and/or ordinary watercourses will be subject to Consent for Permanent and Temporary Works under the Land Drainage Act 1991.
6. A desktop utility search has been undertaken for the site (Ref: CEN12331, March 2019) and should be referenced with this drawing. The Contractor will confirm the location of any services prior to the commencement of any works
7. The electronic model of this drawing is not to be used for setting out.
8. Inter tidal area distances and calculated areas are indicative and subject to change further yo details surveys/ site limitations

LEGEND

- SITE LIMITS
- LOW INTER TIDAL HABITAT AREA
- MEDIUM INTER TIDAL HABITAT AREA
- HIGH INTER TIDAL HABITAT AREA

AREA	AREA (M²)			(m)
	LOW	MED	HIGH	LENGTH
1	9.79			264.54
2A	5.25	4.55		54.87
2B	5.25	4.55		109.63
3	5.24	2.99	2.10	15.22
4	4.45	4.79	2.10	150.81
4B	6.38		4.63	116.12
5	8.22		1.56	45.64

LOWER INTER TIDAL HABITAT AREA = 44.58m²

MEDIUM INTER TIDAL HABITAT AREA = 16.99m²

HIGHER INTER TIDAL HABITAT AREA = 10.39m²

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SKETCH

Tees Estuary Enhancement

Scheme Overview
Figure 4-3

A. Coad	30/04/19	G. Bushell	29/04/19
D. Latham		D. Latham	
2019s0315		1:2000 @ A1	
FIGURE 4-3	S0	P01.01	

Appendix 11

Natural England sampling advice

Date: 02 November 2018
Ref: 261727 - DAS 4050

Lancaster House
Hampshire Court
Newcastle upon
Tyne
NE4 7YH

020 82258152

Mr Steven Rayner (HaskoningDHV UK Ltd.)
Steven.Rayner@rhdhv.com

BY EMAIL ONLY

Dear Steven,

Discretionary Advice Service (Charged Advice)

Development proposal and location: Northern Gateway Container Terminal (NGCT) – Sediment and benthic ecology sampling plans. PD Teesport, Teesside.

Thank you for your consultation on the above. This advice is provided in accordance with the Quotation and Agreement dated 24 October 2018.

This advice is being provided as part of Natural England's Discretionary Advice Service. HaskoningDHV UK Ltd. has asked Natural England to provide advice on the proposed scope of benthic ecological survey to inform an EIA for the proposed scheme.

The following advice is based upon the information within:

- 'Note / Memo: Northern Gateway Container Terminal – sediment and marine ecology sampling plans' (dated 17 October 2018).

Natural England (NE) welcomes the methodology for surveying benthic ecology and sediment quality for the Northern Gateway Container Terminal project, as set out by HaskoningDHV. NE are generally supportive of the methodology, but have the following comments:

Benthic ecological sampling

1. NE support the proposed methodology for surveying benthic ecology within the NGCT footprint. It is the view of NE that the proposed benthic sampling will provide sufficient information and data for a full assessment of the impact of the project upon benthic ecology within the proposed footprint. NE supports sampling in the proposed Riverside Ro-Ro relocation area at QEII Berth.

2. NE welcomes a repeat of the 2006 benthic ecology survey, so that effective comparisons can be drawn and changes from this baseline identified. NE are supportive of the quantity of benthic grabs and trawls proposed within the sampling plan.

3. Natural England support the proposed methodology for surveying benthic ecology within the Tees A and C disposal sites.

4. NE support the proposals for identifying macrofauna and particle size analysis (PSA), as set out within the Sampling Plan.

5. NE advise that the use of survey to characterise the local biotopes, fauna and flora is important when assessing the ecological value of the seabed within the area. This information would help to identify the area's sensitivity, recoverability and resilience to pressures, during both the construction and operational phases of the development.

6. NE advise that the presence of regionally-rare or influential species recorded by the survey should be duly considered within the environmental assessment.

Sediment quality sampling

1. Natural England are satisfied that, based on the given information, that no 'at-depth' sediment quality samples are required to advise the EIA, however NE defers to the Marine Management Organisation (MMO) and Cefas to make a decision based on the evidence presented.

2. Natural England defers to the MMO and Cefas' judgement on the quantity of surface sediment quality samples required to meet OSPAR Regulations.

3. Natural England advise that the agreed mechanism for dealing with contaminated deposits within the QEII Berth should still be adhered to.

If you have any further queries with the advice contained within this letter, please don't hesitate to contact me.

Yours sincerely,

Josh Parker

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Northumbria Area Team
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Appendix 12

Benthic ecology survey report

Northern Gateway Container Terminal Development

Sediment & Marine Ecology Report 2019

Ref: OEL_ ROYNOR0119_TCR

Prepared for

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ID 139027

Client:	Royal Haskoning DHV (RHDHV)
Client Contact:	Steven Rayner (RHDHV)
Contractor:	Ocean Ecology Limited
Report Title:	Northern Gateway Container Terminal Development Sediment & Marine Ecology Report 2019
Report Number:	OEL_ROYNOR0119_TCR
Recommended Citation:	Ocean Ecology Limited (2019). Northern Gateway Container Terminal Development Sediment & Marine Ecology Report 2019. Report No. OEL_ROYNOR0119_TCR. 46 pp.

Version	Date	Description	Author(s)	Reviewer(s)
01	09/05/2019	Draft	Joe Turner	Ross Griffin
02	10/05/2019	Revised following initial review	Joe Turner	Ross Griffin
03	31/05/2019	Revised following review	Joe Turner	Ross Griffin

ACRONYMS AND ABBREVIATIONS

AFDW	Ash-Free Dry Weight
BSH	Broadscale Habitat
CAA	Civil Aviation Authority
CCW	Countryside Council for Wales
ES	Environmental Statement
EIA	Environmental Impact Assessment
GPS	Global Positioning System
HRO	Harbour Revision Order
JNCC	Joint Nature Conservation Committee
MCA	Maritime Coastalguard Agency
MESH	Mapping European Seabed Habitats
MMO	Marine Management Organisation
MNCR	Marine Nature Conservation Review
NMBAQC	National Marine Biological Analytical Quality Control Scheme
nMDS	Non-metric Multidimensional Scaling
NGCT	Northern Gateway Container Terminal
OEL	Ocean Ecology Limited
PfCO	Permission for Commercial Operations
PDT	PD Teesport
PRIMER	Plymouth Routines in Multivariate Ecological Research
PSD	Particle Size Distribution
QMS	Quality Management System
RHDHV	Royal HaskoningDHV
ROG	Recommended Operating Guidelines
SOP	Standard Operating Procedure
WoRMS	World Register of Marine Species
UAV	Unmanned Aerial Vehicle
UXO	Unexploded Ordnance

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Appendix XIV	Epibenthic SIMPER Results.

NON-TECHNICAL SUMMARY

Ocean Ecology Limited (OEL) was commissioned by Royal HaskoningDHV (on behalf of PD Teesport) to conduct a subtidal and intertidal sediment and marine ecology survey for the proposed Northern Gateway Container Terminal (NGCT) project. The key aim for this survey was to assess the benthic ecology and marine sediment composition to support the environmental assessment for the NGCT marine licence application.

Generally, the sediment types present in the Tees Estuary have remained stable when compared to previous surveys. The inner Estuary was characterised by muddy sediments while offshore and outer areas saw an increase in coarser particles and gravel.

The macrobenthic assemblages associated with sediments within the Tees Estuary and in outer areas were diverse and dominated by annelid in terms of both abundance and diversity. Three major macrobenthic groupings were identified, associated with the inner Estuary stations, disposal site A, and disposal site C. The inner Estuary community was comprised of a range of species, primarily polychaetes. In comparison to previous studies the abundance of the opportunistic polychaete worm, *Capitella capitate,* has reduced substantially which potentially indicates lower levels of disturbance. The communities within the offshore disposal areas were very different, particularly around disposal area A that was dominated by bivalves molluscs including the ocean quahog, *Arctica islandica.* Disposal area C had High numbers of polychaete species were dominated around disposal area C including high numbers of the ross worm, *Sabellaria spinulosa.*

Epibenthic communities were dominated in terms of abundance by echinoderms due to the presence of large numbers of brittle stars (*Ophiura* sp.). The characterising epibenthic taxa were similar to those observed in previous surveys with brown shrimp (*Crangon* sp.), plaice (*Pleuronectes platessa*), and the shore crab (*Carcinus maenus*) observed at most stations throughout the Estuary whereas common starfish (*Asterias rubens*) were more prevalent at outer Estuary stations.

Intertidal habitats were relatively similar to those observed during previous surveys. The survey area was generally characterised by ephemeral green algae on non-mobile substrate along the upper shore, fudoicds on rock and boulders along the mid shore and red algal turf along the lower shore. Occassioanl areas of impoverished coarse sediment was also found along the low-mid shore.

1. INTRODUCTION

1.1. Project Description

PD Teesport (PDT) is to submit a marine licence application to the Marine Management Organisation (MMO) for the Northern Gateway Container Terminal (NGCT) project following application for a Harbour Revision Order (HRO) and planning permission in 2006. In support of these applications, an Environmental Impact Assessment (EIA) was conducted and a subsequent Environmental Statement (ES) produced by Royal HaskoningDHV (RHDHV) in 2006 (Royal Haskoning 2006).

The marine elements of the NGCT scheme comprise of the following:

- Capital dredging within the existing dredged approach channel.
- Realignment of the existing approach channel in the vicinity of the proposed terminal and deepening of the two existing turning circles (Tees Dock turning circle and Seaton Channel turning circle) in the Tees Estuary.
- Construction of a 1,000 m quay with a proposed quay deck level of 9.0 m above CD (+6.15 m OD).
- Capital dredging of deep-water berthing areas alongside the proposed quay face (dredged to 16 m bCD).
- Pumping suitable dredged material ashore for use in the reclamation works and for locally raising land levels within the proposed terminal area.
- Disposal of the balance of the capital dredged material at existing offshore disposal grounds in Tees Bay (with the potential for re-use of some of this material as habitat improvement measures within the Tees).
- Relocation of the existing Riverside Ro-Ro facility to accommodate the new container terminal, requiring some highly localised dredging close to the corner with Tees Dock.

Ocean Ecology Limited (OEL) was contracted by RHDHV (on behalf of PDT) to conduct subtidal and intertidal surveys to assess the benthic ecology and marine sediment quality in support of the environmental assessment for the NGCT marine licence application. This was to include provision of survey vessel, environmental personnel, sampling equipment, sample analysis and subsequent reporting.

In addition to the above, to comply with the conditions of an existing ten-year disposal licence (L/2015/00427/1) for maintenance dredging within the Tees Estuary, sediment samples were collected and analysed from two offshore dredge disposal areas.

The main objectives of the survey were therefore to:

- Collect grab samples within the Tees Estuary and within two Tees Bay offshore dredge disposal sites to establish a baseline for marine sediments and associated benthic communities;
- Collect epifaunal trawls to cover the location of the proposed terminal, the berthing pocket, the area that is proposed to be dredged within the approach channel, and at the QEII berth to establish the baseline epifaunal communities present; and
- Undertake a Phase I intertidal survey (facilitated through the use of an Unmanned Aerial Vehicle (UAV)) to characterise the intertidal habitats present.

1.2. Current Understanding

A benthic survey of the lower Tees Estuary was undertaken in 2006 to inform the EIA undertaken for the NGCT HRO application. The survey involved retrieving 0.1 m^2 Day grab samples from 25 pre-determined sampling stations (triplicate samples at six stations) for subsequent macrobenthic and particle size distribution (PSD) analysis. In addition, a benthic epifaunal survey was conducted using an otter trawl with a 2 0mm mesh and 3 mm cod-end at 15 sites within the Tees Estuary.

The 2006 survey identified that subtidal sediments comprised high silt/clay content in the main approach channel, with a higher sand content at the mouth of the estuary. The infaunal community in the main channel was dominated by a low number of opportunistic species which appear to colonise the area in between maintenance dredging programmes. At near-shore and un-dredged locations, the opportunistic *Ophryotrocha* sp. and *Capitella capitata* dominated, which indicates some level of organic enrichment in these areas. Towards the mouth of the estuary, the infauna was dominated by the polychaetes *Chaetozone christiei* and *Spio decorata*, with the cumacean, *Diastylis bradyi*, and the white furrow shell, *Abra alba*, also present in relatively high numbers. The most abundant epifaunal species recorded during the trawl survey in the lower Tees Estuary was the shrimp *Crangon* sp., with the common shore crab, *Carcinus maenas*, more abundant in the middle section of the stuary adjacent to the proposed NGCT quay. Lower abundances of epifauna were recorded at the mouth of the estuary. Infaunal species also recorded in relatively high numbers were *A. Alba* and the brittle star, *Ophiura albida*.

The benthic infaunal survey undertaken to inform the QEII Berth EIA in 2008 consisted of grab samples at two stations within the proposed dredge footprint for QEII. The two QEII Berth sample stations comprised of fine sediment and comprised of a similar faunal assemblage to that found in the main channel in 2006. Overall, the QEII Berth samples indicated that the biological communities within the footprint of the QEII Berth were of relatively low diversity and broadly characteristic of chemically or physically disturbed conditions.

As part of the York Potash Harbour Facilities EIA, a benthic infaunal and epifaunal survey was conducted in 2014 and consisted of 32 subtidal grab samples and 10 epifaunal trawls within the Tees Estuary. As with the 2006 survey, the 2014 York Potash Harbour Facilities benthic infaunal survey identified clear distinctions in macrofaunal communities between the main channel and the outer channel near the bank of the estuary with similar communities identified in each survey. Within the main channel, the biotope complex recorded was mainly SS.SMU.ISaMu (Infralittoral sandy mud) dominated by a variety of polychaetes as well as a common characterising species of this biotope, *A. alba*. In 2014, the outer channel adjacent to the proposed NGCT terminal was dominated by two biotopes: SS.SMu.ISaMU.Cap (*Capitella capitata* in enriched sublittoral muddy sediments) and SS.SMU.SMuVS.CapTubi (*Capitella capitata* and *Tubificoides* spp. in reduced salinity infralittoral muddy sediment), where *C. capitata* dominated and was accompanied by large numbers of *Ophryotrocha* sp. In terms of epifauna, the most abundant species recorded was the shrimp *Crangon crangon* with *C. maenas* and *A. alba* also abundant.

2. METHODOLOGY

2.1. Field Survey

The intertidal survey was undertaken during the hours of low water on the 20th March 2019. The subtidal survey was undertaken in the Tees Estuary and Bay between 21st and 24th March 2019, with 2.5 days of grab sampling (21st to 23rd March 2019) and 1.5 days of trawl sampling (23rd to 24th March 2019).

2.2. Survey Design

The subtidal benthic sampling array consisted of grab sampling stations throughout the Tees Estuary and at Tees Bay A and C offshore disposal areas. The grab stations within the Tees Estuary were a repeat of the 2006 survey (except the three stations located at the QEII berth). The grab stations located at the two offshore disposal locations consisted of four stations within the disposal area and four outside at each disposal location. The sampling array also included 15 scientific beam trawls positioned throughout the Tees Estuary to repeat the 2006 survey and one additional trawl positioned at the QEII berth.

A full conflicts check was undertaken by RHDHV and OEL prior to the survey to ensure all sampling stations were in safe locations and not in conflict with other infrastructure (e.g. cables, pipelines, potential UXO etc.). A summary of the subtidal sampling stations visited is provided in Table 1. The locations of all 2019 grab and trawl sampling locations are shown in Figure 1.

The intertidal survey was undertaken between Tees Dock and Dabholme Gut, either side of Teesport Container Terminal 1. The locations of the quadrats taken are shown in Figure 2.

Table 1. Number of subtidal sample stations for the NGCT sediment and marine ecology survey 2019.

Location	No. of Grab Stations	No. of Beam Trawls
Tees Estuary	25	15
QEII Berth	3	1
Tees Bay Disposal Area A	8	0
Tees Bay Disposal Area C	8	0
Total	**44**	**16**

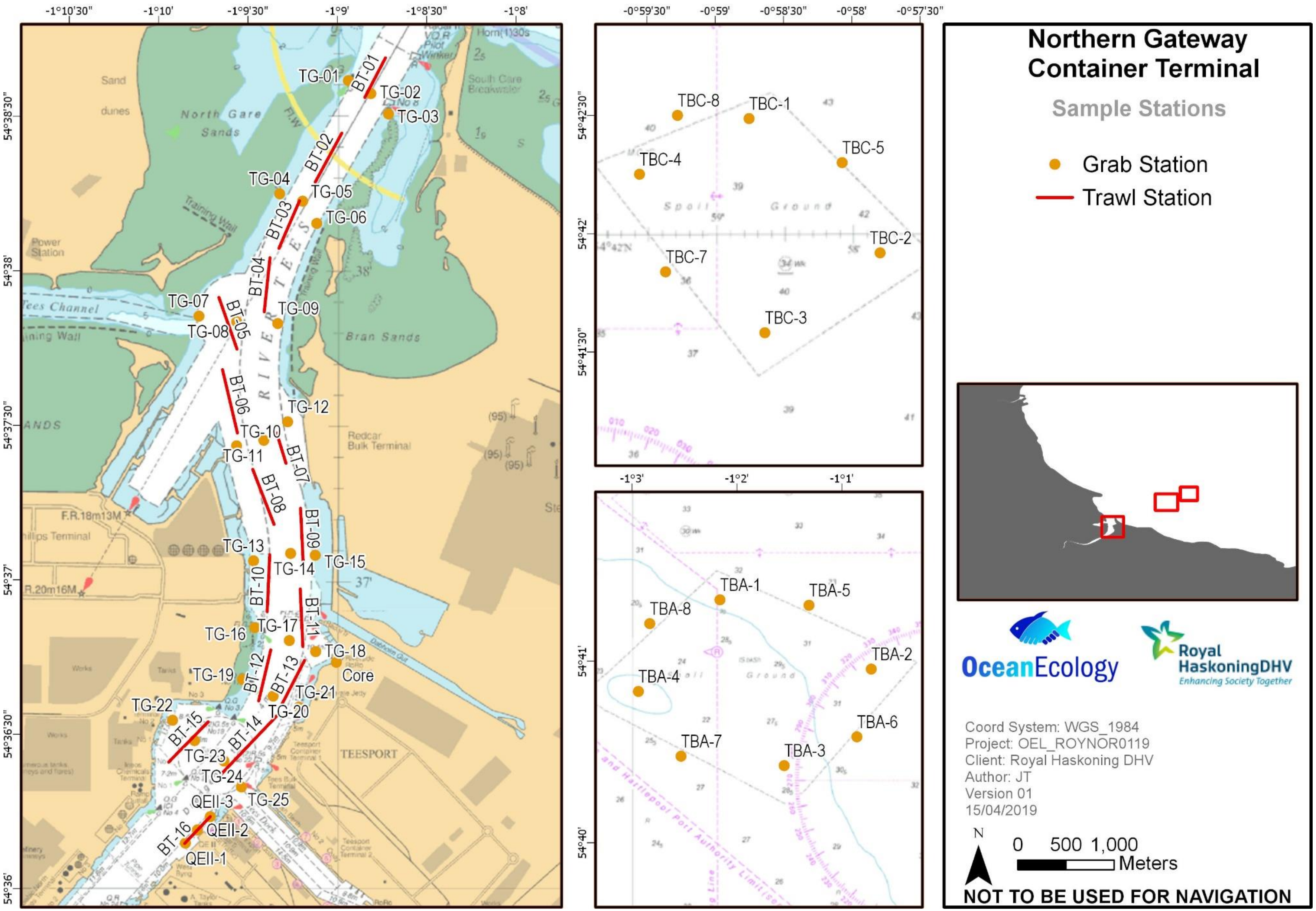

Figure 1. Actual grab and trawl positions sampled during the NGCT sediment and marine ecology survey 2019.

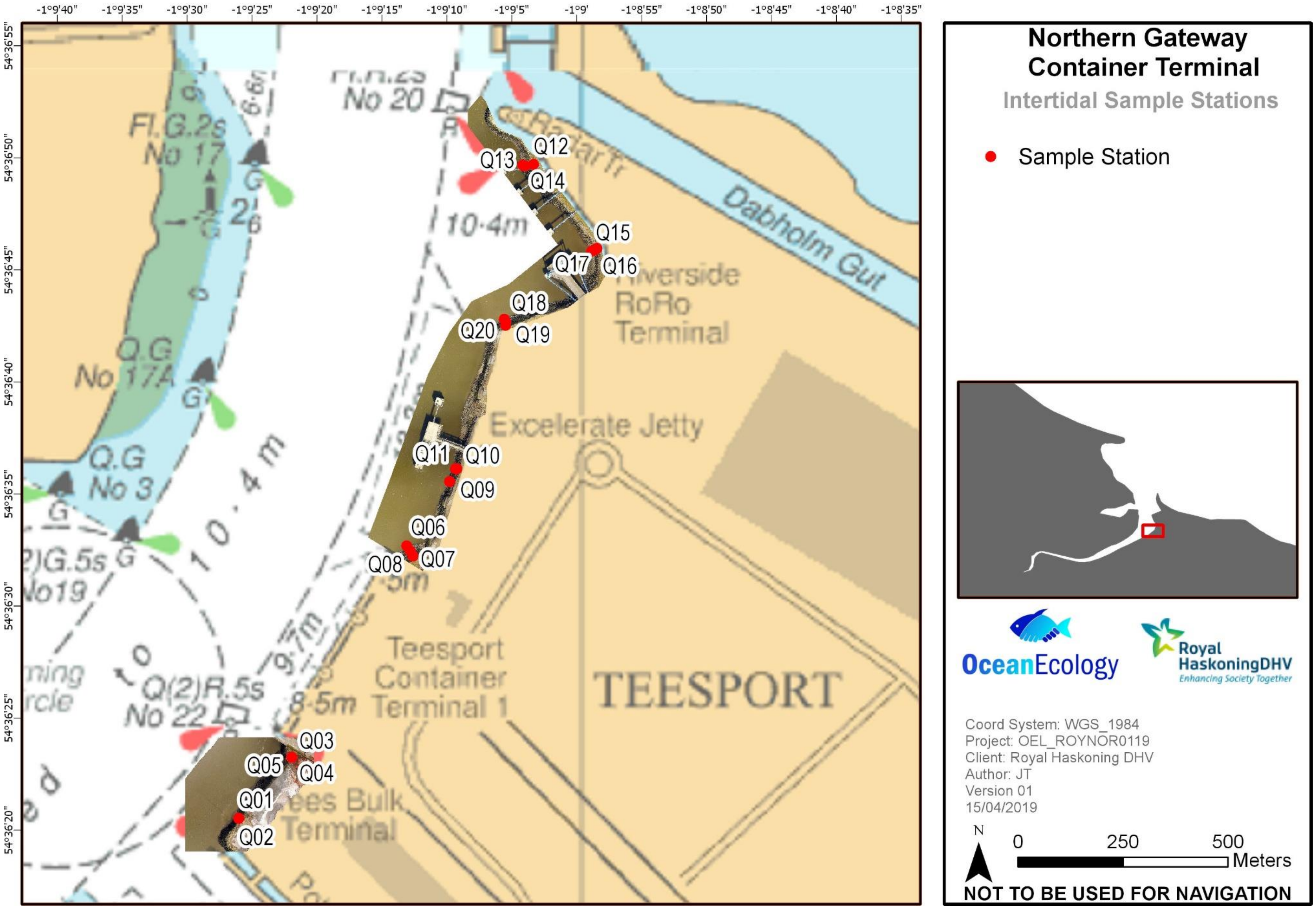

Figure 2. Locations of intertidal quadrats taken during the intertidal NGCT sediment and marine ecology survey 2019 overlain on the UAV imagery derived orthomosaic.

2.3. Survey Vessel

2.3.1. Seren Las

OEL's dedicated survey vessel, *Seren Las,* was employed to undertake all grab and trawl sampling (Plate 1). *Seren Las* is a 10.4 m survey vessel that has recently been refitted to enhance its survey capabilities. The MCA category 2 coded vessel is a safe and stable working platform and is able to comfortably accommodate up to six survey personnel.

Plate 1. Dedicated survey vessel, *Seren Las*, for the NGCT sediment and marine ecology survey 2019.

2.4. Survey Equipment

The vessel was equipped with a Vector V104™ GNSS compass GPS system that provided a highly accurate offset position of the sampling equipment when deployed from the stern. Grab sampling was undertaken using OEL's 0.1 m^2 Day grab. Trawl sampling was undertaken using OEL's 2 m scientific beam trawl with a 5 mm mesh cod end.

For the intertidal survey, OEL provided a 0.01m^2 corer, 0.25 m^2 quadrat and DJI Phantom 4 Unmanned Aerial Vehicle (UAV) operated using DroneDeploy software.

2.5. Sampling Methods

2.5.1. Benthic Grab Sampling

A total of 44 macrobenthic samples and 43 PSD sub-samples were obtained using a 0.1 m^2 Day grab for subsequent macrobenthic and PSD analysis.

Sample Collection

At each pre-determined sample station, the following steps were undertaken to ensure the safe and successful collection of grab samples:

- Vessel approached target location, vessel skipper alerted crew and survey team to prepare grab.
- Sea fastening on grab released to allow deployment from dedicated grab table/cradle.
- Vessel arrived on target location and skipper confirmed sea conditions were suitable for deployment[1] .

[1] If condition unfavourable for deployment (i.e. significant pitch and/or roll of vessel or strong winds) the skipper informed deck crew to sea fasten grab and await further instruction. Once conditions suitable, grab was deployed.

- Winch operator raised grab and vessel crew guided grab over the stern.
- Winch operator lowered grab into the water and if vessel was still on position, to the seabed.
- Grab on bottom, fix taken, grab retrieved to the surface and held in position.
- Once at the surface, the vessel was positioned to minimise pitch and roll (e.g. into wind/tide).
- Vessel skipper confirmed sea conditions were suitable for retrieval. If conditions were unfavourable for retrieval, the winch operator lowered grab into the water immediately to dampen swing.
- Winch operator raised grab to the stern and vessel crew guided the grab back onto the table/cradle.
- Grab lowered onto the grab table and tension released to allow for sample release/inspection.
- The samples were then removed from the grab, placed into clean containers with a label and photographed before processing.

To assure consistency in sampling, grab samples were screened by the lead marine ecologist and considered unacceptable if:

- The jaws failed to close completely or were jammed open by an obstruction, allowing fines to pass through;
- The grab did not strike the seabed in a flat area resulting in an incomplete sample; or
- There was obvious contamination of the sample from equipment, paint chips etc.
- The sample was taken at an unacceptable distance from the target location.

Sample Processing

All field sample processing methods were undertaken in line with the *Guidelines for the Conduct of Benthic Studies at Marine Aggregate Exaction Sites* (Ware et al. 2011), in-house Standard Operating Procedures (SOPs) and OEL's Quality Management System (QMS).

Initial sample processing was undertaken aboard the survey vessel in line with the following methodology:

- Assessment of sample size and acceptability made.
- Photograph of sample with station details and scale bar taken.
- 10 % of sample removed for subsequent PSD analysis and transferred to labelled foil tray.
- Sample emptied onto 0.5 mm sieve net laid over 4 mm sieve table and washed through using gentle rinsing with seawater hose.
- Remaining sample for faunal sorting and identification backwashed into a suitably sized sample container using seawater and diluted 10 % formalin solution added to fix sample prior to laboratory analysis.
- Sample containers clearly labelled internally and externally with date, sample ID and project name.

Field notes and sample photographs taken for each grab sample are provided in Appendices I and II.

2.5.2. Epibenthic Trawl Sampling

Beam trawl tows were undertaken in line with the guidelines set out by Ware et al. (2011) and further detailed in the Recommended Operating Guidelines (ROG) for MESH trawls and dredges (Curtis & Coggan 2007). Tows were undertaken for approximately 7 - 9 minutes on the seabed, at a speed over the ground of 1 - 2 knots. The direction of each trawl was dependent on tide and wind conditions, with each trawl taking place against the prevailing direction of the tide.

A detailed survey log and positional data for all otter and beam trawls is provided in Appendix III.

2.5.2.1. Epibenthic Trawl Sample Processing

Processing of beam trawl samples was undertaken in line with the guidelines set out by Ware et al. (2011) and further detailed in the ROG for MESH trawls and dredges (Curtis & Coggan 2007).

A labelled sample photograph was taken, then all fish and epibenthic fauna were sorted, identified and enumerated (presence / absence for colonial / encrusting species) in the field. Length measurements (to the nearest mm) were taken for all commercial fish and shellfish species and photographs were taken of cryptic specimens. When identification required clarification, individuals were transferred to a labelled sample container and fixed in 4 - 5 % buffered formaldehyde solution and identified on return to OEL's NE Atlantic Marine Biological Quality Control (NMBAQC) scheme participating laboratory. The entire sample was returned to the water once all individuals were identified, enumerated and measured (where required).

Photographs for all beam trawl samples are provided in Appendix IV.

Plate 2. Top left: 2 m scientific beam trawl deployed from the stern. Top right: Releasing catch into fish box. Bottom left: Beam trawl sample. Bottom right: Common shore crab (*Carcinus maenus*) with *Sabellaria* sp. growing on carapace.

2.5.3. Phase I Walkover Survey

The intertidal surveys were undertaken during spring tides in line with guidance in the Marine Monitoring Handbook (Davies et al. 2001) and CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn et al. 2006). During the walkover survey, biotopes were identified according to the EUNIS classification in line with relevant guidance (Parry 2015) (and correlated to the MNCR biotopes).

The distribution of any features of conservation interest was recorded using photographs and GPS fixes where encountered. Other information recorded included general site conditions, sediment surface features, sediment type and characteristics, topography and anthropogenic pressures.

Detailed field notes for the intertidal area are provided in Appendices V and VI.

Quadrat Sampling

Areas representative of each key hard substrate habitat at different tidal heights were assessed by recording the epibiotal taxa present in randomly placed 0.25 m^2 (0.5 m x 0.5 m) quadrats. Identification was undertaken in field and taken to species level where possible.

At each quadrat location the substrate was subject to a visual inspection and observations of presence of surface features (accretions, algae, fauna, etc.) recorded. One high-resolution photograph was taken directly above the quadrat (in plan view) for future reference. A further four photographs were also taken in a north, east, south and west orientation. The location of all samples were recorded using a Garmin E-Trex 10 GPS device.

Core Sampling

Where areas of soft sediment were present, a 0.01 m^2 corer was used to collect a sample for subsequent macrobenthic and PSD analysis. Only one area was identified to be suitable for coring and therefore only one core was taken.

2.5.4. UAV Survey

UAV mapping of the intertidal survey area involved the capture of over 150 high-resolution nadir images across the two intertidal areas either side of Teesport Container Terminal 1. Each flight was planned to achieve a minimum resolution[2] of 5 cm / pixel with an accuracy[3] of 5-10 m and flown by qualified UAV Pilots (RPQs) under a Permission for Commercial Operations (PfCO) granted to OEL by the Civil Aviation Authority (CAA). All flights were conducted in line with relevant CAA regulations.

[2] Measured as Ground-Sampling Distance (GSD).
[3] Measured as Root Mean Square Errors (RMSE).

Plate 3. Top left: Aerial image of intertidal survey area and Teesport Container Terminal. Top right: Aerial image of intertidal survey area and the Riverside Ro-Ro ferry terminal. Bottom left: Soft sediment 0.01 m² core sampling. Bottom right: Hard substratum 0.25 m² quadrat sampling.

2.6. Laboratory Methods

On arrival to the laboratory, all samples were logged in and entered into the project database created in OEL's web-based data management application ABACUS in line with in-house Standard Operating Procedures (SOPs) and OEL's Quality Management System (QMS).

2.6.1. Partical Size Distribution (PSD) Analysis

PSD analysis of separate sediment samples was undertaken by in-house laboratory technicians at OEL's NMBAQC scheme participating laboratory. All PSD analysis was undertaken in line with NMBAQC Best Practice Guidance (Mason 2016).

Frozen sediment samples were first transferred to a drying oven and thawed at 80°C for at least six hours. A small subsample of the whole sample was then taken for laser analysis, prior to wet sieving over a 1 mm sieve. Before sieving, samples were mixed thoroughly with a spatula and all conspicuous fauna (>1 mm) which appeared to have been alive at the time of sampling were removed from the sample. The sample was then returned to a drying oven and dried at 80°C for at least 24 hours prior to dry sieving.

Dry Sieving

Once dry, each sample was run through a series of Endecott BS 410 test sieves (nested at 1.0 φ intervals) using a Retsch AS200 sieve shaker to fractionate the samples into particle size classes. The dry sieve mesh apertures used are shown in Table 2.

Table 2 Sieve series employed for Particle Size Distribution (PSD) analysis (mesh size in mm).

Sieve aperture (mm)										
63	32.5	16	8	4	2	1	0.5	0.25	0.125	0.063

The sample was emptied into the coarsest sieve at the top of the sieve stack and shaken for a standardised period of 20 minutes. The sample was then checked to ensure all particles had been fractioned as far down the sieve stack as their diameter would allow. A further 10 minutes of shaking was undertaken if there was evidence that particles had not been properly sorted (e.g. veneers of silt overlying coarse fractions).

For each sampling station, the results were expressed as absolute percentage of the whole sample retained on each sieve size. PSD statistics and sediment classifications were then generated from the absolute percentages of the sediment retained on each sieve using Gradistat v8.

Laser Diffraction

When the % contribution of fines (<0.063) was >5 %, the <1 mm fraction of sediment was re-analysed using laser diffraction. The fine fraction residue (<1 mm sediments) was transferred to a suitable container and allowed to settle for 24 hours before excess water was syphoned from above the sediment surface. The fine fraction was analysed by laser diffraction using a wet element Beckman Coulter LS 13320. Due to the silty nature of the sediments, ultrasound was used to agitate particles and prevent aggregation of fines.

The dry sieve and laser data were then merged for each sample with the results expressed as a percentage of the whole sample. Once the data was merged, PSD statistics and sediment classifications were generated from the percentages of the sediment determined for each sediment fraction using the Gradistat v8 software.

Sediment descriptions were defined by their size class based on the Wentworth classification system (Wentworth 1922) (Table 3). Statistics such as mean and median grain size, sorting coefficient, skewness and bulk sediment classes (percentage silt, sand and gravel) were also derived in accordance with the Folk classification (Folk 1954).

Table 3. Classification used for defining sediment type based on the Wentworth Classification System (Wentworth 1922)

Wentworth Scale (mm)	Phi units (φ)	Sediment Types
>256 mm	<-8	Boulders
64 - 256 mm	-8 to -6	Cobble
4 - 64 mm	-6 to -2	Pebble
2 - 4 mm	-2 to -1	Granule
1 - 2 mm	-1 to 0	Very coarse sand
0.5 - 1 mm	0 - 1	Coarse sand
250 - 500 µm	01-Feb	Medium sand
125 - 250 µm	02-Mar	Fine sand
63 - 125 µm	03-Apr	Very fine sand
31.25 – 63 µm	04-May	Very coarse silt
15.63 – 31.25 µm	05-Jun	Coarse silt
7.813 – 15.63 µm	06-Jul	Medium silt
3.91 – 7.81 µm	07-Aug	Fine silt
1.95 – 3.91 µm	08-Sep	Very fine silt
<1.95 µm	>9	Clay

2.6.2. Faunal Analysis

All elutriation, extraction, identification and enumeration was undertaken at OEL's NMBAQC participating laboratory in line with the NMBAQC Processing Requirement Protocol (PRP) (Worsfold & Hall 2010). For each sample the excess formalin was drained off into a labelled container over a 0.5 mm mesh sieve in a well-ventilated area. The samples were then re-sieved over a 0.5 mm mesh sieve to remove all remaining fine sediment and fixative. The low-density fauna were then separated by elutriation with fresh water, poured over a 0.5 mm mesh sieve, transferred into a Nalgene, and preserved in 70 % IDA. The remaining sediment from each sample was subsequently separated into 0.5 mm, 1 mm, 4 mm and 8 mm fractions and sorted under a stereomicroscope to extract any remaining fauna (e.g. high-density bivalves not 'floated' off during elutriation).

All fauna present was identified to species level, where possible, and enumerated by trained benthic taxonomists using the most up to date taxonomic literature and checks against existing reference collections. Nomenclature utilised the most up to date taxonomic classifications provided on WoRMS[4]. Colonial fauna (e.g. hydroids and bryozoans) were identified to species level where possible and recorded as present (P). For the purposes of subsequent data analysis, taxa recorded as P were given the numerical value of 1. A full reference collection was retained including at least one example specimen of each taxon sampled.

2.6.2.1. Faunal Biomass

Following identification, all taxa from each sample were pooled into five major groups (Annelida, Crustacea, Mollusca, Echinodermata and Miscellaneous) in order to measure blotted wet weight major group biomass to 0.0001 g. As a standard, the conventional conversion factors as defined by (Eleftheriou & Basford 1989) were applied to biomass data to provide equivalent dry weight biomass (Ash Free Dry Weight, AFDW). The conversion factors applied are as follows:

[4] http://www.marinespecies.org/index.php

- Annelida = 15.5 %
- Crustacea = 22.5 %
- Mollusca = 8.0 %
- Echinodermata = 8.0%
- Others = 15.5 %

2.7. Statistical Analysis

2.7.1. Data Truncation & Standardisation

Macrobenthic taxon lists were checked via the live link to WoRMS[5] within ABACUS. Once the nomenclature had been standardised in accordance with WoRMS accepted names, the taxon list was examined carefully in order to truncate the data, excluding incidental recordings that may have skewed the data analysis and combining taxon records where differences in historical sample analysis were evident. Records of meiofaunal, parasitic, egg and pelagic taxa (e.g. nematode, epitokes and larvae) were recorded, but were excluded when calculating diversity indices or conducting multivariate analysis of community structure. Newly settled juveniles of macrobenthic species may at times dominate the macrobenthos, however OSPAR (2004) guidelines suggest they should be considered an ephemeral component due to heavy post-settlement mortality and not therefore representative of prevailing bottom conditions. OSPAR (2004) guidelines further state that “Should juveniles appear among the ten most dominant organisms in the data set, the statistical analysis should be conducted both with and without these in order to evaluate their importance”. Analysis was therefore conducted on the data set that excluded juveniles, as well as the data set with juveniles included. Comparison between the results of the two analyses revealed a high level of similarity in the clustering of stations into groups, suggesting that the two datasets were essentially revealing the same ecological pattern. The results presented in this report are therefore based on the data set with juveniles excluded.

[5] http://www.marinespecies.org/

2.7.2. Univariate Statistics

2.7.2.1. Diversity Indices

A number of diversity indices were calculated from the macrobethic dataset using the vegan package (Oksanen et al. 2019) in R Studio v1.1.463 (R Core Team 2018) as summarised in Table 4.

Table 4. Biodiversity indices used for detecting differences in the diversity of the macrobenthic communities present.

Diversity Index	Description
Number of Species (S)	The number of species present in a sample, with no indication of relative abundances.
Number of Individuals (N)	Total number of individuals counted in a sample.
Pielou's Evenness (J')	Evenness is a measure of how similar species are in terms of their abundance. A high evenness value (approaching 1) indicates that the majority of species are present in equal abundance. Conversely, a low evenness value indicates that one or more species is numerically dominant.
Shannon Weiner's Diversity (H' Log_e)	Shannon Weiner's diversity index (H' loge) is derived from the number of species present as well as the relative abundance of each species. A high Shannon Weiner's diversity index (approaching 1) indicates a high number of species and an even spread of the abundance between those species (evenness). A low diversity index (approaching zero) indicates a low number of species or an uneven spread of the abundance between the species present.
Species Richness, Margalef's index (d)	Margalef's index (d) is a measure of the number of species present for a given number of individuals. The higher the index, the greater the diversity.
Simpson's indexes (1-λ)	Simpson's indexes are a measure of the probability of choosing two individuals from a sample that are different species. A high Simpson's index (approaching 1) indicates a higher diversity in a sample. A low Simpson's index (approaching zero) indicates a low diversity in a sample.

2.7.3. Multivariate Statistics

The PRIMER v7 software package (Clarke & Gorley 2015) was employed to undertake the multivariate statistical analysis on both the biotic (epibenthic and macrobenthic) and abiotic (PSD) datasets. In order to fully investigate the multivariate patterns in the biotic and abiotic data, a suite of analytical routines were employed as described in detail in Appendix VII. Prior to multivariate analyses data were displayed as a shade plot with linear grey-scale intensity proportional to macrobenthic abundance (Clarke et al. 2014) to determine the most efficient pre-treatment method.

2.8. Biotope Mapping

EUNIS biotopes were identified for the intertidal areas in line with JNCC guidance on assigning benthic biotopes (Parry 2015) to allow the communities to be mapped and allow comparison with existing data. All biotope determination was undertaken through consideration of each of the following information:

- Existing biotope mapping (EMODnet);
- Quadrat/core substrate descriptions for determination of Broad Scale Habitat (BSH); and
- Species information from quadrat/core sampling and target notes taken in the field for assigning EUNIS Level 4 biotopes and above.

3. RESULTS

3.1. Sediments

In total, 44 sediment samples were analysed for full particle size classification. Sediment type is mapped in Figure 3 with full particle size data provided in Appendices VIII and IX.

3.1.1. Sediment Type

Sediment types, as classified using the Folk triangle (Folk 1954), for each of the stations sampled across the survey area in 2019 are presented in Figure 3. A variety of sediment types were present across the survey area and most samples ranged from poorly sorted to extremely poorly sorted. High mud content was common across the survey area where muddy sand (11 stations), mud (10 stations) and sandy mud (9 stations) were the most abundant sediment types present. Mud was present within the Tees at the inshore locations, around the QEII stations (Figure 3). A greater proportion of sand particles were observed in the river mouth and the disposal area A stations while offshore areas had an increased proportion of gravel (Figure 3).

3.1.2. Sediment Composition

Percentage contribution of gravels (>2 mm), sands (0.63 mm to 2 mm) and fines (<63 µm) for each of the main areas is shown in Figure 4. The mean (± SE) proportion of mud across all stations was 48.90 ± 5.26 %, mean (± SE) sand content 44.30 ± 4.85 %, and mean (± SE) gravel content 6.84 ± 2.52 %. Mud content was highest within the estuary (QEII and Tees Estuary) whereas sand and gravel content was greater around the Tees Bay A and Tees Bay C areas. The single intertidal core was characterised by very coarse sediment.

3.1.3. Sediment Groups

Cluster analysis of station-averaged data was performed on a Euclidean distance similarity matrix to group stations according to their sediment characteristics using the SIMPROF routine. The SIMPROF test resulted in twelve sediment groups (and many outliers) which highlighted the fine-scale differences in the sediment types across the survey area. To enable interpretation of the results of a broader scale, a resemblance slice set to a distance of 6 was used to categorise the stations into four separate sediment groups across the area with two outliers (the intertidal core and station TBC-08, Figure 5). The spatial distribution of each of the groups is shown in Figure 6.

Group A (17 stations) was mainly composed of mud (0.086 and 62.5 µm fractions). **Group B** (12 stations) was mostly characterised by fine to coarse sand (500 – 1000 µm). **Group C** (nine stations) was similar to Group A and was characterised by very coarse silt to very fine sand (44 - 125 µm). Finally, **Group D** (four stations) was composed of greater proportions of coarser particles which included pebbles (4 – 64 mm), cobbles (64 – 256 mm), and boulders (> 256 mm).

3.1.4. Sediment Biotopes

Biotopes were determined based upon the PSD and macrobenthic data, the distribution of these biotopes is shown in Figure 7. Offshore areas around disposal site A were best characterised by EUNIS biotope A5.261 '*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment'. Mixed sediments dominated disposal site C that was classified as EUNIS biotope A5.44 'Circalittoral mixed sediments' as the fauna present did not reflect any level 5 EUNIS biotopes. The biotopes that occurred most frequently in the estuarine locations was EUNIS biotope A5.323 '*Nephtys hombergii* and *Tubificoides* spp. in variable salinity infralittoral soft mud'. One station, TG15, was classified as EUNIS biotope A5.325 '*Capitella capitata* and

Tubificoides spp. in reduced salinity infralittoral muddy sediment'. Several stations were unable to be classified further than the EUNIS level 4 biotopes A5.32 'Sublittoral mud in variable salinity' and A5.22 'Sublittoral sand in variable salinity' based on the fauna present.

Plate 3. Grab samples collected during the NGCT sediment and marine ecology survey 2019. Top left: mud (M, representative of sediment group A). Top right: sandy mud (sM, representative of sediment group B). Bottom left: muddy sand (mS, representative of sediment group C). Bottom Right: muddy sandy gravel (msG, representative of sediment group D).

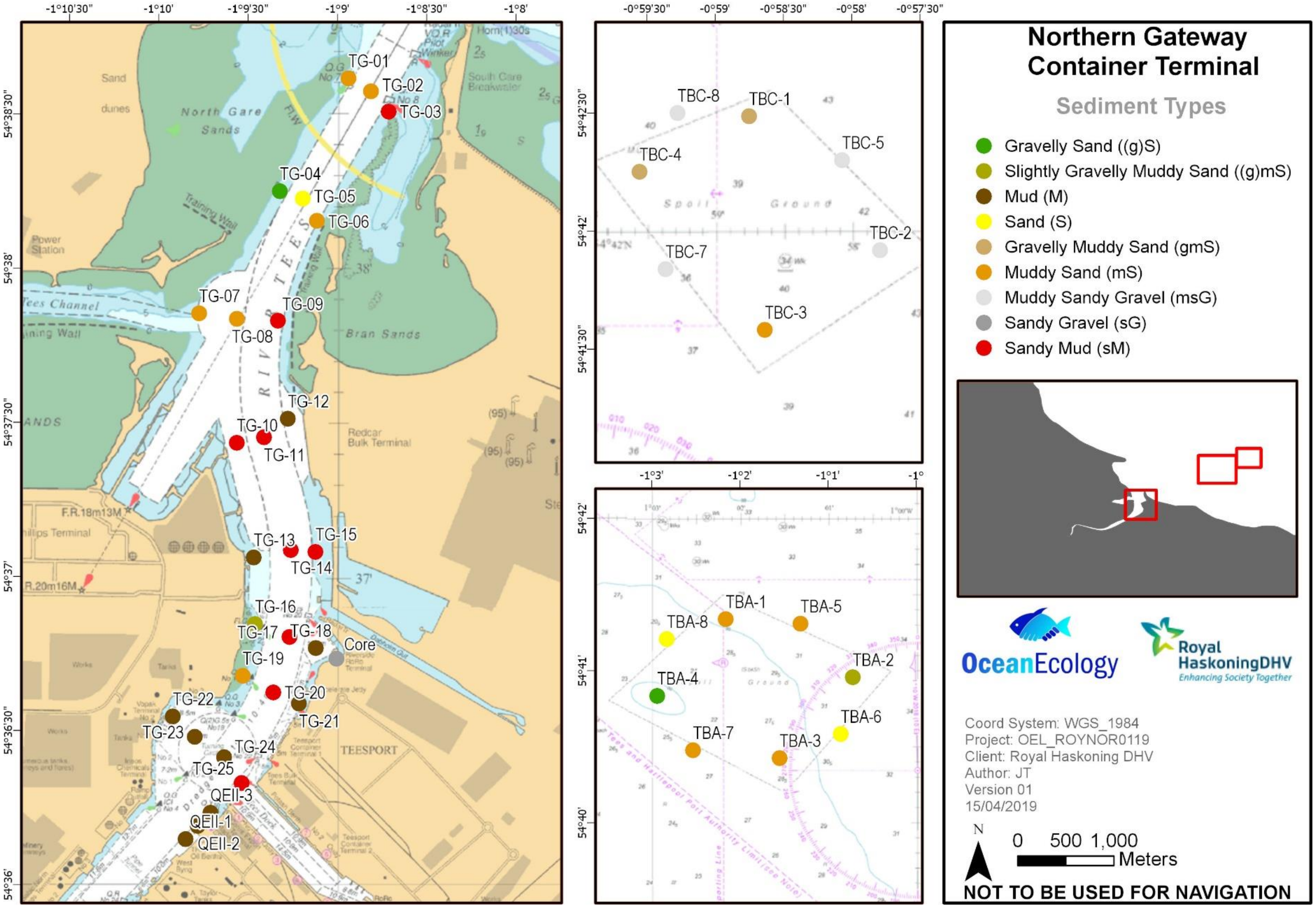

Figure 3. Comparison of Folk (Folk 1954) sediment types as determined from PSD analysis of samples acquired during the NGCT sediment and marine ecology survey 2019.

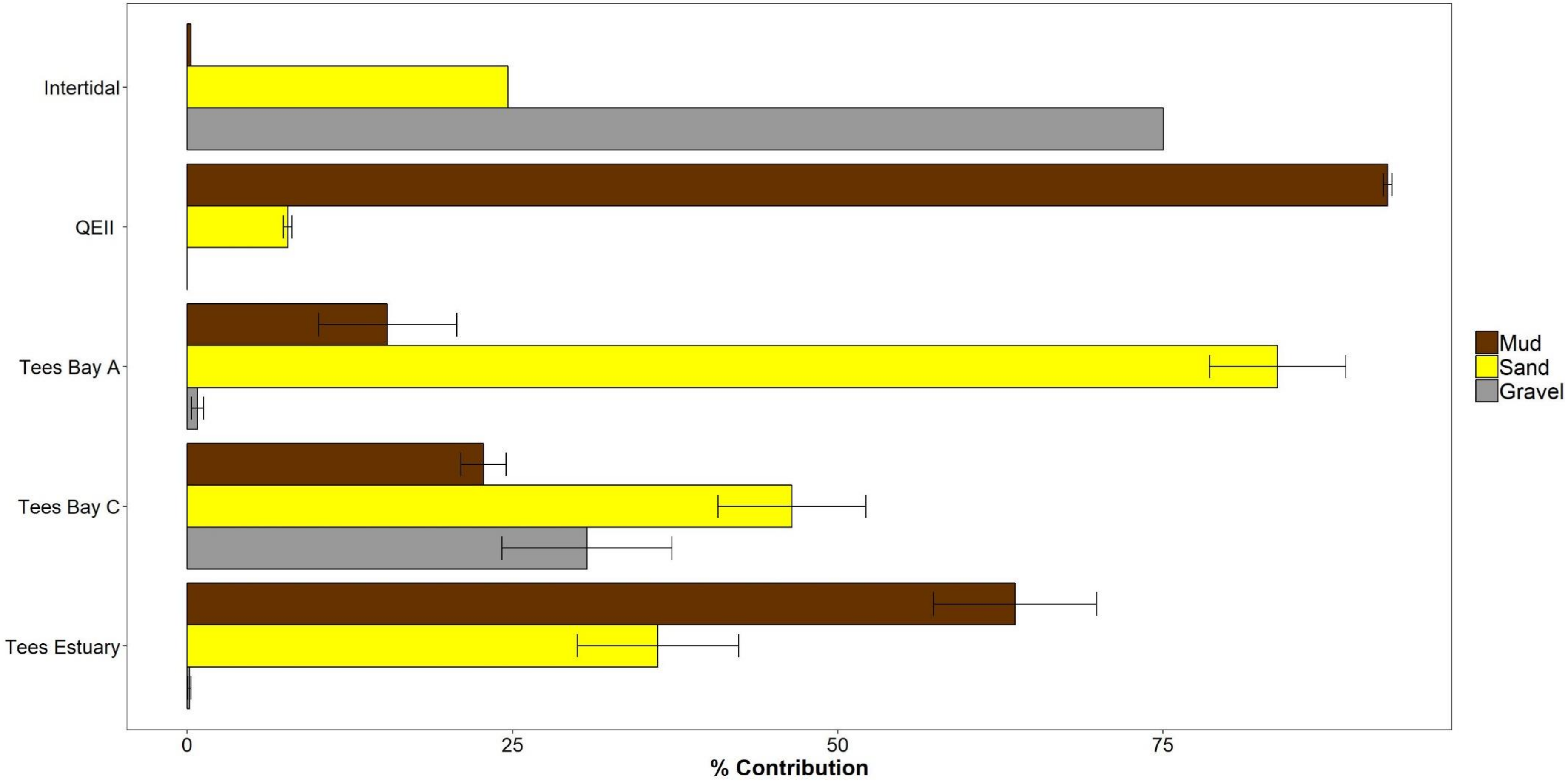

Figure 4. Mean (±SE) percentage contribution of mud, sand, and gravel of samples collected during the NGCT sediment and marine ecology survey 2019.

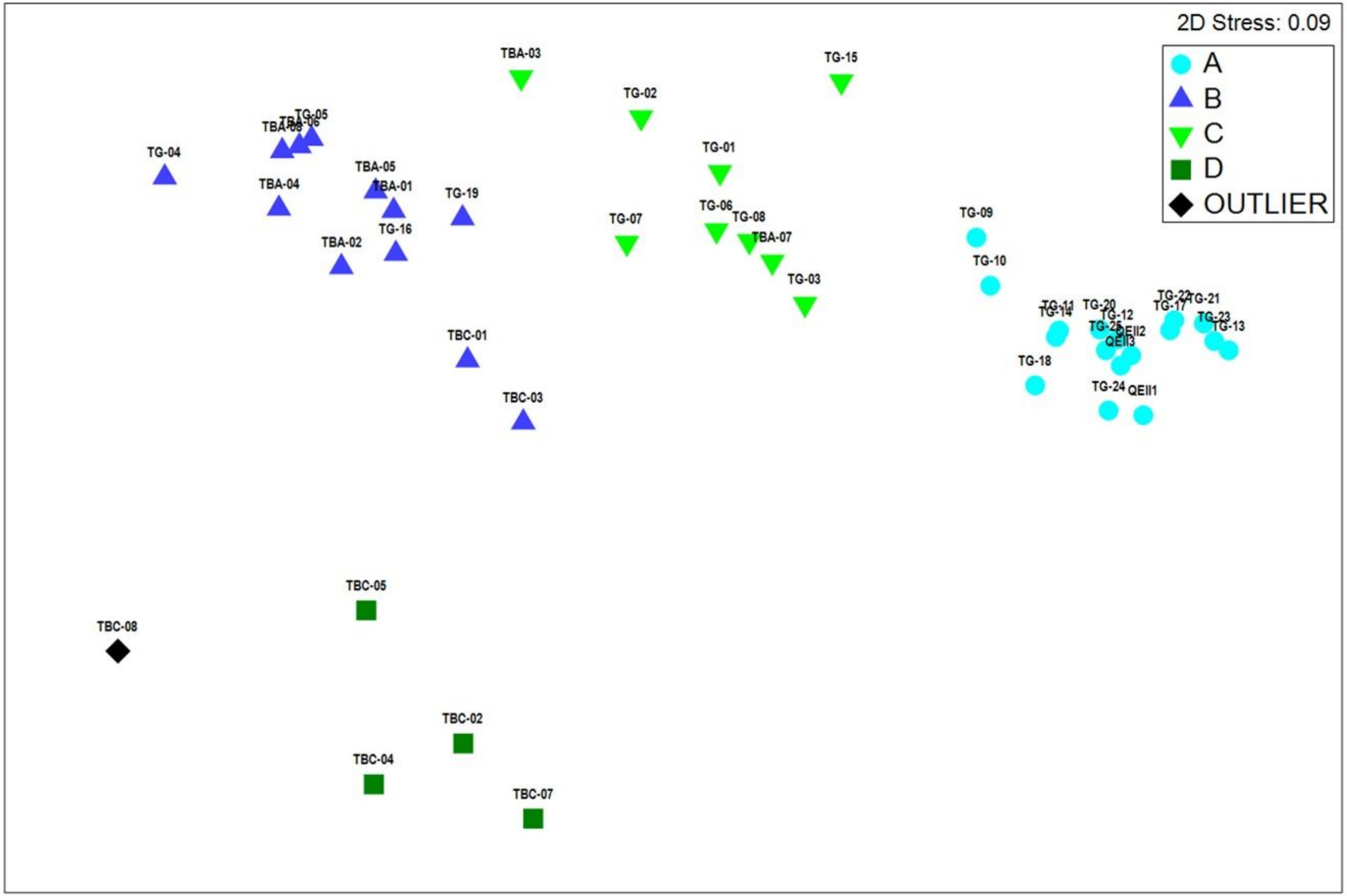

Figure 5. Non-metric MDS ordination plot of sediment groups conducted on station averaged Euclidean distance resemblance PSD data.

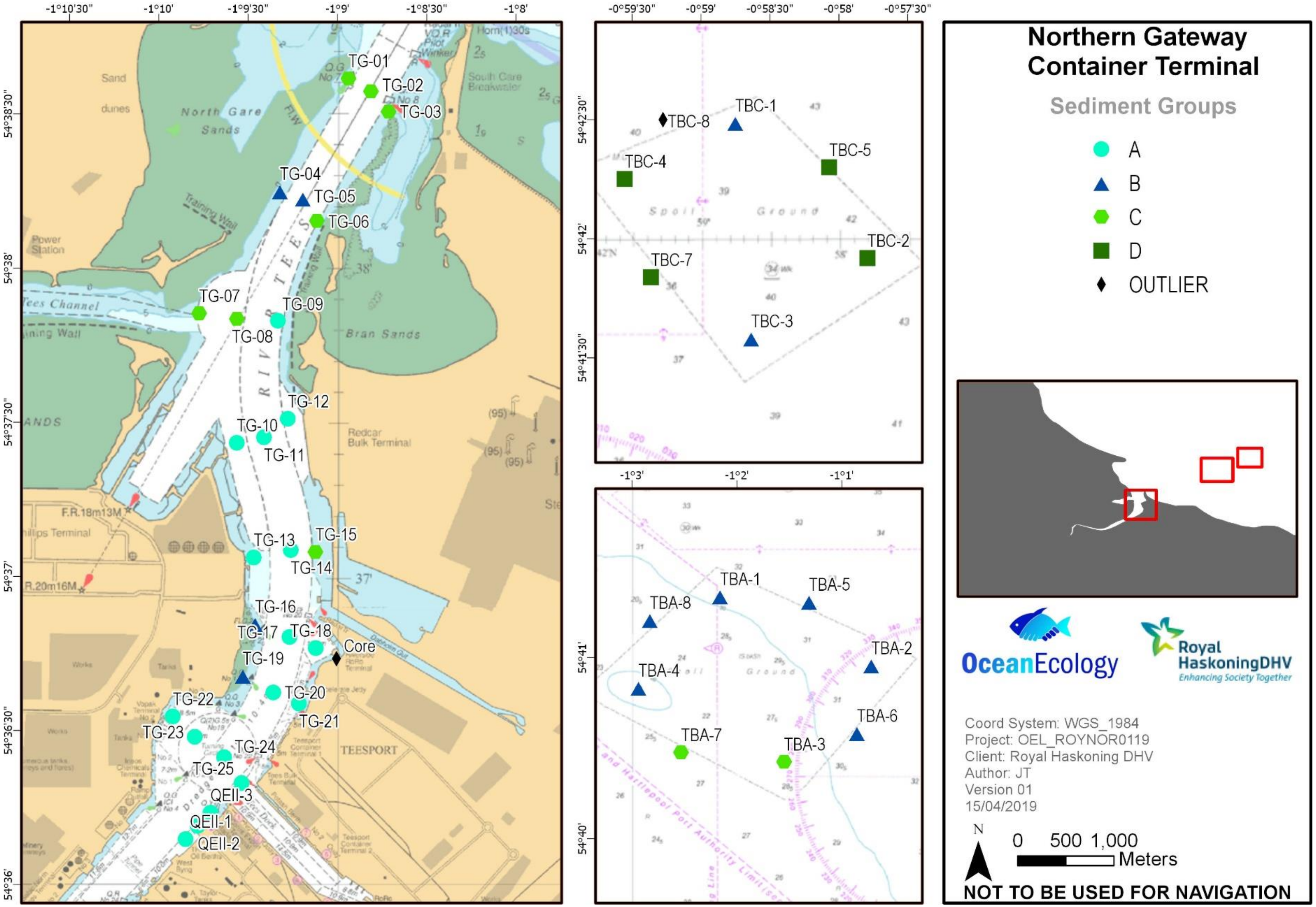

Figure 6. Distribution of sediment groups conducted on station averaged Euclidean distance resemblance PSD data.

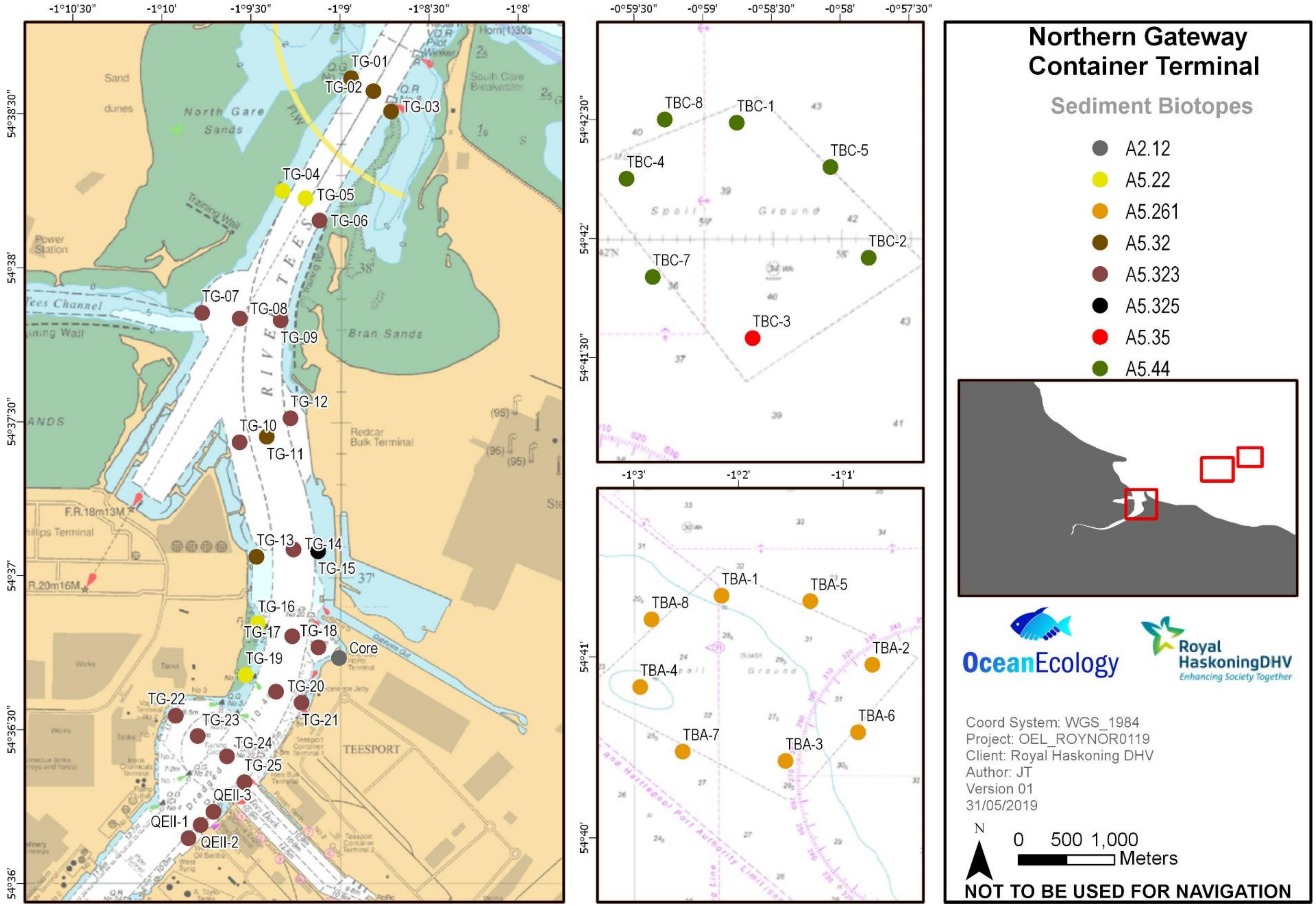

Figure 7. Distribution of biotopes determined from PSD and macrobenthic analysis of samples acquired during the NGCT sediment and marine ecology survey 2019.

3.2. Macrobenthos

3.2.1. Macrobenthic Composition

The macrobenthic assemblages of sediments constituted 292 taxa recorded with a mean (± SE) of 38.78 ± 2.57 taxa per sample. Mean (± SE) abundance was 363.00 ± 46.53 individuals per sample. These values exclude records of meiofaunal, juvenile, parasitic and pelagic taxa as well as eggs as summarised in Table 5. The full abundance and biomass matrices are provided in Appendix X and XI respectively, presenting the abundance of each taxon and biomass per major group (Annelida, Crustacea, Mollusca, Echinodermata and Others) in all samples collected across the survey area.

Table 5. Summary of macrobenthic abundance and diversity of sediments sampled during the NGCT sediment and marine ecology survey 2019

Taxa	Abundance (N)	Number of Taxa (S)
Colonial	-	25
Eggs	10	4
Juvenile	2472	37
Parasite	1	1
Others	13755	217
Total	**16,238**	**284**

Figure 8 illustrates the relative contributions to total abundance (N), diversity (S) and biomass (gAFDM) of the major taxonomic groups of the macrobenthic communities sampled in each of the areas of the estuary and disposal areas. Annelid taxa dominated the assemblage in terms of N and accounted for 68.5 % of all individuals recorded (across all stations). However, molluscs contributed most to abundance in the Tees Bay A area (62.5 %). Annelid taxa contributed most to S and accounted for 55.5 % of the taxa identified across all stations. Mollusc taxa generally contributed most to biomass (overall = 49.2 %), except in the QEII area. Crustaceans, echinoderms, and other taxa all generally contributed little to N, S or biomass except for other taxa in the intertidal.

There was no obvious dominance of a single taxon in the macrobenthic community. The polychaete worm *Dialychone* was the most abundant taxon sampled and accounted for 8.32 % of all individuals recorded (Figure 9A). Nemetode worms occurred most frequently in samples (31.1 %, Figure 9B). The ross worm, *S. spinulosa* represented the taxon that was sampled in the greatest abundance in a single sample (725 individuals) (Figure 9C) while also being the taxon recorded in the greatest average abundance (46.3 individuals per 0.1 m^2) (Figure 9D). The common nut clam *Nucula nucleus* was also frequently sampled occurring in 26.7 % of samples (Figure 9B).

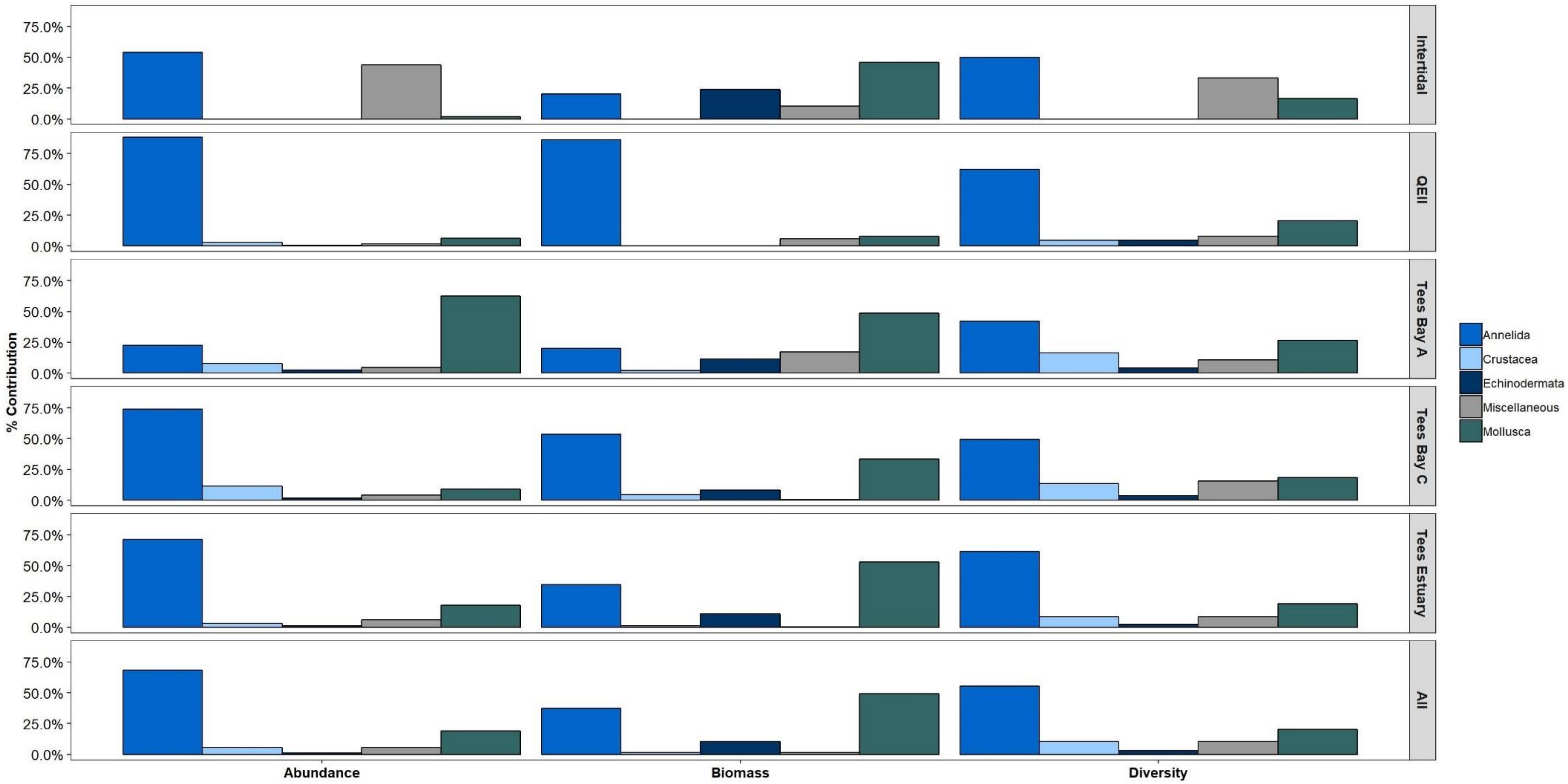

Figure 8. Relative contribution of the major taxonomic groups to the total abundance (N), diversity (S) and biomass (B) of the macrobenthic communities sampled in each area sampled. Also shown is the relative contribution of the major taxonomic groups to the total abundance, diversity and biomass across all areas combined (All).

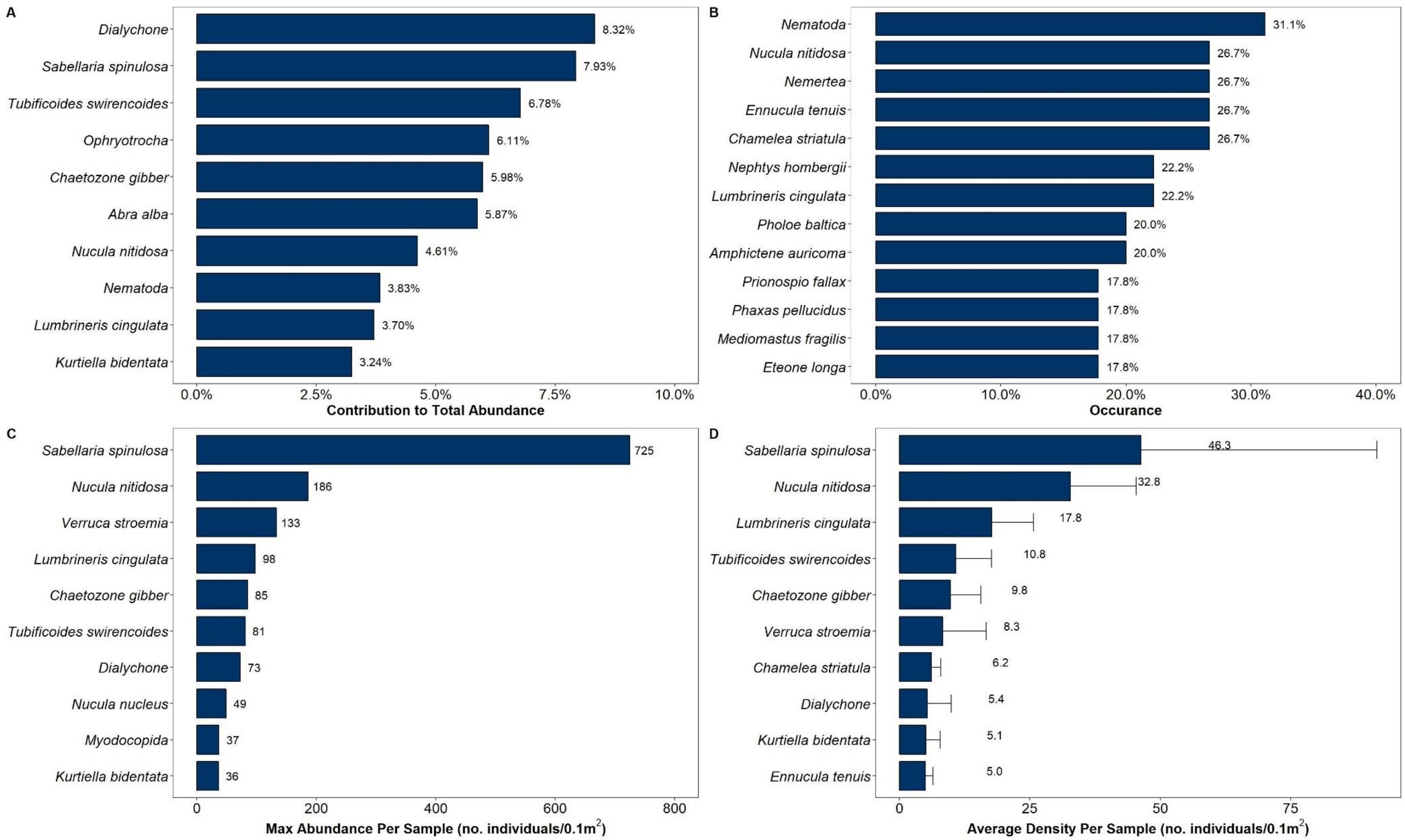

Figure 9. Percentage contributions of the top 10 macrobenthic taxa to total abundance (top left; A) and occurrence (top right; B) from samples collected during NCGT benthic monitoring survey 2019. Also shown are the maximum densities of the top 10 taxa per sample (bottom left; C) and average densities of the top 10 taxa per sample (bottom right; D).

3.2.2. Macrobenthic Faunal Groups

Cluster analysis of square-root transformed macrobenthic abundance data was carried out on a resemblance matrix calculated using the Bray-Curtis similarity coefficient in order to graphically represent the similarity of the epibenthic communities recorded in each sample.

The resulting SIMPROF test identified 10 statistically significant faunal groups (shown by point colour) and eight outliers (an ungrouped single sample). A 30 % similarity slice was overlain onto the cluster analysis dendrogram which identified three faunal groups and five outliers (Figure 10). The corresponding non-metric multidimensional scaling (nMDS) ordination plot (Figure 11) graphically displays the similarity between the samples based on the distance between the sample points. The degree of clustering of intra-group sample points demonstrates the level of within group similarity whilst the degree of overlap of inter-group sample points is indicative of the level of similarity of the different faunal groups.

The stress value of the nMDS ordination (0.15) indicates that the two-dimensional plot provides a relatively representative interpretation of the similarity between the samples. The results of the SIMPER routine enabled the characteristic taxa within each of the faunal groups to be determined by providing a level of percentage contribution (%Contrib) to the group similarity which are discussed for each faunal group in detail below. Results of the SIMPER routine are provided in Appendix XII.

Faunal Group A was identified at 25 of the trawl stations (representing 56 % of macrobenthic samples) and occurred at all stations within the Tees Estuary and QEII areas. These communities were comprised of a range of taxa with no dominance of a single taxa. The polychaetes *Chaetozone gibber* and *Dialychone* contributed most to within group similarity (11.31 % and 9.07 % respectively). However, *Tubificoides swirencoides*, *Abra alba*, and Nematode worms also contributed 8.93 %, 6.90 % and 6.76 % to the within group similarity respectively.

Faunal Group B occurred at the eight stations associated with offshore dredge disposal site C. This group was dominated by the polychaete *Lumbrineris cingulata* which contributed 21.25 % of the within group similarity. Other prevalent species included the ross worm (*S. spinulosa*) and Nemertea which contributed to 5.92 % and 5.41 % of the within group similarity respectively.

Faunal Group C occurred at seven of the eight stations associated with offshore dredge disposal site A (TBA-04 was an outlier). This group was dominated by bivalves, particularly *N. nitidosa* which contributed 26.01 % of the within group similarity. Other prevalent species included *Chamelea striatula*, Nematode worms, and *Ennucula tenuis* which contributed to 10.87 %, 6.94 %, and 6.47 % of the within group similarity respectively.

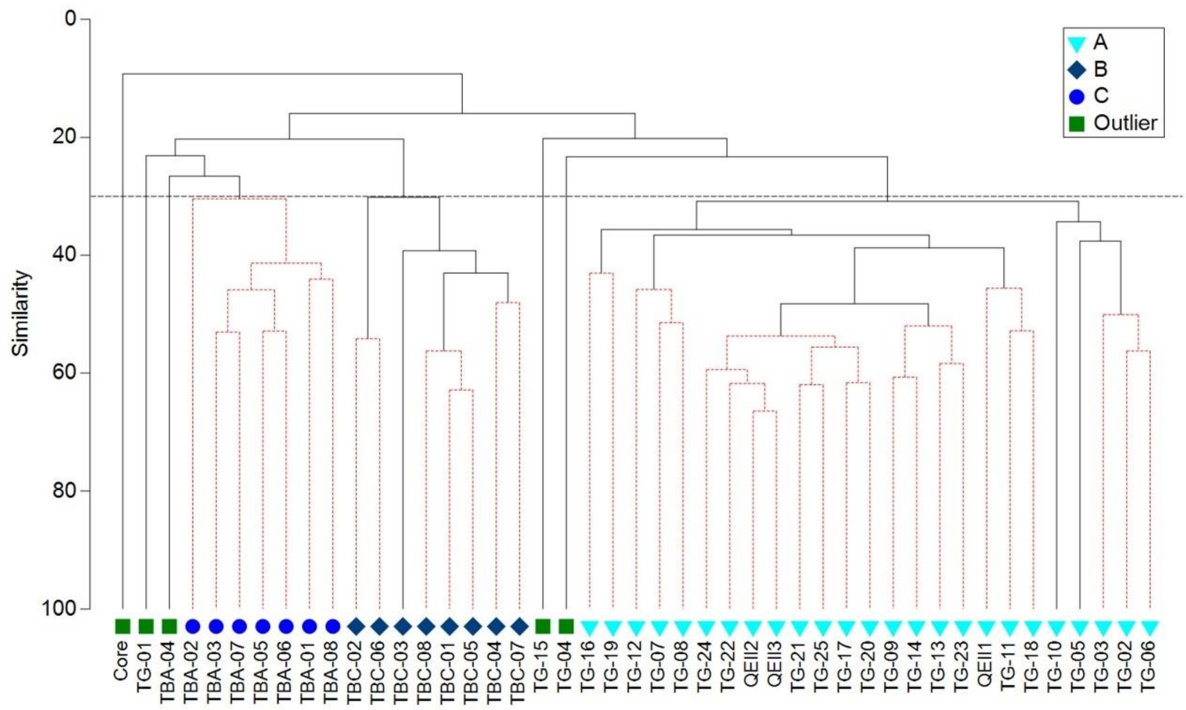

Figure 10. Dendrogram, with overlain 30 % similarity slice, based on square-root transformed Bray-Curtis similarity macrobenthic abundance data. Red shows groups separated by SIMPROF.

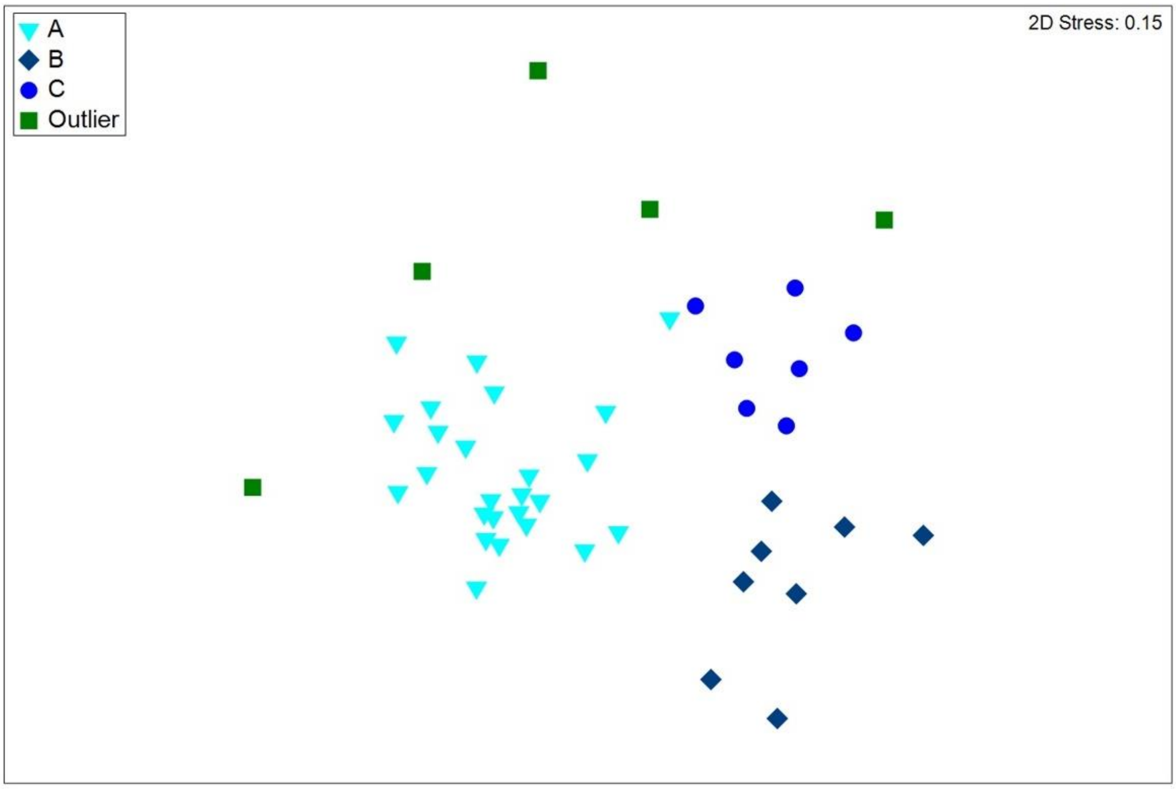

Figure 11. Non-metric MDS ordination plot of square-root transformed Bray-Curtis similarity macrobenthic abundance data.

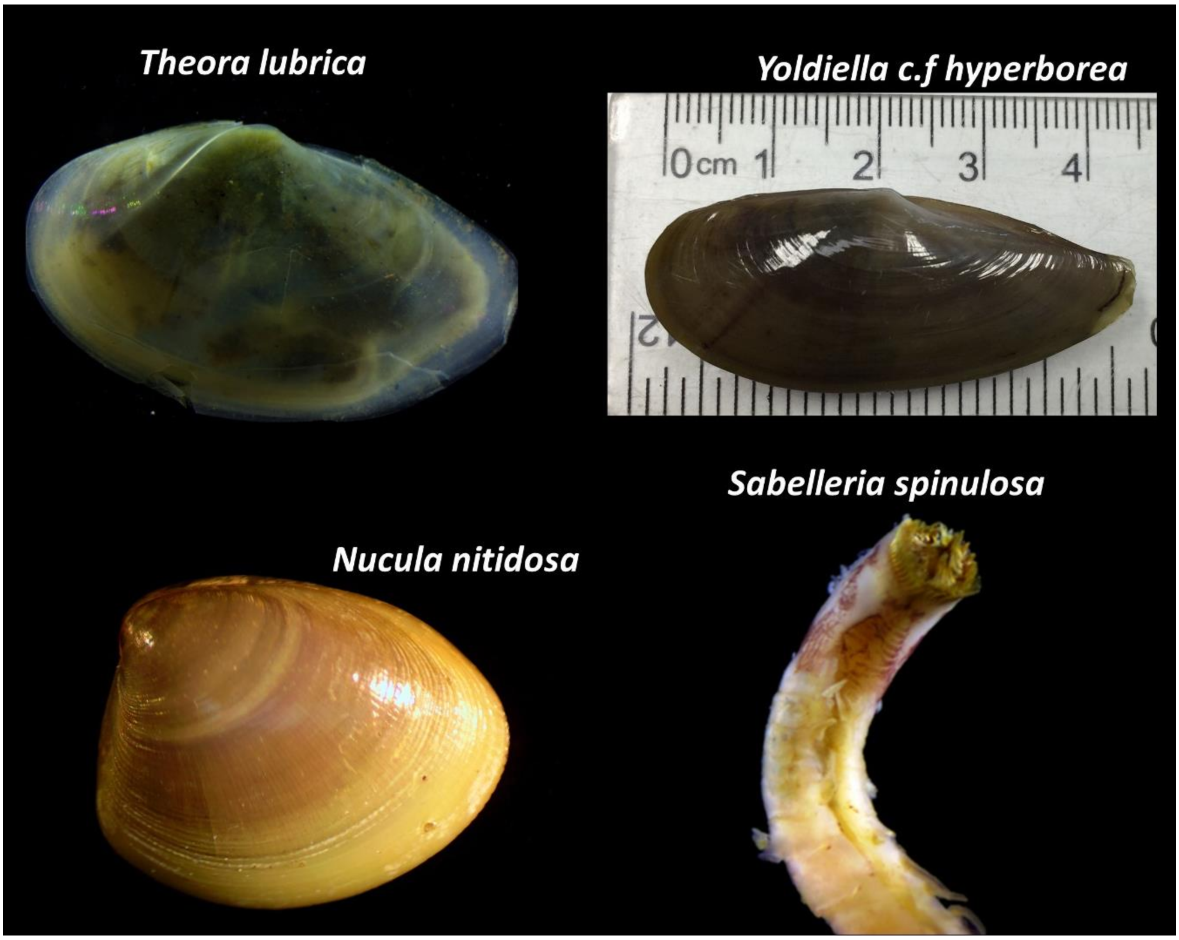

Plate 4. Example micrographs of the non-native (*Theora lubrica* and *Yoldiella c.f hyperborea*) and key macrobenthic taxa sampled during the NGCT sediment and marine ecology survey 2019. © Ocean Ecology Ltd.

3.3. Epibenthos

3.3.1. Epibenthic Composition

Prior to analysis of the epifaunal data, the faunal lists underwent a truncation and standardisation process. All records of infauna (15 taxa) were removed from analysis of epibenthic data. A relatively diverse epifaunal assemblage was sampled with a total of 40 epibenthic taxa recorded with a mean (± SE) of 12.94 ± 0.90 taxa per sample. Mean (± SE) abundance per sample was 1188.63 ± 818.51 individuals. A total of 18 fish taxa and 22 macroinvertebrate taxa were recorded with the most abundant macroinvertebrate taxon being the brittle star (*Ophiura sp.*) and the most abundant fish taxon being the European Plaice (*Pleuronectes platessa*). The full epifaunal matrix is provided in Appendix XIII presenting the abundance of each taxon in all trawl samples acquired across the survey area. Figure 12 illustrates the relative contributions of the major taxa to species richness (S) and total abundance (N), and of the epifaunal community sampled across the survey area. Overall, echinoderms dominated the epifaunal assemblages in terms of numbers of individuals (N) accounting for 84.6 % of all individuals. As demonstrated in Figure 13, this could be attributed to the notable abundances of brittlestars (*Ophiura sp.*) that dominated the assemblages in terms of N accounting for 80.3 % of all individuals recorded. Shore crabs (*C. maenus*) and crandonid shrimps, (*Crangon* sp.) were the dominant taxa with respect to occurrence and were both recorded in all 16 trawl stations.

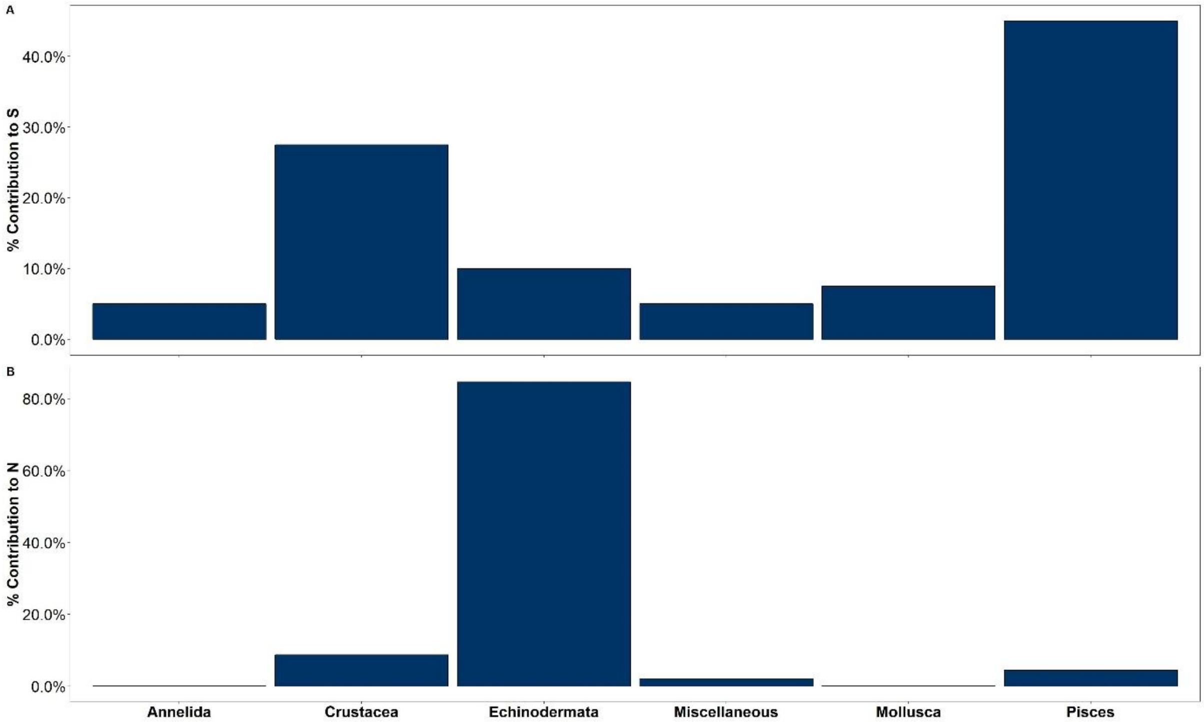

Figure 12. Relative contribution of the major taxonomic groups to the total diversity (A) and abundance (B) of epibenthic fauna sampled during the NGCT sediment and marine ecology survey 2019.

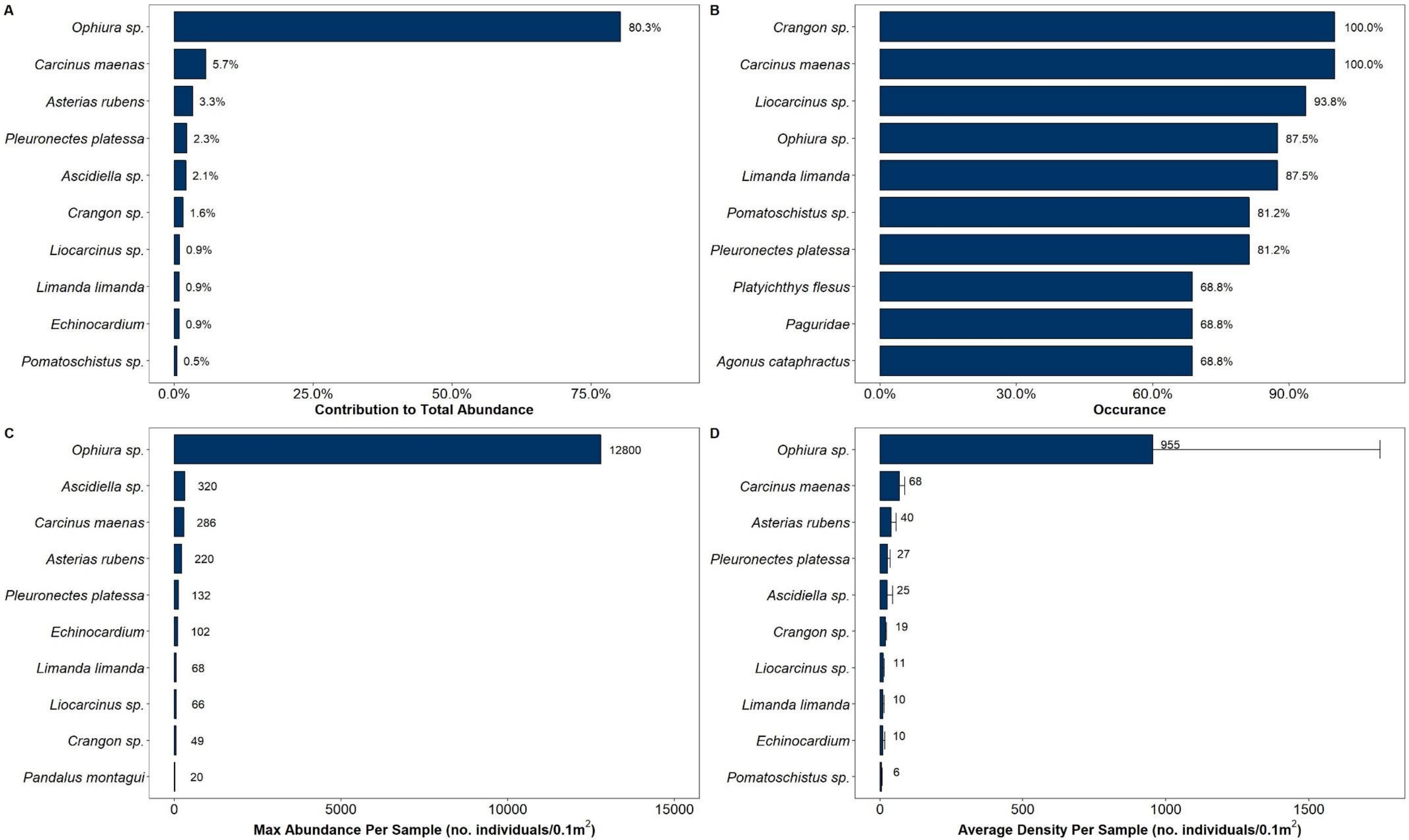

Figure 13. Percentage contributions of the top 10 epibenthic taxa to total abundance (A) and occurrence (B) from epifaunal trawls collected during the NGCT sediment and marine ecology survey 2019. Also shown are the maximum abundance of the top 10 taxa per sample (C) and mean densities of the top 10 taxa per sample (D).

3.3.2. Epibenthic Faunal Groups

Cluster analysis of square-root transformed macrobenthic abundance data was carried out on a resemblance matrix calculated using the Bray-Curtis similarity coefficient in order to graphically represent the similarity of the epibenthic communities recorded in each sample.

The resulting dendrogram (displayed on the X-axis of the shade plot, Figure 14) and SIMPROF test identified two statistically significant faunal groups (shown by point colour) and one outlier (an ungrouped single sample). The corresponding non-metric multidimensional scaling (nMDS) ordination plot (Figure 15) graphically displays the similarity between the samples based on the distance between the sample points. The degree of clustering of intra-group sample points demonstrates the level of within group similarity whilst the degree of overlap of inter-group sample points is indicative of the level of similarity of the different faunal groups.

The stress value of the nMDS ordination (0.11) indicates that the two-dimensional plot provides a representative interpretation of the similarity between the samples. The results of the SIMPER routine enabled the characteristic taxa within each of the faunal groups to be determined by providing a level of percentage contribution (%Contrib) to the group similarity which are discussed for each faunal group in detail below. Results of the SIMPER routine are provided in Appendix XIV.

Faunal Group A was identified at 13 of the trawl stations (representing 81 % of epibenthic trawls) and occurred at locations throughout the survey area (Figure 16). These communities were dominated by *C. maenus, P. platessa*, and crangonid shrimp (*Crangon* sp.) that contributed 24.10 %, 13.93 % and 11.90 % to the within group similarity respectively.

Faunal Group B occurred at the two outermost trawl stations at the mouth of the estuary and was dominated by *A. rubens* that contributed 53.06 % of the within group similarity. Other prevalent species included brittlestars (*Ophiura* sp.) and crangonid shrimp (*Crangon* sp.) which contributed to 19.00 % and 13.43 % of the within group similarity respectively.

The outlier group, trawl BT06, was separated from the other faunal groups due to high abundances of brittlestars (*Ophiura* sp.) that were an order of magnitude greater than at other stations.

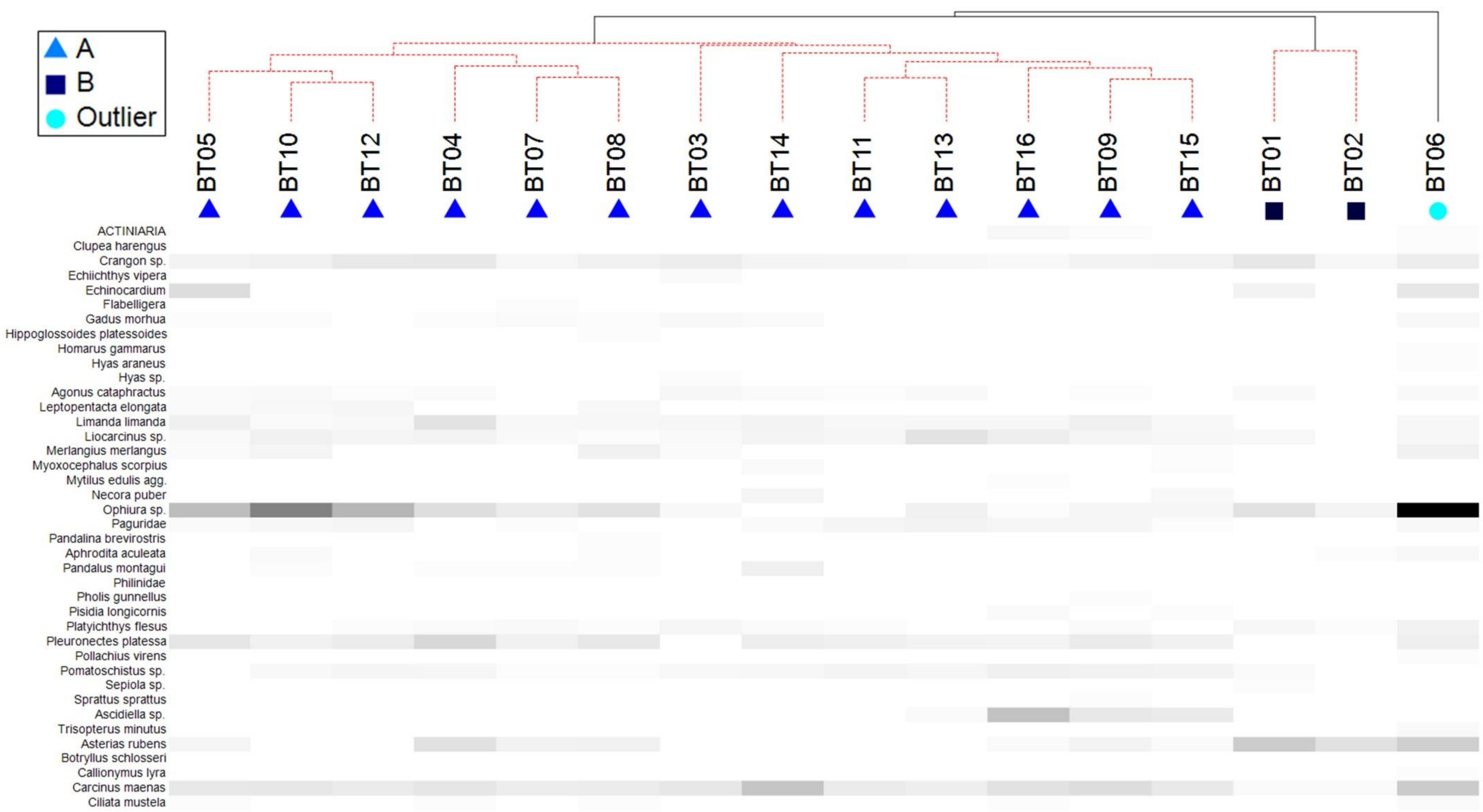

Figure 14. Shade plot with dendrogram based on square-root transformed Bray-Curtis similarity epibenthic abundance data. Faunal Groups were separated by SIMPROF.

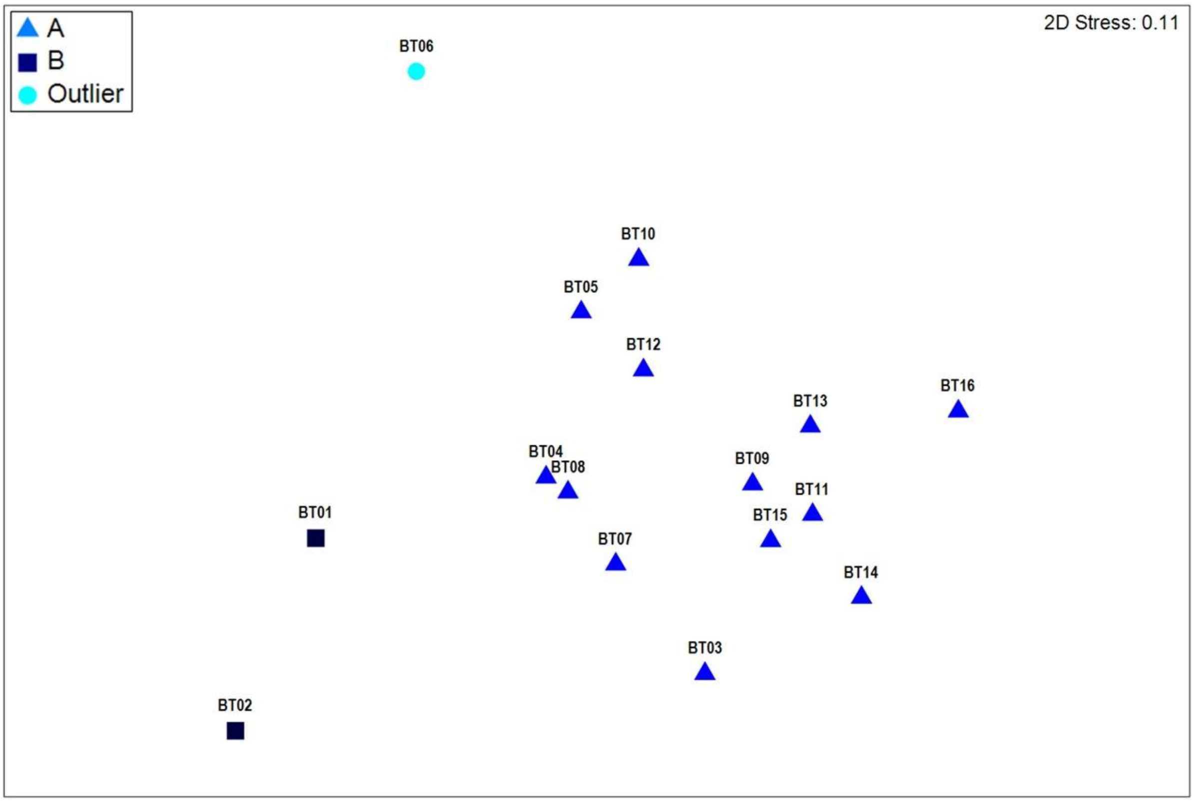

Figure 15. Non-metric MDS ordination plot of square-root transformed Bray-Curtis similarity epibenthic abundance data.

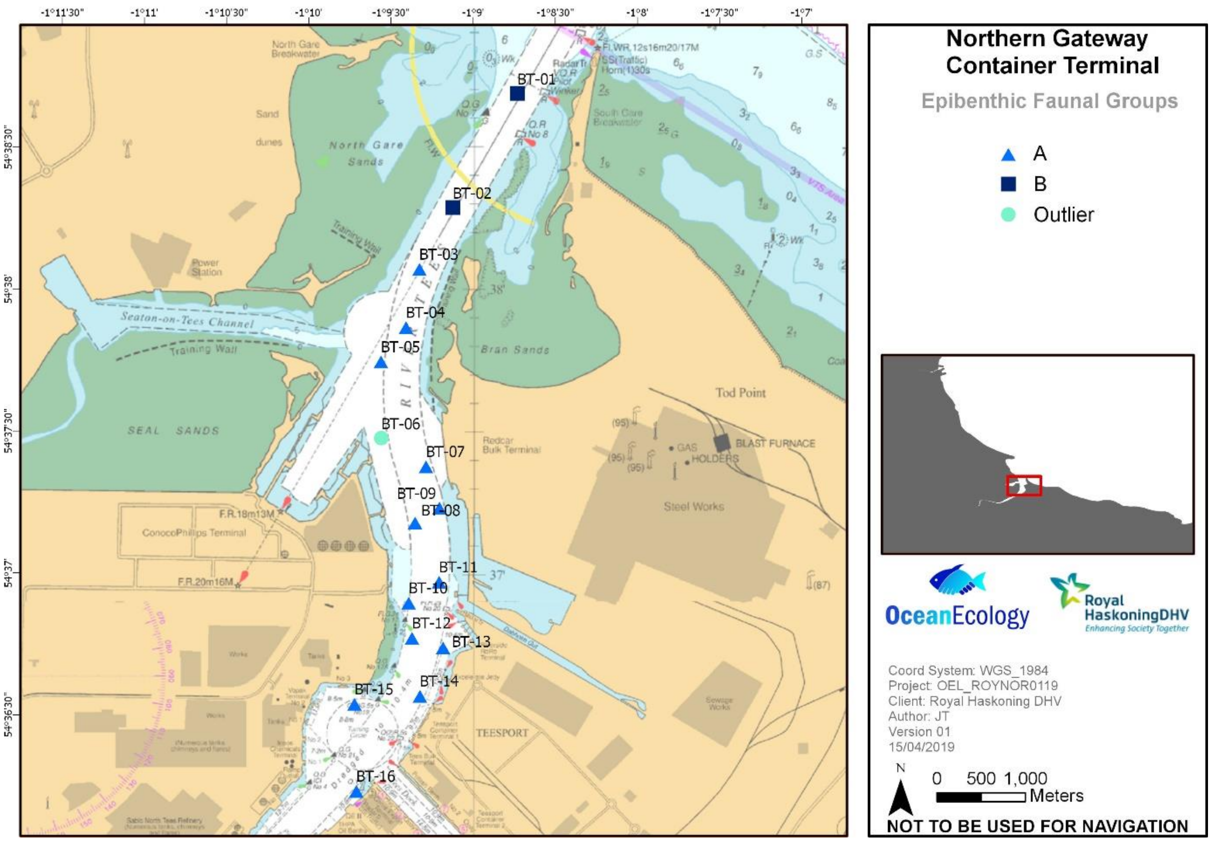

Figure 16. Spatial distribution of faunal groups across the 2019 sampling array.

3.4. Intertidal Areas

3.4.1. Biotope Mapping

Two distinct areas were targeted for intertidal biotope mapping: (1) the area from the north eastern corner of the Teesport Container Terminal 1 quay up to the end of the breakwater north of Teesport Riverside RoRo Terminal and (2) the area from the south western corner of the Teesport Container Terminal 1 quay to the end of the breakwater to the south west. Biotope maps were derived from UAV imagery alongside the Phase I walkover and quadrat sampling. Both areas showed similar zonation patterns with a limited number of biotopes observed (Table 5). Biotopes are mapped in Figure 17 and Figure 18.

The shoreline was backed by industrial developments and the upper shore was characterised by ephemeral algae on non-mobile substrate (A1.45) along the entirity of the survey area. These areas then gave way to areas of rock and boulders, often dominated by fucoids (A1.33 – Fucoids in variable salinity).The lower rocky shore areas were dominated by the biotope A1.33 - Red algal turf in lower eulittoral, sheltered from wave action. In some areas, coarse sediment beaches occurred on the lower to mid shore (A2.12 – Estuarine coarse sediment shores) and occasionally formed a mosaic with A1.33 - Red algal turf in lower eulittoral, sheltered from wave action.

A full list of biotopes recorded during the Phase I walkover survey is provided in Table 6 and a summary of biotopes with photographs is provided in Appendix VI.

Table 6. Key biotopes recorded in the Phase I intertidal survey during the NGCT sediment and marine ecology survey 2019.

Habitat	EUNIS Code	EUNIS Description
A1 - Littoral rock and other hard substrata	A1.32	Fucoids in variable salinity.
	A1.33	Red algal turf in lower eulittoral, sheltered from wave action.
	A1.45	Ephemeral green or red seaweeds (freshwater or sand-influenced) on non-mobile substrate.
A2 - Littoral Sediment	A2.12	Estuarine coarse sediment shores

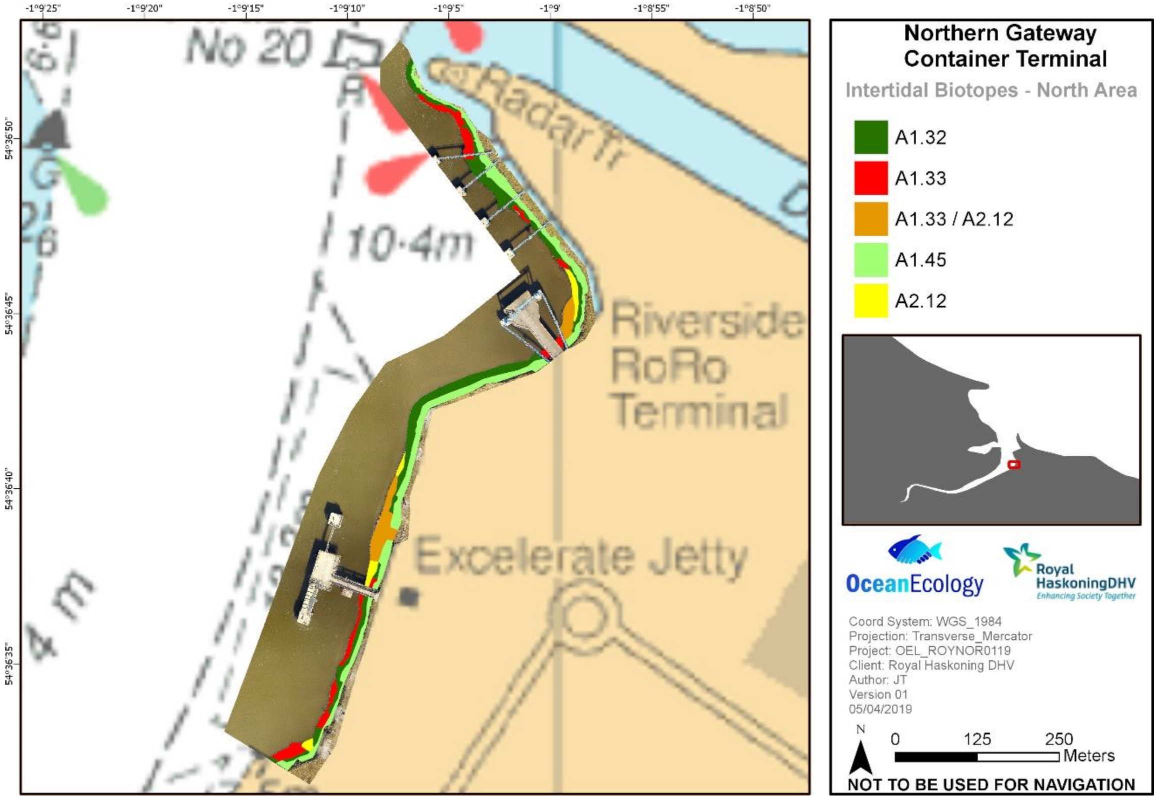

Figure 17. Intertidal biotope map from the north eastern corner of the Teesport Container Terminal 1 quay up to the end of the breakwater north of Teesport Riverside RoRo Terminal overlain on the UAV imagery derived orthomosaic. Note the brown areas in the orthomosic imagery are representative of the water surface.

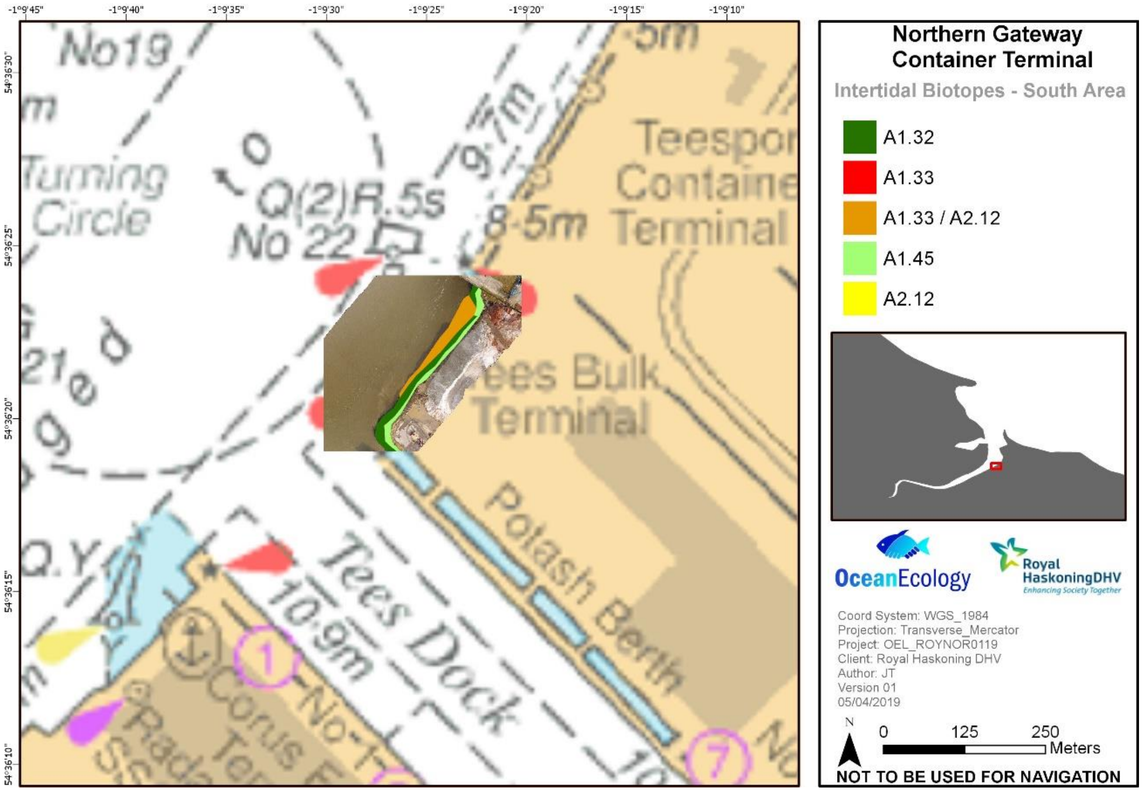

Figure 18. Intertidal biotope map from the south western corner of the Teesport Container Terminal 1 quay to the end of the breakwater to the south west overlain on the UAV imagery derived orthomosaic. Note the brown areas in the orthomosic imagery are representative of the water surface.

3.5. Species of Conservation Interest and Non-natives

Most species present in the Tees Estuary are typical of sublittoral macrobenthic and epibenthic communities. However, two non-native species and two species that receive designation under nature conservation legislation were recorded (Table 17).

Two individuals of the invasive species *Theora lubrica* were found at station TG-23 deep within the Tees Estuary. *T. lubrica* is a small bivalve that belongs to the family Semelidae (see Plate 4). It is native to Japan, China and Indonesia and has been recorded as an invasive species in Australia and New Zealand as well as being found on the Spanish coast in 2011 representing the first record in the Atlantic (Adarraga & Martínez 2011). *T. lubrica* seems capable of surviving highly degraded habitats including low oxygen and high organic matter areas (Bogi & Galil 2007). The possible ecological effects of this invasive species have not been thoroughly studied with positives (increased bioturbation) and negatives (bioaccumulation of contaminants) both being reported.

Multiple specimens of *Yoldiella* species were collected at seven stations, particularly around the QEII area. Following discussions with expert bivalve taxonomists at the National Museum of Wales they were assigned to *Yoldiella c.f hyperborea*. The genus *Yoldiella* is in need of further taxonomic study with three species recorded on the East coast of the USA, Norway and Iceland as well as two potential subspecies. Molecular systematics would be required to determine which population or species these specimens belong to with certainty. *Yoldiella* is not currently known to be invasive elsewhere.

Juvenile specimens of the ocean quahog, *Arctica islandica*, were found at 12 stations, primarily in the offshore disposal areas. *A. islandica* is on the OSPAR List of threatened and/or declining species and habitats and is also a Feature of Conservation Importance (FOCI) in England and Wales.

The Ross worm, *S. spinulosa*, occurred in 14 samples and was most dominant in samples collected in offshore disposal area C with 725 individuals recorded in a single sample. *S. spinulosa* is on the OSPAR list of threatened and/or declining species and habitats due to the ability to form reefs which are an Annex I feature of the Habitats Directive. Despite the high density of individuals at this location, the visual inspection of the grab samples indicated that the tube aggregations were representative of a low-lying veneer formation that was not deemed to meet the Annex I reef qualifying criteria as described by Gubbay (2007).

4. DISCUSSION

4.1. Project Requirements

Ocean Ecology Limited (OEL) was commissioned by Royal Haskoning DHV (RHDHV) on behalf PD Teesport (PDT) to conduct a subtidal and intertidal sediment and marine ecology survey for the proposed Northern Gateway Container Terminal (NGCT) project. The key objectives of this survey programme and subsequent analysis were to establish a baseline for the marine sediments present and the associated macrobenthic and epifaunal communities as well as to characterise the intertidal habitats present.

4.2. Sediments

Muddy sediments dominated the inner areas of the Tees Estuary. This was also observed in previous studies where sandy mud and slightly gravelly sandy mud dominated the sediment groups present (Fugro 2014). This implies that the sediments are relatively stable within the inner areas of the estuary which is indicative of relatively low water movement (Gray & Elliott 2009). Stations in the outer areas of the estuary saw an increase in the contribution of sand particles and the proportion of gravel increase along the inshore to offshore gradient. This is likely linked to increased hydrodynamic energy and results in sediment types that are expected to occur in these environments (Gray & Elliott 2009).

4.3. Macrobenthic Communities

The macrobenthic assemblages observed were diverse and constituted of 292 taxa. As has been observed in previous surveys, annelid taxa, particularly polychaetes, dominated the assemblages in terms of abundance and diversity across all stations (Fugro 2014). Interestingly, the opportunistic species *Capitella capitata* was only recorded in high numbers at one station (TG-15) having previously been more widespread (Royal Haskoning 2009, Fugro 2014). *C. capitata* is regarded as an opportunistic species given its tolerance to pollution, such as heavy metal accumulation, and reduced oxygen content (James & Gibson 1980, Tsutsumi 1987). The Tees estuary has been highly polluted in the past, with heavy metal concentrations up to 500 times greater than unpolluted areas (Davies et al. 1991). However, the large reduction in *C. capitata* does suggest that the communities are less impacted and organically enriched than in previous years.

Three macrobenthic faunal groups were identified and clearly separated the estuary (Group A), disposal area C (Group B), and disposal area A (Group C). The estuarine faunal group was not dominated by a single species, based upon the percentage contributions of each taxa to within group similarity. Taxa within the estuary were similar to previous surveys including nematode worms, *Chaetozone gibber*, and *Tubificoides swirencoides* (Royal Haskoning 2009, Fugro 2014).

The offshore macrobenthic communities appeared to be substantially different from the estuarine communities. This may be due to a lack of previous enrichment as lower estuary discharges were primarily surface-based meaning communities in outer estuary areas may be more stable (Warwick et al. 2002). At disposal area C, although polychaetes were still abundant, the Ross worm, *Sabellaria spinulosa*, occurred in a number of samples in high abundances. Dense subtidal aggregations of tubes created by *S. spinulosa* may form biogenic reefs that can stabilise cobble, pebble and gravel habitats and provide a consolidated habitat for epibenthic species (Pearce et al. 2011). These reefs form solid, raised structures above the surrounding seabed, thus increasing local habitat complexity and creating a biogenic habitat onto which various other species may become established. The *S. spinulosa* tube aggregations sampled at disposal area C were not however deemed to be representative of biogenic reef habitat.

Macrobenthic faunal group C, found primarily around disposal area A, was characterised by bivalve taxa. Additionally, individuals of the ocean quahog *Arctica islandica* were also found in offshore samples. Juveniles have been recorded in previous surveys within the estuary area (Fugro 2014) however, this taxa was more prevalent in the offshore areas in this survey. Growth rates of *A. islandica* can have a strong positive correlation with grain size (Witbaard et al. 2019). High levels of fine or suspended sediments may impact *A. islandica* growth so it is likely that conditions within the estuary create sub-optimal conditions (Witbaard & Bergman 2003).

4.4. Epibenthic Communities

A total of 40 epibenthic species were identified from the trawls including 18 fish species. This is comparable to previous surveys in 2006 (47 total and 10 fish species, (Royal Haskoning 2006)) and 2013 (58 total and 19 fish species, (Fugro 2014)). The discrepancy in the number of species present appears to be related to the number of annelids recorded. Annelids contributed to 5 % of species in 2019 as opposed to 21 % in 2013. Several annelids were removed prior to analysis of the epifaunal data due to them having infaunal traits. This is the most likely cause of the reduction and demonstrates the importance of conducting a detailed data truncation process through consideration of life history traits of species sampled as part of any marine biological assessment.

A large increase in the numbers of brittlestars (*Ophiura* sp.) was observed in the 2019 survey when compared to previous survey data. Echinodermata only accounted for 1 % of total numbers of individuals in 2013 (Fugro 2014) compared to 84.6 % in 2019, with *Ophiura* sp. alone accounting for 80.3 % of individuals recorded. *Ophiura* sp. was reported to be abundant at station BT08 in 2006 (Royal Haskoning 2006) however the highest numbers were observed at stations BT06, BT05, BT10, and BT12 where its occurrence across the survey area has also increased. Brittlestars can occur in very dense beds on sediments and in estuarine environments (Wolff 1968, Hughes 1998). The beds can play an important role in improving water quality due to their filter-feeding nature contributing to wider ecosystem function (Hughes 1998).

Overall, the epibenthic communities in the Tees Estuary appear to be stable with similar taxa observed over multiple surveys. Brown shrimp (*Crangon* sp.) and plaice (*Pleuronectes platessa*) have remained abundant across all surveys since 2006 and occurred at all or most (81.2 %) of stations in 2019 and in 2013. Additionally, the shore crab (*Carcinus maenus*) was also abundant in 2006 which suggests that the main characterising species of the epibenthic communities remain largely unchanged.

4.5. Intertidal Habitats

Intertidal habitats were relatively similar to those identified in previous surveys in 2008 (Royal Haskoning 2009). The intertidal area of the Tees within the survey locations is predominantly artificial due to industrial development. This restricts the ability for a more natural rocky shore community to develop and as such was relatively species poor with only a few biotopes present. The survey area was generally characterised by ephemeral green algae on non-mobile substrate along the upper shore, fudoicds on rock and boulders along the mid shore and red algal turf along the lower shore. Occasional areas of impoverished coarse sediment was also found along the low-mid shore. There was no evidence of intertidal mudflats present in the survey area, as had been previously suggested.

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Appendix 13

Historic benthic ecology survey data

Royal HaskoningDHV

Results of previous benthic surveys in the Tees estuary

2006 NGCT benthic survey

Benthic grabs

The 2006 survey confirmed that none of the species present in sediments from the survey area are rare and therefore, in this respect, the species present were considered typical of the estuarine environment. The statistical analysis of the macrofaunal data identified that there was no obvious difference in the diversity of species recorded within the main channel and those outside of the channel. There was however a slight increase in abundance within the samples located outside of the channel compared to those within it. It should be noted that the proposed reclamation area, as well as the turning circle were found to contain low abundance and diversity.

Although biotopes were not identified during the NGCT 2006 infaunal survey data analysis, three main groups (referred to as Group A, B, C) were established based on the infaunal species present. The three groups correlated to sediment composition, indicating that the biological community present in each group was influenced by the environment present across the survey site. Group C samples were generally located in sandy sediments (i.e. towards the mouth of the Tees estuary). Group A and group B were generally present in sediments with a high percentage of fine material (i.e. to the east of Seaton Channel and in the main channel areas), with group A found in sandy silty sediments and group B in silty sediments. Both groups (A and B) contained predominantly polychaetes with Chone sp. and Ophyryotrocha sp. present in Group B for example. Group B also contained bivalve molluscs Abra alba. C. capitata and Ophyryotrocha sp. dominated Group A. These species are characteristic of fine sediments, usually with some level of organic pollution and associated depleted oxygen levels. Samples in Group C were characterised by polychaetes Chaetozone christiei and Spio decorata species. Crustaceans (Diastylis bradyi for example) and Molluscs (Abra alba for example) were also present in Group C (Royal Haskoning, 2006).

Trawls

A benthic epifaunal survey was conducted to inform the 2006 NGCT EIA. The survey involved use of an otter trawl with a 20mm mesh and 3mm cod-end at 15 sites within the Tees estuary.

The most abundant species recorded during the 2006 trawl survey was shrimp Crangon sp., which was recorded throughout the estuary, followed by shore crab Carcinus maenas which was more abundant in the middle section of the estuary adjacent to the proposed NGCT quay. Lower abundances of epifauna was recorded at the mouth of the estuary. Infuanal species were also recorded, the most abundant being A. Alba.

Results of other relevant benthic ecological surveys in the Tees estuary

Since production of the NGCT ES in 2006, Royal HaskoningDHV is aware of two additional benthic infaunal surveys that have been undertaken to inform EIAs for developments within and adjacent to the Tees estuary, specifically the QEII Berth and the York Potash Harbour Facilities. A summary of the infaunal survey data from each survey, and how the data relates to that presented in the 2006 ES, is set out below.

Comparison of the findings of the QEII Berth benthic survey (2008) with the findings of the NGCT benthic survey (2006)

The benthic infaunal survey undertaken to inform the QEII Berth EIA (undertaken during 2008) consisted of grab samples at two stations within Tees estuary. Data from the survey were combined with data from the 25 stations sampled during the infaunal survey undertaken for the NGCT EIA, to enable the samples to be comparatively assessed within a broader context.

Multivariate analysis of the combined data set identified faunal similarity between samples and found that the NGCT samples broadly fell into three groups reflecting species preference for (1) sandy, (2) silty (muddy), or (3) mixed sediments. The two QEII Berth samples were comprised of fine sediment and fell into the 2nd group of silty or muddy sediments, indicating that the data conformed to the structure of a typical fine sediment community, containing an unremarkable silty sediment infaunal assemblage typical of these sediment types.

Overall, the QEII Berth samples indicated that the biological communities were of relatively low diversity, broadly characteristic of chemically or physically disturbed conditions and were very similar in faunal composition to previously surveyed fine sediment within the estuary during the 2006 infaunal survey.

Comparison of the findings of the York Potash Harbour Facilities benthic survey (2014) with the findings of the NGCT benthic survey (2006)

The benthic infaunal survey undertaken as part of the York Potash Harbour Facilities EIA (Royal HaskoningDHV, 2014) consisted of 32 subtidal grab samples. The data were analysed to determine the biotopes present across the survey site. The results of the 2006 NGCT and the 2014 York Potash Harbour Facilities benthic infaunal surveys identified a clear distinction between the main channel and the outer channel near the bank of the estuary.

The 2006 survey undertaken to inform the NGCT EIA identified the presence of group B in the navigation channel; this group contained predominantly polychaetes and common species were Chone sp., Ophryotrocha sp. and bivalve molluscs Abra alba. The survey undertaken in 2014 for the York Potash Harbour Facilities identified the dominant biotope complex recorded in the navigation channel was SS.SMU.ISaMu (Infralittoral sandy mud). Similar to Group B, SS.SMU.ISaMu is typically dominated by a rich variety of polychaetes, and a common characterising species of this biotope is A. Alba.

In 2006, the outer channel adjacent to the proposed NGCT terminal was dominated by Group A samples, which were characterised by Capitella capitata and Ophryotrocha sp. This was still the case in 2014 where two biotopes were recorded, namely SS.SMu.ISaMU.Cap (Capitella capitata in enriched sublittoral muddy sediments) and SS.SMU.SMuVS.CapTubi (Capitella capitata and Tubificoides spp. in reduced salinity infralittoral muddy sediment), where C. capitata dominated and was accompanied by large numbers of Ophryotrocha sp. These species are characteristic of fine sediments, usually with some level of organic pollution and associated depleted oxygen levels.

As noted above, the most abundant species recorded during the 2006 trawl survey was shrimp Crangon sp. which was recorded throughout the estuary, followed by shore crab Carcinus maenas which was more abundant in the middle section of the estuary adjacent to the proposed NGCT quay.

Lower abundances of epifauna was recorded at the mouth of the estuary. Infaunal species were also recorded, the most abundant being A. Alba. Similarly, in the 2014 epifaunal survey, the most abundant species recorded was shrimp Crangon crangon. C. maenas and A. Alba were also abundant, and the species were three of the ten most abundant species present in 2014.

The comparison of the 2006 and 2014 benthic survey data recovered from the Tees estuary indicates that there have been no material changes to the infaunal communities between the two surveys.

Appendix 14

Underwater noise modelling report

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York Potash Project Harbour Facilities: Underwater Noise Impact Assessment

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This report is a controlled document. The Report Documentation Page lists the version number, record of changes, referencing information, abstract and other documentation details.

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List of Contents

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1 Introduction

This report has been prepared by Subacoustech Environmental Ltd for Haskoning DHV UK Ltd. York Potash Ltd is proposing to develop harbour facilities at Bran Sands on the Tees Estuary. The harbour facilities would consist of a port terminal, storage facilities and a conveyor system. The facility is proposed to be used to facilitate the export of fertiliser.

This report presents the results of an underwater noise study based on the proposed construction and operational activities in the Tees River and Estuary. This study has been undertaken to predict and assess the environmental impact of underwater noise likely to be produced during the construction and operational phase of the proposed scheme.

There are a number of construction options still under consideration and this study has taken these into account. Underwater noise propagation has been modelled and predicted in regard to impact piling and dredging activities.

This report follows on from a report of a subsea noise baseline survey (Cheesman and Collett, 2014), undertaken by Subacoustech Environmental Ltd, which describes the method for measurements undertaken and presents the data and findings for the baseline underwater noise environment.

1.1 Site details

The proposed harbour facility is to be constructed in the Bran Sands area of the Tees Estuary. Figure 1-1 highlights the proposed location of the port terminal and the key areas that are required to be dredged along with the locations of the other aspects of the facility.

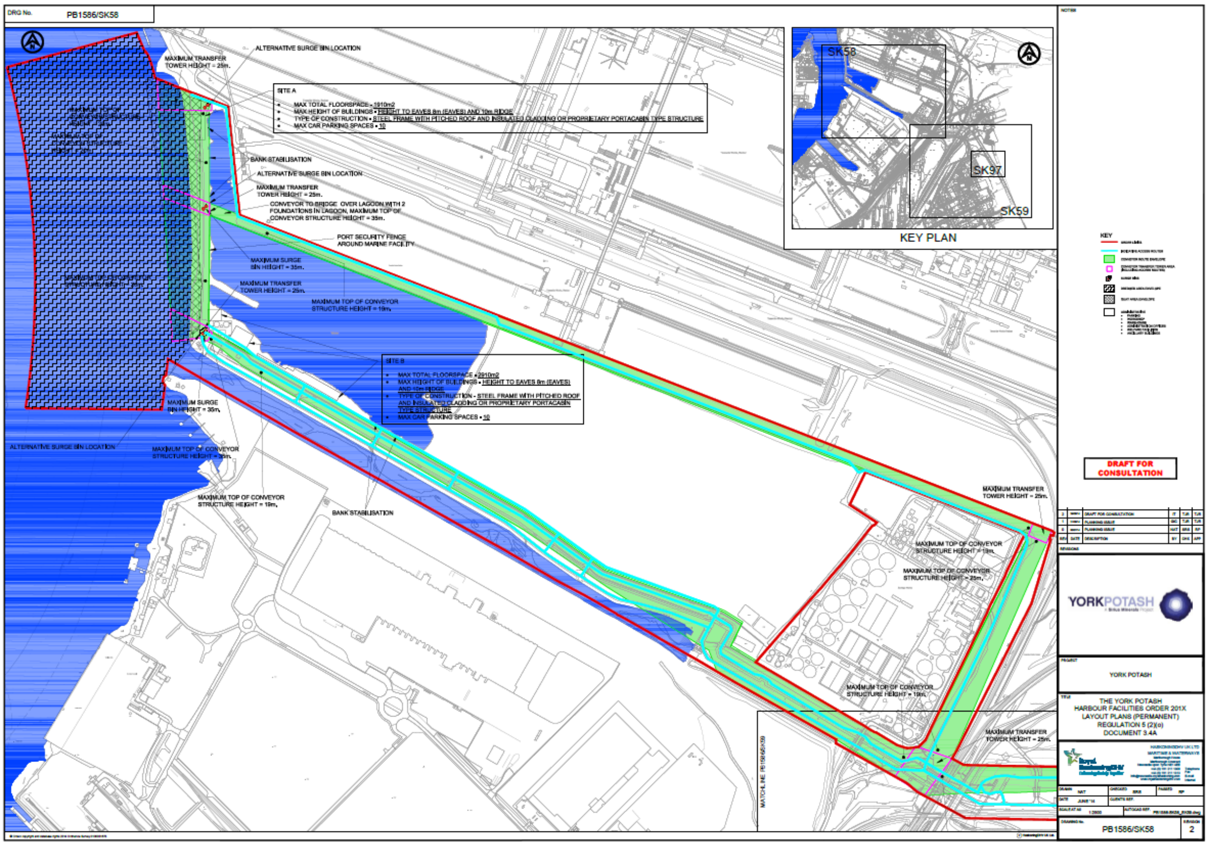

Figure 1-1 Map showing the indicative layout of the proposed harbour facility

1.2 Assessment approach

The approach taken in this assessment is consistent with the latest guidance currently being developed as part of the implementation of the EU Marine Strategy Framework Directive.

Sections 2 to 5 cover the modelling and reporting of noise propagation and transmission loss in terms of the physical processes and are reported in standard measurement units. This describes an estimation of the noise environment as a result of the activities being undertaken.

The results of the modelling are then used to inform an assessment of the potential impact on marine fauna (Section 6). This assessment is based on the currently available scientific literature and other studies. However, it is acknowledged that there are significant gaps in the available scientific knowledge (particularly with regards to the behavioural effects of noise on fish in the wild) and as such the results are presented and discussed with regard to a range of different criteria and metrics.

2 Modelling approach

2.1 Introduction

In order to estimate the noise levels likely to arise during construction of the proposed scheme, predictive underwater noise modelling was undertaken. This involved estimating noise levels from impact piling and dredging operations. This modelling was carried out using Subacoustech's INSPIRE model for impact piling operations and the openly available RAMSGeo software package to provide a comparison to INSPIRE and also to model dredging activities.

2.2 Noise level metrics

Sound may be expressed in many different ways depending upon the particular type of noise, and the parameters of the noise that allow it to be evaluated in terms of a biological effect. These are described in more detail below.

2.2.1 Sound pressure level (SPL)

The Sound Pressure Level (SPL) is normally used to characterise noise and vibration of a continuous nature such as drilling, boring, continuous wave sonar, or background sea and river noise levels. To calculate the SPL, the variation in sound pressure is measured over a specific time period to determine the Root Mean Square (RMS) level of the time varying sound. The SPL_{RMS} can therefore be considered to be a measure of the average unweighted level of the sound over the measurement period.

The SPL is calculated using the following formula where *p* is the sound pressure in Pascals (Pa) and p_{ref} is the reference sound pressure which is 1 µPa for underwater sound.

$$SPL = 20 \log\left(\frac{p}{p_{ref}}\right)$$ **Equation 2-1**

As an example, small sea-going vessels typically produce broadband noise at source SPLs from 170 – 180 dB re 1 µPa @ 1 m (Richardson *et al*, 1995), wheras a supertanker generates SPLs of typically 198 dB re 1 µPa @ 1 m (Hildebrand, 2004).

2.2.2 Peak-to-peak level

The peak-to-peak level is a measure of SPL usually calculated using the maximum variation of the pressure from positive to negative within the wave. This represents the maximum change in pressure (differential pressure from positive to negative) as the transient pressure wave propagates. Where the wave is symmetrically distributed in positive and negative pressure, the peak to peak level will be twice the peak (also sometimes known as the zero to peak) level, which equates to a level that is 6dB higher. Peak-to-peak levels of noise are often used to characterise sound transients from impulsive sources such as impact piling and seismic airgun sources.

2.2.3 Sound Exposure level (SEL)

When assessing the noise from transient sources such as blast waves, impact piling, or seismic airgun noise, the issue of the time period of the pressure wave is often addressed by measuring the total energy of the wave. This form of analysis was used by Bebb and Wright (1953 to 1955), and later by Rawlins (1987) to explain the apparent discrepancies in the biological effect of short and long range blast waves on human divers. More recently, this form of analysis has been used to develop an interim exposure criterion for assessing the injury range for fish from impact piling operations (Hastings and Popper, 2005; Popper *et al*, 2006; Carlson *et al*, 2007).

The Sound Exposure Level (SEL) sums the acoustic energy over a measurement period, and effectively takes account of both the SPL of the sound source and the duration the sound is present in the acoustic environment.

For continuous sounds of duration less than one second, the SEL will be lower than the SPL. For periods of greater than one second the SEL will be numerically greater than the SPL (i.e. for a continuous sound of ten seconds duration the SEL will be 10dB higher than the SPL, for a sound of 100 seconds duration the SEL will be 20dB higher than the SPL, and so on).

2.3 The INSPIRE model

The INSPIRE model is a semi-empirical underwater noise propagation model based around a combination of numerical modelling and actual measured data. It is designed to calculate the propagation of noise in shallow, mixed coastal water, typical of the coastal conditions around the UK. INSPIRE is designed to model and predict the propagation of underwater impact piling noise.

The model provides estimates of the unweighted peak, peak-to-peak and RMS SPL of noise as well as various other metrics along 180 equally spaced radial transects. For each modelling run, a criterion level can be specified allowing a contour within which a given effect may occur. These results are then plotted over digital bathymetry data so that impact ranges can be clearly visualised and assessed as necessary.

2.3.1 Input parameters

Two modelling positions have been chosen in order to show the greatest spatial range of results. The modelled positions were based on the extremities of the proposed port terminal. From here on, these modelling positions have been referred to as the North and South positions.

The parameters and assumptions used within the INSPIRE model for impact piling are outlined below in Table 2-1. Two different sized pile diameters have been modelled in order to consider the proposed construction options for the berth. One option is based on forming a suspended deck structure with driven steel tubular piles (of the order of 914mm) into the bed. The hammer energy for this option has been assumed to be 125kJ, based on piling operations sampled previously. An alternative proposed construction option comprises of a solid faced structure in the form of a combi-piled wall. This consists of a number of king piles (of the order of 2000mm) which are linked with secondary driven steel sheet piles. The king piles have been modelled using an assumed hammer energy of 305kJ and are expected to produce a greater sound levels, in comparison to sheet piles, due to their size and the energy required to install them.

Table 2-1 INSPIRE input parameters for impact piling

North Position	54.6205° N, 001.1517° W
South Position	54.6163° N, 001.1514° W
Depth above LAT (MHWS)	5.5 m
Assumed Pile Diameter	914 mm/2000 mm
Assumed Hammer Energy	125 kJ/305 kJ

2.4 The RAMSGeo model

The RAMSGeo software package, an acoustic model, is based on the well-known and much used RAM (Range-dependent Acoustic Model) software (Collins 1994 and Collins *et al.* 1996). RAMSGeo is able to model any noise source where it is reasonable to assume it as a point source. As the INSPIRE model is predominantly used and set up to model impact piling noise, RAMSGeo has been used to model underwater noise from dredging. RAMSGeo has also been used as a comparison to INSPIRE to provide confidence in the INSPIRE model outputs.

RAMSGeo is a fully range dependent parabolic equation (PE) model that performs underwater acoustic transmission loss calculations. Unlike INSPIRE, which has an emphasis on real world measurements, RAMSGeo is a purely theoretical model based solely around the physical acoustic processes that occur underwater.

The software is widely used for the modelling of propagation since it:

- models low frequency propagation well;
- allows for the incorporation of variable bathymetry; and
- allows for the incorporation of complex bottom types.

Unlike the INSPIRE model, RAMSGeo software package is currently only setup to run one chosen transect for a given iteration of the model. Therefore, three representative transects have been chosen to model the noise sources of interest as a comparison to INSPIRE.

2.4.1 Assumptions

The following assumptions have been made about the nature of the environment with respect to acoustic propagation modelling:

- The variation of temperature throughout the water column can affect sound propagation. As the depth of water is shallow and exhibits a great deal of mixing, a uniform temperature profile has been assumed. This is based on average temperatures measured by Subacoustech Environmental in UK coastal waters throughout the year. A representative sound speed of 1470 m/s has been used in the calculations.
- The 'nominal' depth of the representative noise sources is taken to be mid-depth.
- The estuary bed substrate is assumed to be made up of predominantly silt (65% to 70%), clay (20%), with sand and gravel providing the remainder (Halcrow, 1991). Consequently the physical parameters shown in Table 2-2, as presented by Jensen *et al*, 1994, have been assumed.

Table 2-2 Physical parameters used in RAMSGeo model

Sound Speed Ratio c_p/c_w	1.1
Density Ratio ρ_b/ρ_w	1.7
Compressional Wave Attenuation α_p	1.0
Shear Wave Attenuation α_s	1.5

The broadband noise source can be broken up into its individual octaves which are modelled under a narrowband approximation and the individual energy contribution from the bands summed. Figure 2-1 and Figure 2-2 show power spectral density (frequency) plots of measured noise sources. These have been used to apply a weighting to the modelled noise and noise propagation. These noise sources are used as a comparison to the proposed work in the River Tees due to their similarity in river situation and activity type and scale.

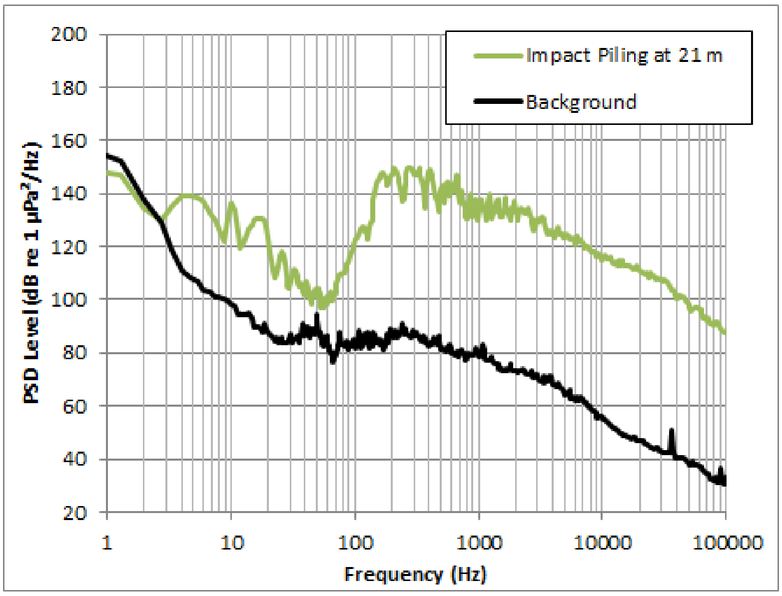

Figure 2-1 Power Spectral Density from measurement taken of impact piling in the River Thames

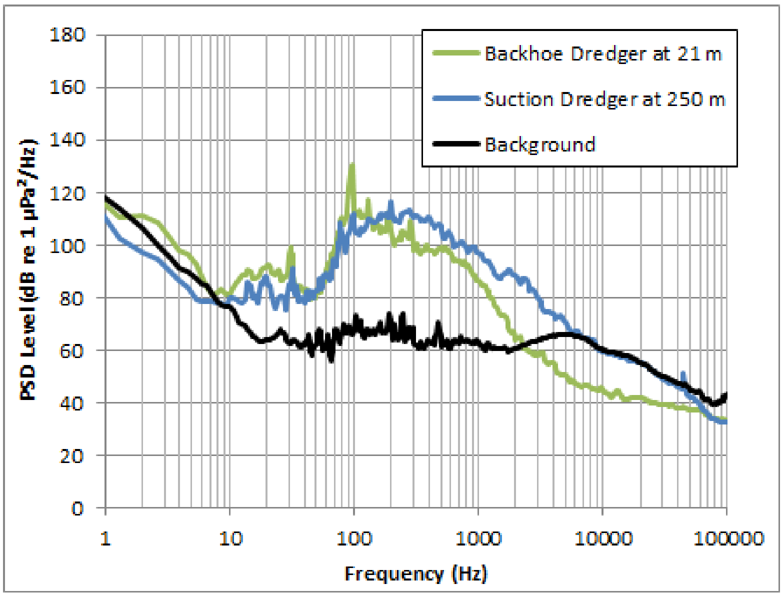

Figure 2-2 Power Spectral Density from measurement taken of backhoe dredging and suction dredging in Broadhaven Bay, Ireland

The South position has been chosen to carry out modelling using RAMSGeo. This is principally because it provides the greatest distance in a straight line before reaching the river bank in the area of interest within the river and hence the furthest distance for the sound to propagate. The bathymetry used for modelling the three chosen transects is shown in Figure 2-3.

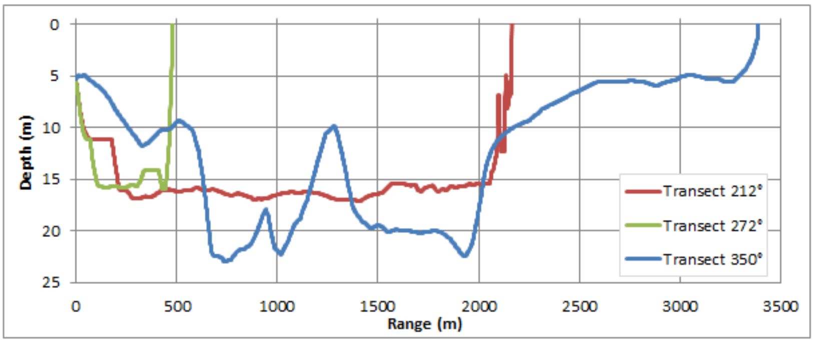

Figure 2-3 Bathymetry used for the three transects modelled in RAMSGeo at the south position

2.5 Review of existing data

2.5.1 Suction dredging

Cutter suction dredging (CSD) involves the use of a rotating cutter head to loosen rock and seabed in conjunction with a suction inlet that sucks up the material onto the vessel. Trailing suction hopper dredging (TSHD) involves a suction pipe with a drag head that is dragged over the seabed whilst dredging.

Underwater noise monitoring carried out by Subacoustech Environmental during CSD and TSHD has shown that suction noise dominates measured levels where the sediment is made up of sand and silt. Figure 2-4 shows a typical time history of dredging noise. The first 40 seconds of the time history are seen to remain at a constant pressure level with a number of transients. After this point the noise levels increase. It is thought that the dredger may have reached a region of gravel or rocky material as noise similar to large aggregate rattling up the suction pipe is audible on the recording. This produces the numerous high level transient peaks in underwater pressure visible between 40 and 70 seconds of the time history shown in Figure 2-4. This shows that there can be considerable variation in the noise levels and frequency components of noise from a suction dredger, which arise from different aspects of the dredger's operation.

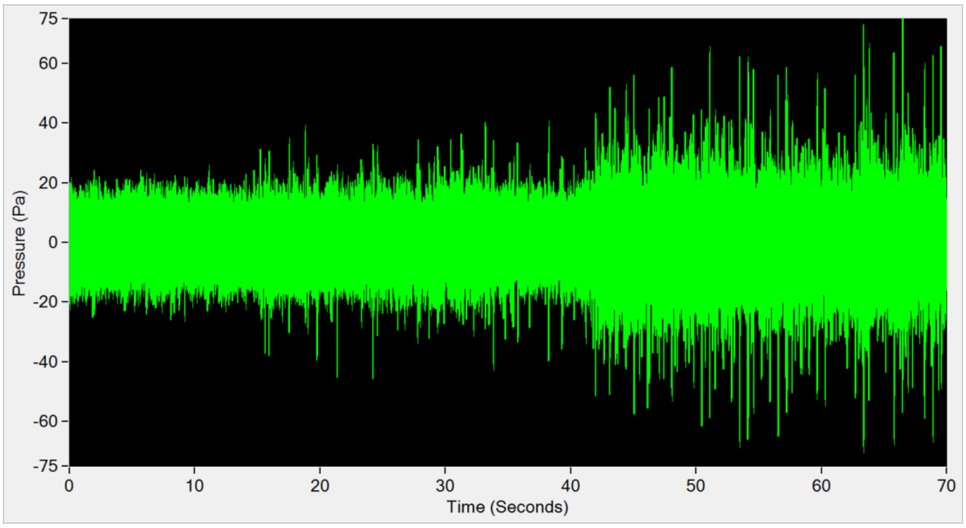

Figure 2-4 Pressure time history from suction dredging activity

Table 2-4 shows a representative number of existing, reported underwater noise data of CSDs and TSHDs. The extrapolated source levels are seen to be greater for TSHDs when compared with CSDs, despite the operation of a cutterhead. As the sediment to be dredged in the River Tees is predominantly sand, silt and clay, it is thought that if a CSD were to be used, similar noise levels would be produced as by TSHDs. For the basis of this study, source levels and spectra from TSHD measurements have been used to represent worst case emitted noise levels from suction dredging.

Table 2-3 Summary of reported CSD and TSHD underwater noise surveys

Dredger	Specification	Date and Location	Sediment	Source Level	Transmission Loss Model	Author
JFJ De Nul (CSD)	Overall Length: 140.7m Cutter Power: 7,600 kW Total Power: 27,240 kW	Coast of Dubai (2004)	Sand/Silt	169 dB re 1 µPa @ 1 m	20 log(r)	Howell and Nedwell, 2004
Florida (CSD)	Overall Length: 160m Cutter Power: 2,237 kW Total Power: 18,938 kW	New York/New Jersey Harbour (2012)	Limestone	175 dB re 1 µPa @ 1 m	15 log(r)	Reine *et al*, 2012
City of Westminster (TSHD)	Overall Length: 99.9 m Total Power: 4,080 kW	Hastings Shingle Bank (2008)	Gravelly sand	186 dB re 1 µPa @ 1 m	16 log(r)	Parvin *et al*, 2008
Taccola (TSHD)	Overall Length: 94.5 m Total Power: 6,050 kW	-	-	188 dB re 1 µPa @ 1 m	20 log(r)	Nedwell *et al,* 2008 (from Langworthy *et al,* 2004)
Mellina (TSHD)	Overall Length: 94.4 m Total Power: 3,300 kW	Broadhaven Bay, Ireland (2009)	Sand/slit	174 dB re 1 µPa @ 1 m	15 log(r)	Nedwell *et al*, 2009

2.5.2 Backhoe dredging

Figure 2-5 presents an example time history of underwater noise measured during operation of a backhoe dredger. The time history indicates considerable variation in underwater pressure levels and illustrates the levels of noise during each part of the dredging process.

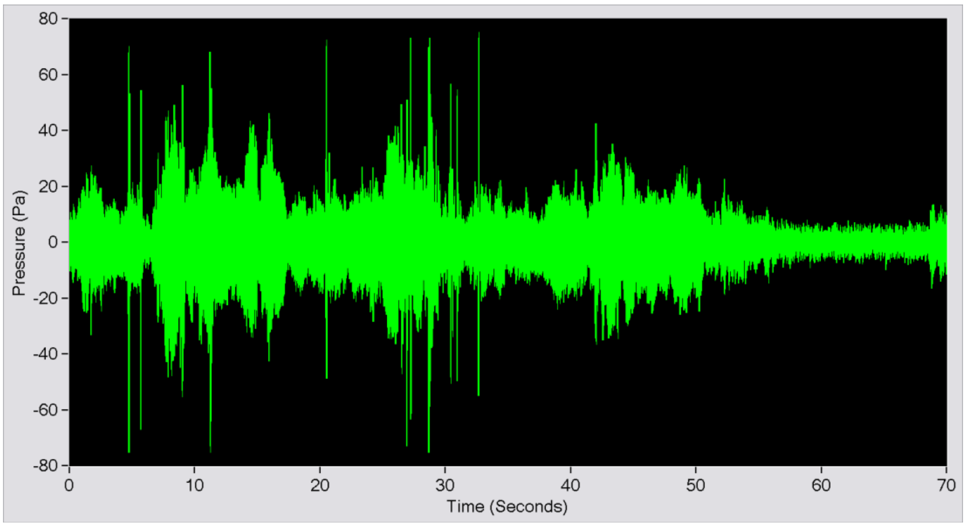

Figure 2-5 Pressure time history from backhoe dredging activity

Table 2-5 shows two reported underwater noise measurements of backhoe dredgers. Nedwell *et al.* (2009) reported that the dominant source of noise in measurements was due to the excavator bucket scraping along the bottom of the seabed. Reine *et al.* (2012) identified six distinct events that occur during a backhoe dredger operation which characterise sounds produced by the *New York* dredger whilst removing fractured limestone. Four of the events were linked to a single cycle of bucket deployment and retrieval which were bottom grab, barge loading, hydraulic ram noise and engine/generator noise. The two other events were associated with the manoeuvring of the dredge plant and with barge anchoring. SPL for the individual source levels of each event were calculated to be between 164 to 179 dB re 1 µPa at 1 m.

Table 2-4 Summary of reported underwater noise surveys of Backhoe Dredgers

Dredger	Specification	Date and Location	Sediment	Source Level	Transmission Loss Model	Author
Zenna	-	Broadhaven Bay, 2008	-	176 dB re 1 µPa @ 1 m	24 log(r)	Nedwell *et al*, 2009
New York	Overall length: 61 m Total power: 2,561 kW Bucket capacity: ~20 m^3	New York/New Jersey Harbour	Limestone	164 - 179 dB re 1 µPa @ 1 m	15 log(r)	Reine *et al*, 2012

2.5.3 Vessel movements

Vessels of all sizes from small speed boats to large super-tankers create underwater noise. Shipping noise is a significant contributor to the overall background levels in the sea and estuarine waters. Table 2-6 shows the range of vessels and their acoustic characteristics in terms of the dominant frequency ranges and source levels. The presented source levels are similar to those presented in the previous section for dredging. One important point to highlight is the transitory nature of underwater noise from passing vessels whereas a dredger will operate in a defined area, so the cumulative noise exposure in a fixed position will be greater than the exposure from a vessel passing by.

Table 2-5 Summary of reported underwater noise source levels and dominant frequency ranges for small, medium and large vessels (OSPAR 2009)

Category	Example Vessel Types	Dominant Frequency Range	Source Level
Small boats	Small leisure vessels, speed boats, work boats (<50 m)	100 – 1000 Hz	160 – 175 dB re 1 µPa @ 1 m
Medium-size ships	Tugboats, supply ships, research vessels (50 – 100 m length)	300 – 1000 Hz	165 - 180 dB re 1 µPa @ 1 m
Large vessels	Container and cargo ships, super-tankers (>100 m length)	50 – 300 Hz	180 - 190 dB re 1 µPa @ 1 m

3 Modelling results

3.1 Introduction

The modelling presented in this section provides the predicted broadband unweighted noise levels for the proposed impact piling operation and dredging activities. The modelling results have been presented as level versus range plots to illustrate the propagation of the noise over distance as well as contour plots showing, visually, the spatial impact of the noise.

The results of the baseline noise survey have been used as a reference for the operational noise impact assessment in Section 3.4, as the construction noise effect is temporary and, in particular with the impact piling, typically much higher than background noise.

3.2 Modelling of impact piling

Modelling unweighted noise levels has been undertaken, using the INSPIRE model, for the installation of contiguous steel piles for construction of the proposed port terminal by means of impact piling, using an impact piling hammer with energy of 125kJ for a 914mm diameter sized pile. An alternative construction option consists of a combi-piled wall with king piles linked with sheet piles. The king piles have been modelled based on a 2000mm diameter sized pile driven using a hammer with energy of 305kJ. Both sized piles have been modelled at two locations, at the extremities of the proposed port terminal, as previously discussed.

Table 3-1 gives a summary of the estimated ranges out to which certain unweighted levels of noise are expected to occur for the installation of a 914mm diameter pile. From this it can be seen that the propagation from the two modelled locations are similar until the sound drops below approximately 170dB re 1 µPa, where the bathymetry causes increased attenuation. Table 3-2 provides a summary of the estimated ranges for unweighted noise levels for the installation of a 2000mm pile.

It is also worth noting that in the case of both modelling locations, the minimum range reaches a limit (24m at the north location and 20m at the south location, indicated by the *). This is because this range is the shortest distance from the modelling location to the river bank, as illustrated in Figure 3-2 and Figure 3-3. Equally, the maximum range reaches a limit (2750m at the north location and 4900m at the south location, indicated by **) because the modelled sound reaches the river bank along the river.

Table 3-1 Summary of the modelled ranges for unweighted peak-to-peak SPL for impact piling operations for a 914mm diameter pile

Impact Piling (914 mm/125 kJ)	North Location			South Location		
	Maximum Range	Minimum Range	Mean Range	Maximum Range	Minimum Range	Mean Range
220 dB re 1 µPa	6 m	4 m	5 m	6 m	4 m	5 m
200 dB re 1 µPa	42 m	24 m*	37 m	54 m	20 m*	43 m
190 dB re 1 µPa	160 m	24 m*	94 m	210 m	20 m*	120 m
180 dB re 1 µPa	600 m	24 m*	280 m	760 m	20 m*	340 m
170 dB re 1 µPa	1930 m	24 m*	480 m	2400 m	20 m*	550 m
160 dB re 1 µPa	2750 m**	24 m*	510 m	4900 m**	20 m*	630 m

Table 3-2 Summary of the modelled ranges for unweighted peak-to-peak SPL for impact piling operations for a 2000 mm diameter pile

Impact Piling (2000 mm/305 kJ)	North Location			South Location		
	Maximum Range	**Minimum Range**	**Mean Range**	**Maximum Range**	**Minimum Range**	**Mean Range**
220 dB re 1 µPa	14 m	10 m	12 m	16 m	12 m	13 m
200 dB re 1 µPa	150 m	24 m*	88 m	190 m	20 m*	120 m
190 dB re 1 µPa	560 m	24 m*	260 m	700 m	20 m*	330 m
180 dB re 1 µPa	1800 m	24 m*	470 m	2300 m	20 m*	550 m
170 dB re 1 µPa	2750 m**	24 m*	500 m	4900 m**	20 m*	630 m
160 dB re 1 µPa	2750 m**	24 m*	510 m	4900 m**	20 m*	630 m

In order to show the modelled propagation of unweighted peak-to-peak SPLs from the impact piling of a 914mm diameter pile, three representative transects (with the following direction; South West 212°, West 272°, and North 350°) have been chosen to show propagation up and down the river as well as across the river to the opposite bank. Figure 3-1 presents the noise propagation for these three transects as a level versus range plot at the South location. From this figure it can be seen that the modelled transmission loss decays at a greater rate for the North 350° transect when compared to the South West 212° and South 272° transect. This is due to the more variable bathymetry along the route of the North 350° transect (which causes the transmission loss), in comparison with the relatively consistent bathymetry along the South West 212° and South 272° transects (illustrated previously in Figure 2-3 in Section 2.5). Contour plots are presented in Figure 3-2 and Figure 3-3 showing the ranges to which the specified levels have been reached for all 180 transects at the North and South location. Similarly, the same plots are shown for the modelled propagation of unweighted peak-to-peak SPLs from the impact piling of a 2000mm diameter pile in Figure 3-2 to Figure 3-6.

It should be noted that the predicted noise levels due to impact piling operations will exceed the background levels as previously measured by Subacoustech Environmental (Cheesman and Collett, 2014).

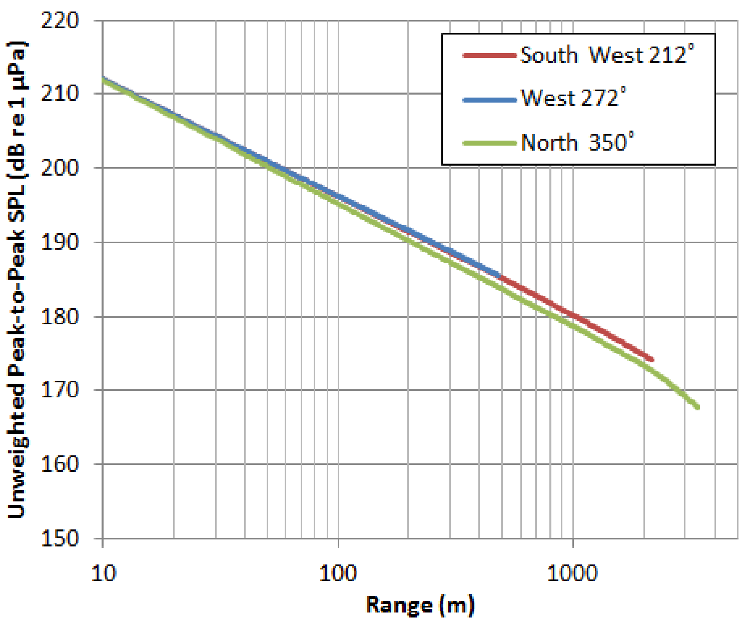

Figure 3-1 Level versus range plot showing the propagation of underwater noise across three transects from impact piling of a 914mm diameter pile using the INSPIRE model at the south location

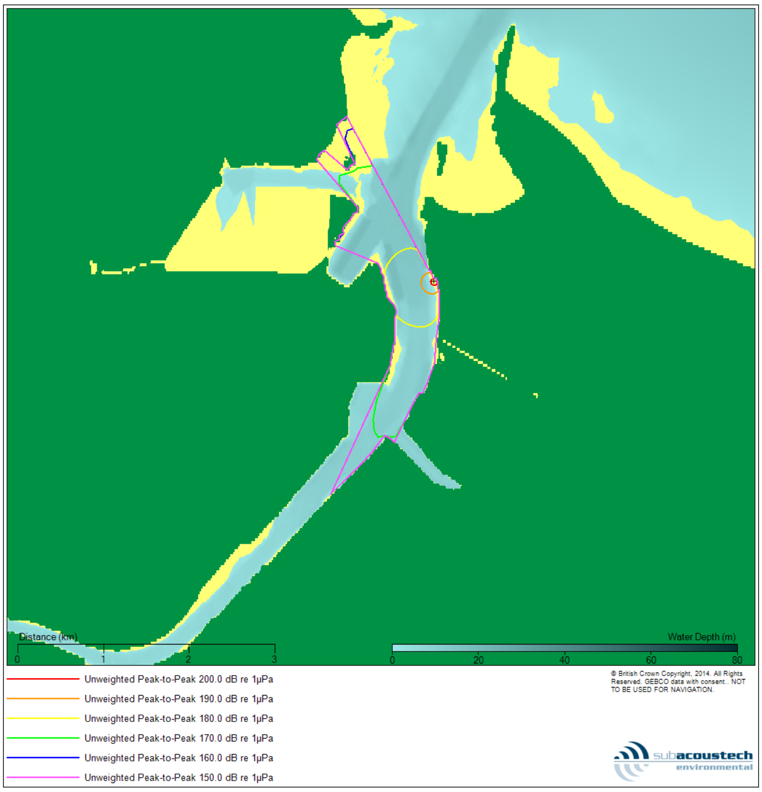

Figure 3-2 Contour plot showing the predicted unweighted peak-to-peak SPL from impact piling of a 914mm diameter pile at the north location

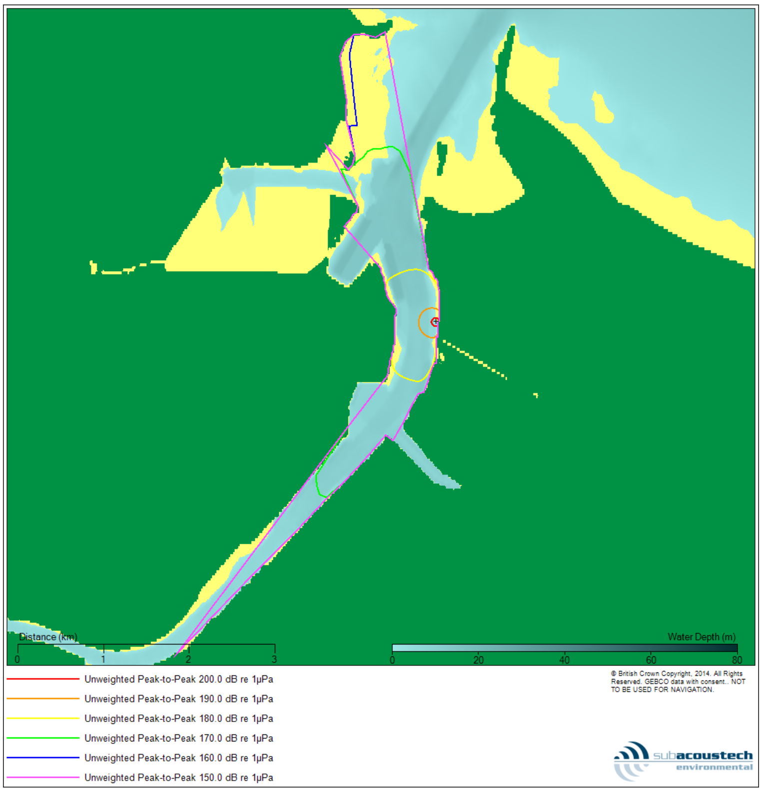

Figure 3-3 Contour plot showing the predicted unweighted peak-to-peak SPL from impact piling of a 914mm diameter pile at the south location

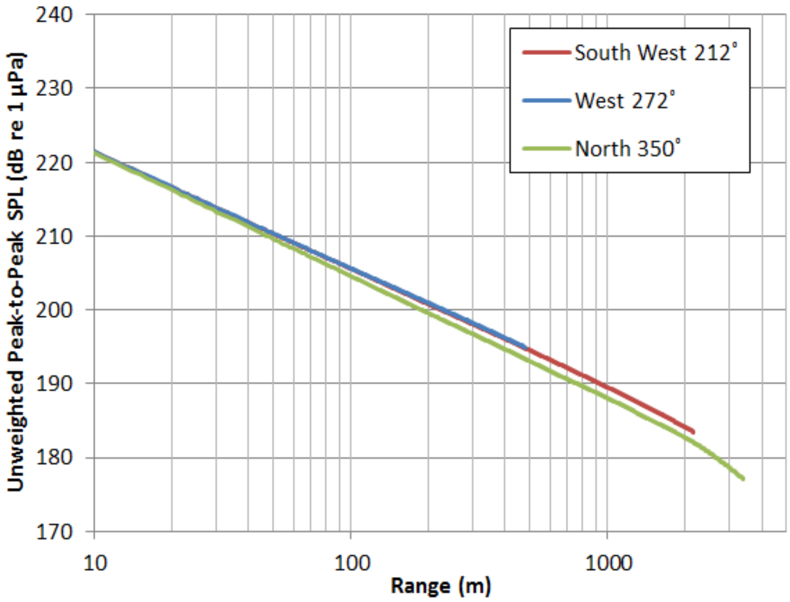

Figure 3-4 Level versus range plot showing the propagation of underwater noise across three transects from impact piling of a 2000mm diameter pile using the INSPIRE model at the south location

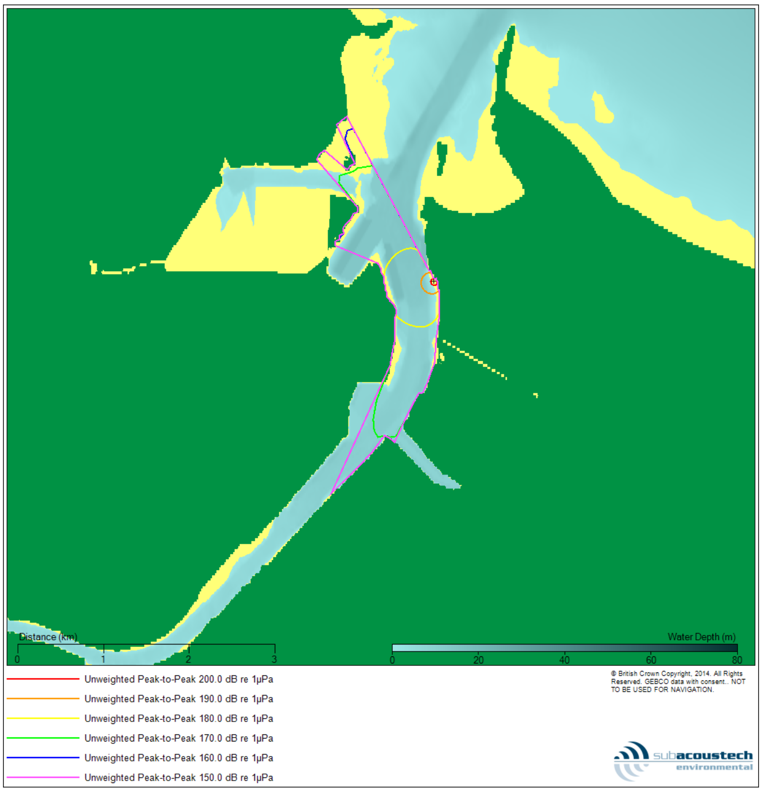

Figure 3-5 Contour plot showing the predicted unweighted peak-to-peak SPL from impact piling of a 2000mm diameter pile at the north location

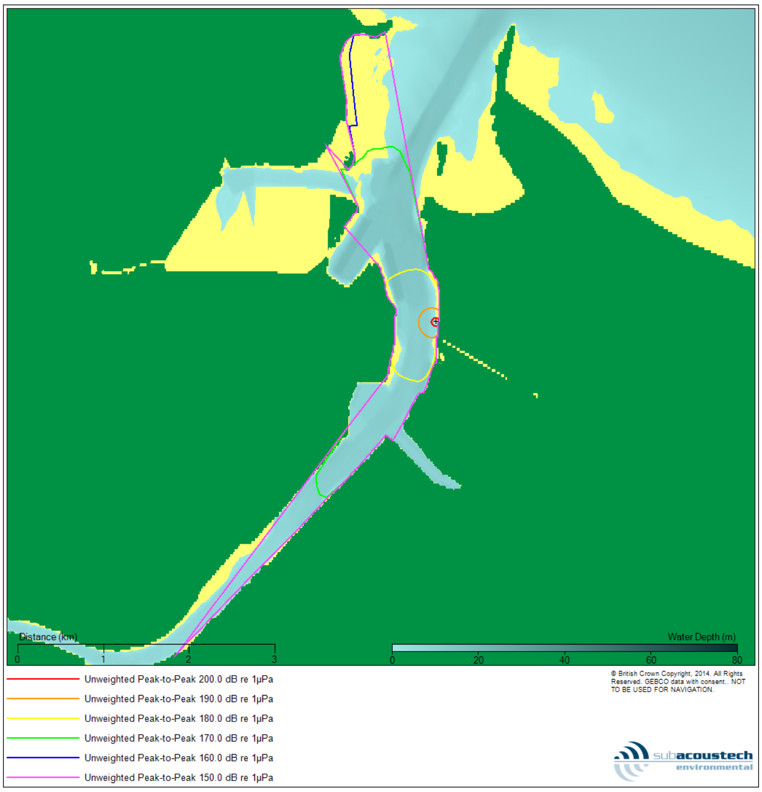

Figure 3-6 Contour plot showing the predicted unweighted peak-to-peak SPL from impact piling of a 2000mm diameter pile at the south location

3.3 Modelling of dredging noise

Modelling of unweighted noise levels has been carried out, using RAMSGeo, to estimate the RMS SPL from two different dredging operations; backhoe dredging and suction dredging. As previously discussed in Section 2.5, modelling has been undertaken along three transects at the south modelling location.

Table 3-3 summarises the estimated ranges out to which certain unweighted RMS SPLs are expected to occur, given as increments of 10dB. Ranges are presented for levels down to 110dB re 1 µPa, below average background levels as measured by Subacoustech Environmental (Cheesman and Collett, 2014). It can be seen that the unweighted RMS levels for suction dredging extend to a greater range compared to the predicted ranges for a backhoe dredger.

As with the impact piling results, the minimum range reaches a limit. Three representative transects have been modelled, and the limit is the river bank opposite as opposed to the near bank (which in this case is 485m along the West 272° transect, again indicated by the *).

Table 3-3 Summary of the modelled ranges for unweighted RMS sound pressure levels in 10 dB increments for dredging activities (ranges based on three transects)

	Backhoe Dredging			Suction Dredging		
	Maximum Range	**Minimum Range**	**Mean Range**	**Maximum Range**	**Minimum Range**	**Mean Range**
160 dB re 1 µPa	< 5 m	< 5 m	< 5 m	20 m	20 m	20 m
150 dB re 1 µPa	10 m	10 m	10 m	95 m	75 m	88 m
140 dB re 1 µPa	30 m	25 m	28 m	475 m	335 m	423 m
130 dB re 1 µPa	105 m	65 m	92 m	2140 m	485 m*	1310 m
120 dB re 1 µPa	480 m	275 m	400 m	2460 m	485 m*	1700 m
110 dB re 1 µPa	1860 m	485 m*	1090 m	2920 m	485 m*	1860 m

Figure 3-7 and Figure 3-8 present the noise propagation results for the three modelled transects, from a backhoe dredger and a suction dredger, as level versus range plots. These figures show the modelled transmission loss decays at a greater rate for the North 350° transect, similar to the INSPIRE modelled impact piling transects.

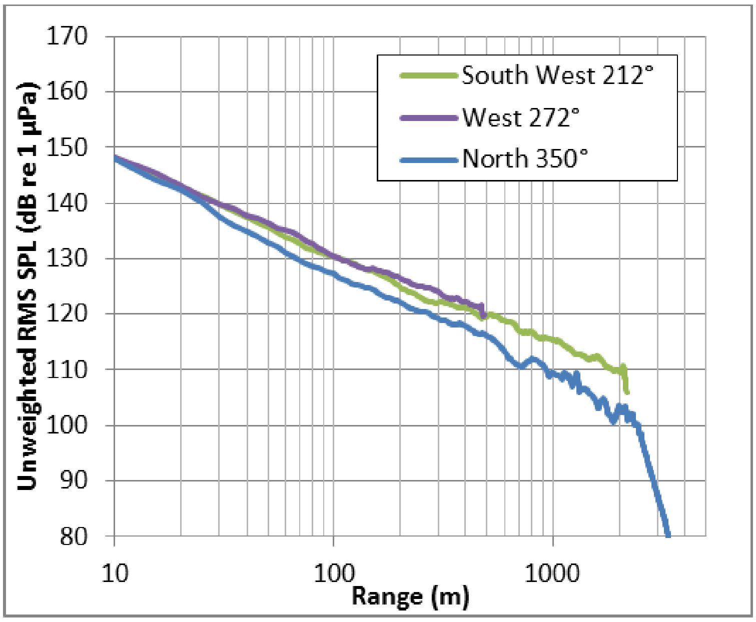

Figure 3-7 Level versus range plot showing the predicted propagation of underwater noise across three transects from a backhoe dredger using the RAMSGeo model

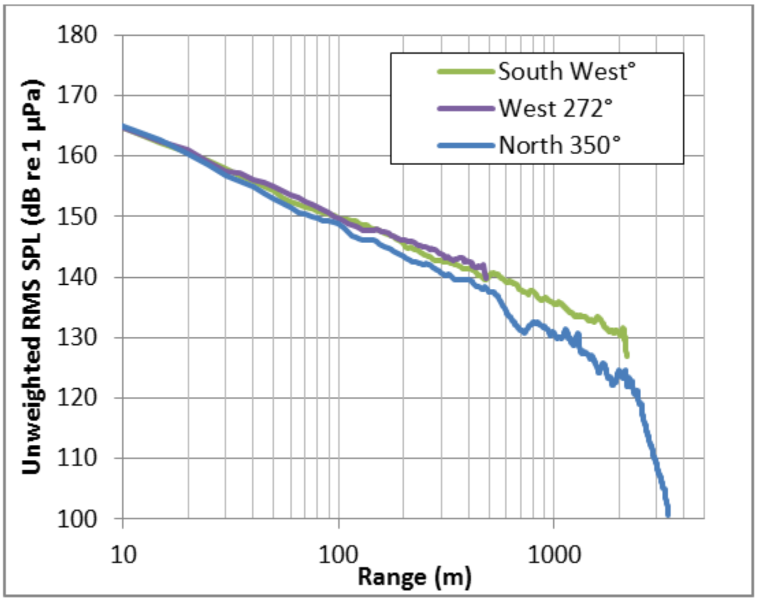

Figure 3-8 Level versus range plot showing the predicted propagation of underwater noise across three transects from a suction dredger using the RAMSGeo model

3.4 Operational phase – Vessel movement noise

The subsea noise baseline survey undertaken by Subacoustech Environmental in April 2014 (Cheesman and Collett, 2014) consisted of measurements of background noise in the River Tees and estuary. Measurements over the first day of the survey ranged from 96.6 to 133.0 dB re 1 µPa with an average of 118.0 dB re 1 µPa. On the second day the noise levels ranged between 105.0 and 142.3 dB re 1 µPa with an average of 118.9 dB re 1 µPa. The higher levels were recorded due to underwater noise from passing and moored vessels.

Table 3-4 provides a summary of the overall number of vessel movements in the River Tees on a monthly basis from January to September 2013. Table 3-5 presents a summary of the expected number of vessel movements during the operational phase of the proposed scheme per year. Based on the greatest number of expected vessel movements of 191 per year (during Phase 2 of the proposed scheme), the overall increase would be less than 1.8 % per year or one vessel movement every two days. Therefore, the increase in average noise levels during the operational phase from increased vessel movements would be minimal.

Table 3-4 Data of vessel movements per month recorded for January to September of 2013 in the River Tees (data provided by Tees Estuary Harbour Master)

Month	Vessel movements
January	824
February	808
March	981
April	922
May	1009
June	871
July	899
August	867
September	869
Monthly Average	**894**

Table 3-5 Summary of the expected number of vessels, dependent on load capacity, that are expected to arrive into the port during operational phase 1 and 2 (data provided by Haskoning DHV UK Ltd)

Vessel size (Dead weight tonnage, DWT)	Vessel numbers anticipated in Phase 1 (per year)	Vessel numbers anticipated in Phase 2 (per year)
55,000	30	59
65,000	25	50
75,000	22	44
85,000	19	38

4 Modelling confidence

4.1 Summary

In order to provide confidence in the accuracy of INSPIRE model, comparisons have been made between the outputs from the model (Section 3), measured data from similar operations elsewhere within the UK and data calculated using RAMSGeo. RAMSGeo is also compared to measured data to demonstrate its proficiency.

Both comparisons show good agreement and indicate a high degree of confidence in the INSPIRE vs RAMSGeo modelling (see Sections 4.2 and 4.3 for details).

4.2 Comparison with measured data

To compare the modelled results against measured data, they have been run retrospectively against a similar impact piling project undertaken in the River Thames, for which measurements have been taken. By plotting the estimated propagation from the models with the measured data points from the survey, the accuracy of the model can be attained.

Figure 4-1 shows the estimated noise level with range for INSPIRE and RAMSGeo models, plotted against unweighted peak-to-peak levels from actual measurements. The piles driven were 762mm in diameter with a blow energy of 126kJ. The source level of the measurements has been extrapolated to be 230dB re 1 µPa @ 1 m. Based on modelled parameters for the River Thames, both models show good agreement with the measured data. It should be noted that the measurements beyond 1km were taken following the bend in the river whereas the models use the bathymetry for a straight line. Hence the sound propagation is modelled to the point at which the river bank is reached, which is a distance of approximately 1km.

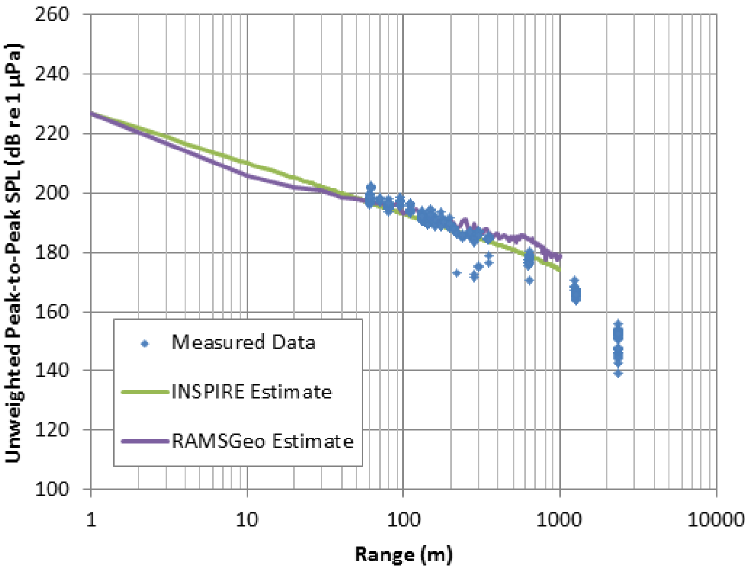

Figure 4-1 Comparison between measured data and an estimate using INSPIRE and RAMSGeo models for impact piling noise propagation in the River Thames

4.3 Comparison of INSPIRE and RAMSGeo models

Two transects using parameters from the River Tees have been chosen to compare the modelled outputs from the INSPIRE and RAMSGeo models with regard to impact piling. The modelled outputs for each transect are presented in Figure 4-2. Again, both plots indicate good agreement between the two models up to a distance of approximately 3 to 4 km from the noise source.

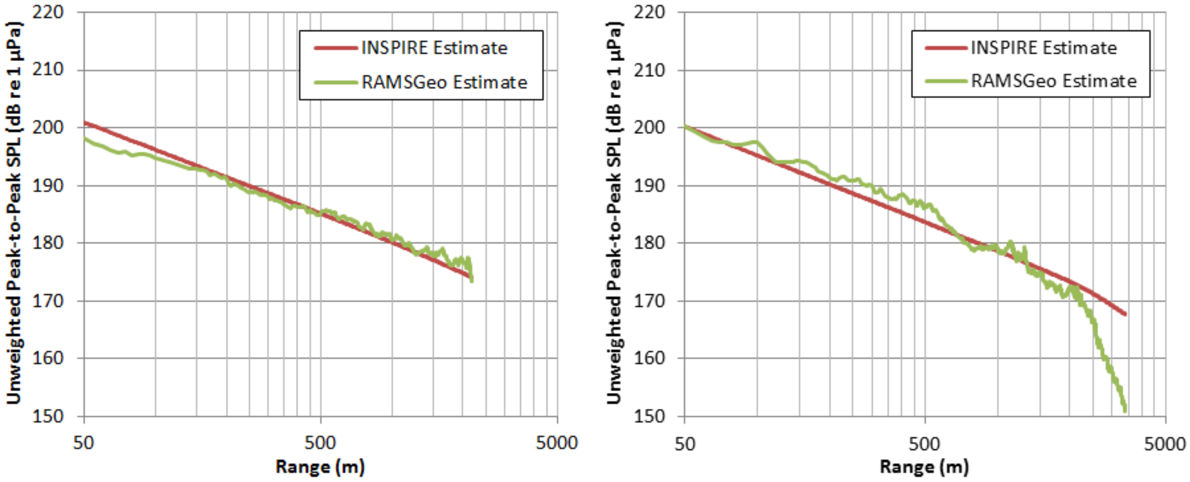

Figure 4-2 Comparison between INSPIRE and RAMSGeo modelling of an impact piling operation along the South West 212° transect (left) and the North 350° transect (right)

5 Analysis of environmental effects

5.1 Background

Over the past 20 years it has become increasingly evident that noise from human activities in and around underwater environments may have an impact on the marine species in the area. The extent to which intense underwater sound might cause an adverse environmental impact in a particular species is dependent upon the incident sound level, frequency, duration and/or repetition rate of the sound wave (see, for example, Hastings and Popper, 2005). As a result, scientific interest in the hearing abilities of aquatic animal species has increased. These studies are generally based on evidence from high level sources of underwater noise such as blasting or impact piling, as these sources are likely to have the greatest environmental impact and therefore the clearest observable effects. In the absence of direct evidence from other sources these reviews have been used to inform assessments of lower level underwater noise sources such as dredging.

The impacts of underwater sound can be broadly summarised into three categories:

- physical traumatic injury and fatality;
- auditory damage (either permanent or temporary); and
- behavioural avoidance.

The criteria used in this study to determine physical injury or fatality have been discussed in section proposed by Parvin *et al* (2007).

Parvin *et al* (2007) suggests that for continuous sound, direct injury to gas-containing structures or auditory mechanisms may occur at lower incident sound levels depending on duration and frequency content of the noise. Several studies have been carried out relating to the onset of auditory damage in terms of Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) (see, for example, Nedwell *et al* (2007) and Southall *et al* (2007) for a review of these studies).

At levels lower than those that cause auditory injury, noise may nevertheless have important behavioural effects on a species, of which the most significant is avoidance of the insonified area (the region within which noise from the source is above ambient underwater noise levels). The significance of the effect requires an understanding of its consequences; for instance, avoidance may be significant if it causes a migratory species to be delayed or diverted. However, in other cases, the movement of species from one area to another may be of no consequence.

5.2 Species of concern

Several species of fish and marine mammal have been identified as being of importance in the areas in and around the Tees River and Estuary.

The species of fish considered in this study are:

- Dab (*Limanda limanda*), a flatfish. Based on current peer reviewed audiogram data (Chapman and Sand, 1974), dab is the most sensitive flatfish to under water sound. Hence, dab has been used as a surrogate for other flatfish (e.g. flounder and plaice) and where quality audiogram data is not available. In this study the dab audiogram has also been used as a surrogate for European eel, due to a similar frequency response (Jerkø *et al*, 1989).
- Herring (*Clupea harengus*), a fish very sensitive to sound pressure. Based on peer reviewed audiogram data (Enger and Andersen, 1967), herring is the most sensitive marine fish to underwater sound. Herring has also been used as a surrogate for sprat as they are also a clupeiform fish.

- Salmon (*Salmo salar*), a fish which possesses a substantial swim bladder but, as it is not in close proximity to the inner ear, salmon are therefore less sensitive to underwater nosie and vibration. In this study audiogram data from Hawkins and Johnstone (1978) have been used.
- Sandeels or sand lances (*Ammodytes tobianus*) lack a swim bladder and generally have poor sensitivity to sound (Suga *et al*, 2005) relative to other species included in this report. They are capable of hearing low frequencies typically less than about 500 Hz.
- Sea trout (*Salmo trutta*) are considered to have a low sensitivity to sound (Nedwell *et al*, 2006).

The species of marine mammal considered in this study are:

- Harbour (common) seal (*Phoca vitulina*), a pinniped that, based on current peer reviewed audiogram data (Møhl, 1968; Kastak and Schusterman, 1998), is the most sensitive seal species to underwater sound and may be representative of other marine mammals that are sensitive to mid-frequency underwater sound (up to 75 kHz). Harbour seal will also be used as a surrogate for grey seal as the audiogram data available from Ridgway and Joyce (1975) do not provide hearing sensitivities for frequencies below 1 kHz. However, the audiogram is similar to Møhl's harbour seal audiogram and hence it has been used as a surrogate.

5.3 Criteria to be used

In order to assess the environmental effects that impact piling and dredging activities are likely to have, the following noise metrics have been used with regards to the impact on the marine species listed in Section 5.2. These noise metrics include unweighted metrics (Parvin *et al*, 2007), the dB_{ht}(*Species*) (Nedwell *et al*, 2007), and M-Weighted SELs (Southall *et al*, 2007).

5.3.1 Unweighted metrics

The data currently available relating to the levels of underwater noise likely to cause physical injury or fatality are primarily based on studies of blast injury at close range to explosives with an additional small amount of information on fish kill as a result of impact piling. All the data concentrates on impulse underwater noise sources as other sources of noise are rarely of a sufficient level to cause these effects.

Parvin *et al* (2007) present a comprehensive review of information on lethal and physical impacts of underwater noise on marine receptors previously studied and propose the following criteria to assess the likelihood of these effects occurring:

- lethal effect may occur where peak noise levels exceed 240 dB re 1 µPa; and,
- physical injury may occur where peak noise levels exceed 220 dB re 1 µPa.

Additional criteria have also been considered for assessing the impact of noise on fish injury, based on the work of the Fisheries Hydroacoustic Working Group (FHWG) in the USA. FHWG (2008) assigns criteria based on unweighted noise levels. This includes a peak SPL of 206 dB re 1 µPa (SPL_{peak}) and an accumulated SEL over a period of time of 187 dB re 1 µPa^{2}s. It should be noted that these are generic criteria which make no distinction between individual species.

Other assessments have used data from McCauley *et al* (2000), which investigated the reactions of caged Australian species of fish to seismic airgun blasts to set the criteria, but the applicability of these results to the reality of reactions by wild fish exposed to piling in UK waters is very questionable. However, this paper provides the following values:

- Possible moderate to strong avoidance: 168 – 173 dB SPL_{peak} re 1 µPa.

- Startle response or C-turn reaction: 200 dB SPL_{peak} re 1 µPa.

The 200 dB SPL_{peak} re 1 µPa figure will be referred to in the results, but appropriate cautions should be exercised with drawing any conclusions.

5.3.2 The dB_{ht}(*Species*)

Unweighted noise metrics do not provide an indication of the impact that the sound will have upon a particular fish or marine mammal species. This is of fundamental importance when considering the behavioural impact of aquatic life to underwater sound, as this is associated with the perceived loudness of the sound by the species. Therefore, the same underwater sound will affect marine species in a different manner depending upon the hearing sensitivity of that species.

The dB_{ht}(*Species*) metric (Nedwell *et al,* 2007) incorporates this concept of "loudness" for a species. The metric is built around a species' hearing ability by referencing the sound to the species' hearing threshold, and hence evaluates the level of sound a species can perceive.

Since any given sound will be perceived differently by different species (as they have differing hearing abilities) the species name must be appended when specifying a level. For instance, the same sound might have a level of 70 dB_{ht}(*Gadus morhua*) for cod and 40 dB_{ht}(*Salmo salar*) for salmon.

The perceived noise levels of source measured in dB_{ht}(*Species*) are usually much lower than the unweighted levels because the sound will contain frequency components that the species cannot detect.

The species upon which the dB_{ht}(*Species*) analysis has been conducted in this study have been selected based upon regional significance and also, crucially, upon the availability of a good quality, peer-reviewed audiogram. The audiograms used in this study for the species listed in Section 5.2 are shown in Figure 5-1 and Figure 5-2.

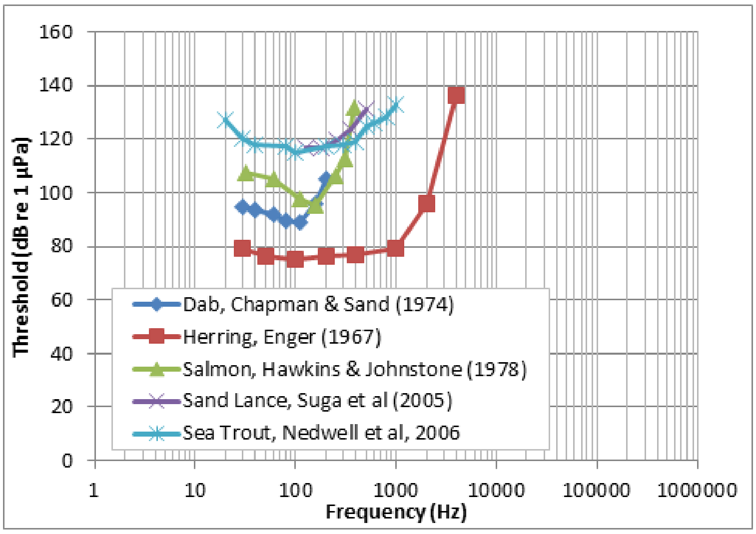

Figure 5-1 Comparison of hearing thresholds for species of fish

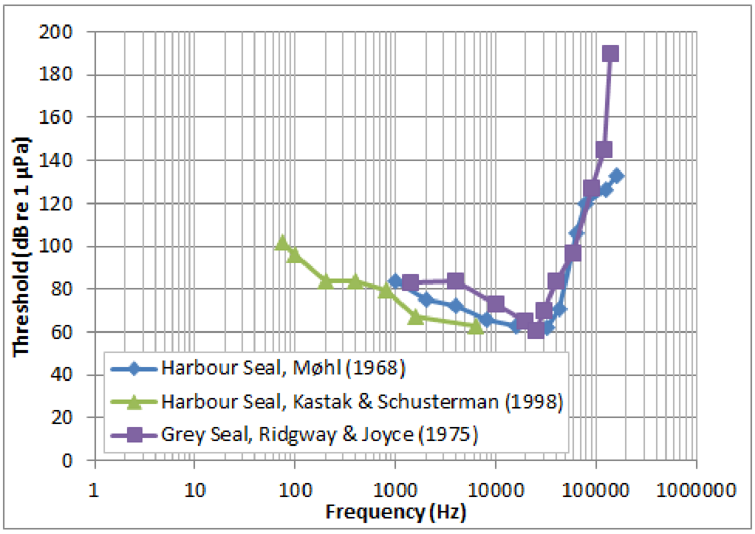

Figure 5-2 Comparison of hearing thresholds for species of marine mammal

Based on a large body of measurements of fish avoidance to noise (Maes *et al*, 2004), and from re-analysis of marine mammal behavioural response to underwater sound using the dB_{ht}(*Species*) metric, the following assessment criteria (Table 5-1) were published by the Department of Business, Enterprise and Regulatory Reform (BERR) (Nedwell *et al*, 2007) to assess the potential impact of underwater noise to marine species. In essence, Nedwell *et al* (2007) suggests the use of criteria which follow a similar approach as used to assess human response to noise (e.g. the dB(A)).

Table 5-1 Assessment criteria used in this study to assess the potential impact of underwater noise on marine species

Level in dB_{ht}(*Species*)	**Effect**
Above 130	Possibilty of traumatic hearing damage from a single event
90 and above	Strong avoidance reaction be virtually all individuals
75 and above	Some avoidance reaction by the majority of individuals, but habituation or context may limit effect.*
*In the presence of another biological imperative (such as migration to breeding or feeding grounds or avoiding a predator) individuals may not exhibit any behavioural reaction to the noise source.	

5.3.3 M-Weighted SELs

Southall *et al* (2007) presents a set of interim criteria for the levels of underwater noise that may lead to auditory injury in marine mammals based on M-Weighted SELs and peak SPLs. These criteria are presented in Table 5-2. Instead of using species specific audiograms to determine hearing sensitivity in marine mammals (as is the case of the dB_{ht}(*Species*)), the criteria proposed by Southall *et* al (2007) groups marine mammals into four main "M-Weighting" groups. These groups are low, mid and high frequency cetaceans and pinnipeds (in water).

Table 5-2 Proposed injury criteria for various marine mammal groups (after Southall, et al, 2007)

Marine mammal group	Sound type		
	Single pulse	Multiple pulses	Non-pulses
Low, Mid, and High Frequency Cetaceans			
Sound Pressure Level	230 dB re. 1 µPa (peak)	230 dB re. 1 µPa (peak)	230 dB re. 1 µPa (peak)
Sound Exposure Level	198 dB re. 1 μPa^2s (M)	198 dB re. 1 μPa^2s (M)	215 dB re. 1 μPa^2s (M)
Pinnipeds (in water)			
Sound Pressure Level	218 dB re. 1 µPa (peak)	218 dB re. 1 µPa (peak)	218 dB re. 1 µPa (peak)
Sound Exposure Level	186 dB re. 1 μPa^2s (M_{pw})	186 dB re. 1 μPa^2s (M_{pw})	203 dB re. 1 μPa^2s (M_{pw})

In order to obtain the weighted sound levels the data are first filtered using the proposed filter responses presented in Southall *et al* (2007), then the sound exposure level is calculated. Table 5-3 presents a summary of the various marine mammal groups, the suggested frequency range of hearing of each, and example species.

In this study only pinnipeds (in water) have been considered, as only harbour and grey seal have been identified as marine mammals of importance at the site.

Table 5-3 Functional marine mammal groups, their assumed auditory bandwidth of hearing, and genera presented in each group (reproduced from Southall et al, 2007)

Functional hearing group	Estimated auditory bandwidth	Genera represented	Expample species
Low frequency cetaceans	7 Hz to 22 kHz	Balaena, Caperea, Eschrichtius, Megaptera, Balaenoptera (13 species/subspecies)	Grey whale, right whale, humpback whale, minke whale
Mid frequency cetaceans	150 Hz to 160 kHz	Steno, Sousa, Sotalia, Tursiops, Stenella, Delphinus, Lagenodelphis, Lagenorhynchus, Lissodelphis, Grampus, Peponocephala, Feresa, Pseudorca, Orcinus, Globicephala, Orcaella, Physeter, Delphinapterus, Monodon, Ziphius, Berardius, Tasmacetus, Hyperoodon, Mesoplodon (57 species/subspecies)	Bottlenose dolphin, striped dolphin, killer whale, sperm whale
High frequency cetaceans	200 Hz to 180 kHz	Phocoena, Neophocaena, Phocoenoides, Platanista, Inia, Kogia, Lipotes, Pontoporia, Cephalorhynchus (20 species/subspecies)	Harbour porpoise, river dolphins, Hector's dolphin
Pinnipeds (in water)	75 Hz to 75 kHz	Arctocephalus, Callorhinus, Zalophus, Eumetopias, Neophoca, Phocarctos, Otaria, Erignathus, Phoca, Pusa, Halichoerus, Histriophoca, Pagophilus, Cystophora, Monachus, Mirounga, Leptonychotes, Ommatophoca, Lobodon, Hydrurga, and Odobenus (41 species/subspecies)	Fur seal, harbour (common) seal, grey seal

Southall *et al* (2007) also discuss the levels of underwater noise that may cause a behavioural avoidance response in marine species. The study concludes that the currently available evidence does not support the development of specific numeric criteria for the levels of underwater noise likely to cause a behavioural avoidance response. Instead, a severity scale is developed to rank the effects of a source of underwater noise in terms of the observable behavioural response. The findings of this study are used as the basis for the Joint Nature Conservation Committee (JNCC) guidance document on the deliberate disturbance of marine mammals (JNCC, 2009). In the document the various severity ratings are summarised as “relatively minor and/or brief, score 0-3; with higher potential to affect feeding, reproduction, or survival, score 4-6; and considered likely to affect these life functions, score 7-9”. It is also noted that the timescales over which a noisy activity may occur may be of significance. If an avoidance reaction lasts for less than 24 hours and does not occur again in subsequent days, it may not be considered to have caused a significant avoidance response, whereas an activity causing an avoidance response over a longer period would. Generally the guidance indicates that there is a greater risk of a disturbance offence being committed if the observable effect ranks as 5 or above on the Southall *et al* (2007) severity scale.

Whereas this is useful in the context of observing behavioural response in marine species during an activity, it is difficult to quantify the potential for a behavioural avoidance response to occur in a predictive exercise such as this study.

6 Interpretation of results

6.1 Introduction

The following sections discuss the modelling results (Section 3) in terms of noise metrics. This discussion will help guide the assessment of environmental impact to marine species from impact piling and dredging related noise.

6.2 Unweighted metrics

The Source Level for the noise from impact piling operations of a 914mm diameter pile, using a hammer with a maximum blow energy of 125kJ, was estimated to be 223.5 dB re 1 µPa @ 1 m (SPL_{peak}). The Source Level for the impact piling of a 2000 mm diameter pile, using a maximum blow energy of 305kJ, was estimated to be 232.8 dB re 1 µPa @ 1 m (SPL_{peak}). The estimated source levels for both pile diameters exceed the 220 dB re 1 µPa (SPL_{peak}) criteria for physical injury (Parvin *et al*, 2007). The 240 dB re 1 µPa (SPL_{peak}) criteria for lethal effect is not predicted to be reached for the proposed impact piling operations. Table 6-1 and Table 6-2 present a summary of impact ranges to which various unweighted criteria are estimated to extend. The maximum range to which 220 dB re 1 µPa (SPL_{peak}) extends, indicating physical injury, is 4 m for the 914mm pile and 8m for the 2000mm pile. The 206 dB re 1 µPa (SPL_{peak}) criteria for fish injury (FHWG, 2008) is predicted to be a maximum of 10m for 914mm pile and 36m for 2000mm pile. The maximum impact range for the 200 dB re 1 µPa (SPL_{peak}) criteria, where startle reactions in fish have been observed by McCauley *et al,* 2000, is predicted to extend to 22m for 914mm pile and 84m for 2000mm pile.

Table 6-1 Summary of the modelled ranges for unweighted peak sound pressure levels for impact piling operations of a 914mm diameter pile

Criteria and Effect (914 mm/125 kJ)	**Species**	**Max Range**	**Min Range**	**Mean Range**
220 dB re 1 µPa **(**SPL_{peak}**)** (Physical injury)	All	4m	2m	3m
206 dB re 1 µPa **(**SPL_{peak}**)** (Physical injury)	Fish	10m	8m	9m
200 dB re 1 µPa **(**SPL_{peak}**)** (Behavioral effect)	Fish	22m	18m	20m

Table 6-2 Summary of the modelled ranges for unweighted peak sound pressure levels for impact piling operations of a 2000mm diameter pile

Criteria and Effect (2000 mm/305 kJ)	**Species**	**Max Range**	**Min Range**	**Mean Range**
220 dB re 1 µPa **(**SPL_{peak}**)** (Physical injury)	All	8 m	6 m	7 m
206 dB re 1 µPa **(**SPL_{peak}**)** (Physical injury)	Fish	36 m	20 m*	28 m
200 dB re 1 µPa **(**SPL_{peak}**)** (Behavioral effect)	Fish	84 m	20 m*	61 m

The source levels for the noise from dredging operations, using a backhoe dredger was estimated to be 165 dB re 1 µPa @ 1 m (SPL_{RMS}) and for a suction dredger was estimated to be 183 dB re 1 µPa @ 1 m (SPL_{RMS}). These source levels are all below the criteria discussed above in relation to impact piling.

6.3 The dB_{ht}(*Species*)

6.3.1 Auditory injury

The 130 dB_{ht}(*Species*) perceived level is used to indicate traumatic hearing damage over a very short exposure time. Table 6-3 shows the ranges to which traumatic hearing damage may occur. Herring and harbour seal are seen to have the greatest ranges for 130 dB_{ht} which are seen to extend to a maximum of 18m and 34m for the 914mm pile and for the 2000mm pile a maximum range of 56m and 62m, respectively. The dB_{ht} source levels for the other species are not estimated to exceed the 130 dB_{ht} criteria.

The modelled dB_{ht}(*Species*) sound propagation for backhoe and suction dredging are not estimated to reach the level at which traumatic hearing damage is likely to occur for any species.

Table 6-3 Summary of the modelled ranges for 130 dB_{ht}(Species) levels for impact piling operations

130 dB_{ht}(*Species*)		**Impact Piling (914 mm/125 kJ)**		**Impact Piling (2000 mm/305 kJ)**	
		North Position	**South Position**	**North Position**	**South Position**
Dab	**Max**	< 2m	< 2m	6m	6m
	Min	< 2m	< 2m	4m	4m
	Mean	< 2m	< 2m	5m	5m
Herring	**Max**	16m	18m	46m	56m
	Min	14m	14m	24m	20m
	Mean	15m	17m	41m	45m
Salmon	**Max**	< 2m	< 2m	4m	4m
	Min	< 2m	< 2m	2m	2m
	Mean	< 2m	< 2m	3m	3m
Sand Lance	**Max**	< 2m	< 2m	< 2m	< 2m
	Min	< 2m	< 2m	< 2m	< 2m
	Mean	< 2m	< 2m	< 2m	< 2m
Sea Trout	**Max**	< 2m	< 2m	< 2m	< 2m
	Min	< 2m	< 2m	< 2m	< 2m
	Mean	< 2m	< 2m	< 2m	< 2m
Harbour Seal	**Max**	32m	34m	56m	62m
	Min	24m	20m	24m	20m
	Mean	29m	30m	47m	50m

6.3.2 Behavioural response: impact piling

Table 6-4 and Table 6-5 present a comparison of estimated 90 and 75 dB_{ht}(*Species*) impact ranges for behavioural response for the species of interest from impact piling operations. Maximum, minimum and mean ranges are presented for both North and South modelling positions.

As seen with the unweighted levels presented in Section 3-2, the minimum range reaches a limit (24 m at the North position and 20m at the South position, indicated by the *). From Table 6-4 it can be seen that the estimated impact ranges from impact piling a 914mm diameter pile are expected to be less than 400m for dab, salmon, sand lance and sea trout.

Table 6-5 shows that for the impact piling of a 2000mm diameter pile, the estimated impact ranges are seen to reach a maximum of 2.89km for dab and 1.80km for salmon with the maximum ranges for sand lance and sea trout not exceeding 250m. The largest impact ranges are predicted for herring and harbour seal of 4.89km, where 75 dB_{ht} impact ranges extend to the river bank for all 180 modelled transects (where the limit was reached for all transects is indicated by ** next to the maximum range).

Figure 6-1 to Figure 6-12 present the ranges in Table 6-4 and Table 6-5 in the form of contour maps. It can be seen that the impact ranges for the South position are greater for all species. Figure 6-2, Figure 6-6**,** Figure 6-8 and Figure 6-12 again show that the impact ranges for herring and harbour seal are the greatest. Note that the 130 dB_{ht}(*Species*) contours are not visible at the scale on these figures because they cover a very small area.

Table 6-4 Summary of the modelled ranges for 90 and 75 dB_{ht}(Species) levels for impact piling of a 914mm diameter pile (see previous section for explanation of * and **)

Impact Piling (914 mm/125 kJ)		North Position		South Position	
		90 dB_{ht}(*Species*)	**75 dB_{ht}(*Species*)**	**90 dB_{ht}(*Species*)**	**75 dB_{ht}(*Species*)**
Dab	**Max**	36m	220m	40m	260m
	Min	24m*	24m*	20m*	20m*
	Mean	32m	124m	34m	150m
Herring	**Max**	1.95km	2.75km**	2.37km	4.89km**
	Min	24m*	24m*	20m*	20m*
	Mean	480m	510m	550m	630m
Salmon	**Max**	40m	270m	54m	390m
	Min	24m*	24m*	20m*	20m*
	Mean	35m	140m	42m	210m
Sand Lance	**Max**	12m	60m	14m	80m
	Min	10m	24m*	10m	20m*
	Mean	11m	49m	11m	58m
Sea Trout	**Max**	14m	72m	16m	90m
	Min	12m	24m*	14m	20m*
	Mean	13m	55m	15m	65m
Harbour Seal	**Max**	2.50km	2.75km**	3.01km	4.89km
	Min	24m*	24m*	20m*	20m*
	Mean	500m	510m	580m	630m

Table 6-5 Summary of the modelled ranges for 90 and 75 dB_{ht}(Species) levels for impact piling of a 2000 mm diameter pile (see previous section for explanation of * and **)

Impact Piling (2000 mm/305 kJ)		**North Position**		**South Position**	
		90 dB_{ht}(*Species*)	**75 dB_{ht}(*Species*)**	**90 dB_{ht}(*Species*)**	**75 dB_{ht}(*Species*)**
Dab	**Max**	460 m	2.30 km	520 m	2.89 km
	Min	24 m*	24 m*	20 m*	20 m*
	Mean	220 m	500 m	280 m	580 m
Herring	**Max**	2.75 km**	2.75 km**	4.89 km**	4.89 km**
	Min	24 m*	24 m*	20 m*	20 m*
	Mean	510 m	510 m	630 m	630 m
Salmon	**Max**	200 m	1.23 km	290 m	1.80 km
	Min	24 m*	24 m*	20 m*	20 m*
	Mean	110 m	410 m	160 m	500 m
Sand Lance	**Max**	26 m	180 m	32 m	240 m
	Min	22 m	24 m*	20 m*	20 m*
	Mean	24 m	100 m	28 m	140 m
Sea Trout	**Max**	46 m	290 m	56 m	360 m
	Min	24 m*	24 m*	20 m*	20 m*
	Mean	40 m	150 m	44 m	200 m
Harbour Seal	**Max**	2.75 km**	2.75 km**	4.47 km	4.89 km**
	Min	24 m*	24 m*	20 m*	20 m*
	Mean	510 m	510 m	620 m	630 m

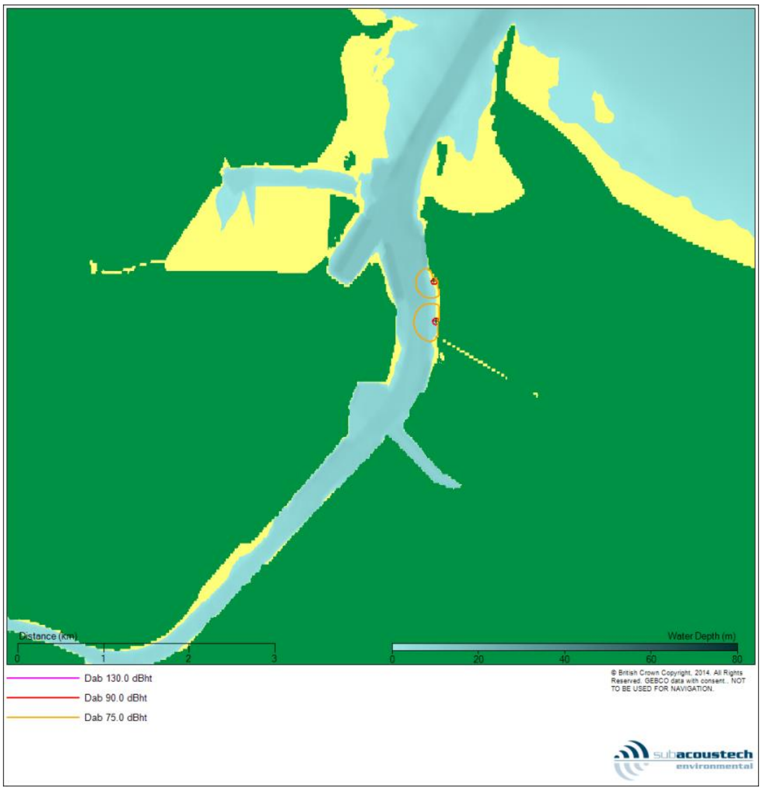

Figure 6-1 Contour plot showing the predicted 90 and 75 dB$_{ht}$ levels for dab for impact piling operations using 914mm diameter pile and blow energy of 125 kJ

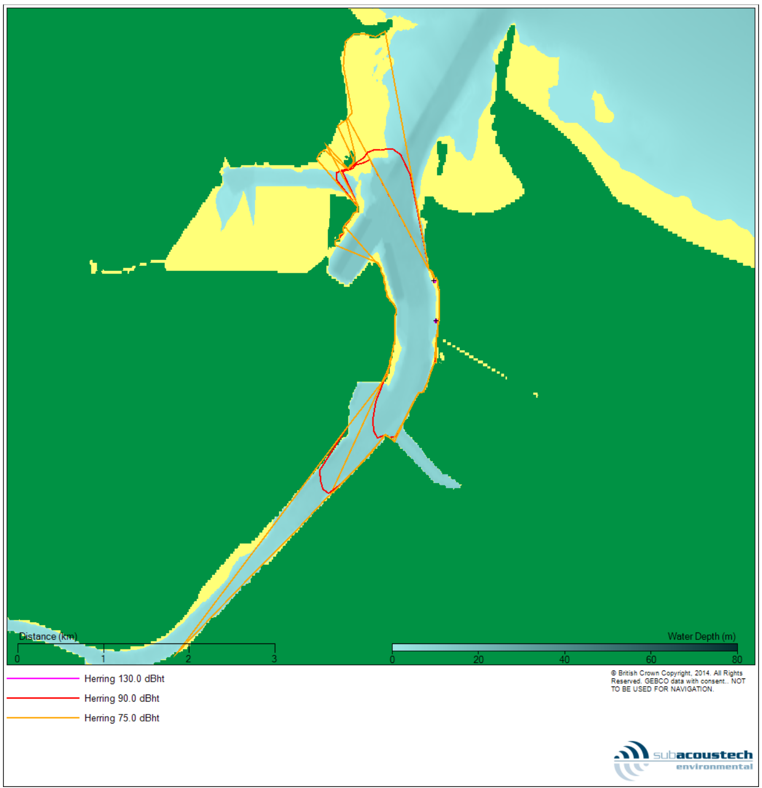

Figure 6-2 Contour plot showing the predicted 130, 90 and 75 dB$_{ht}$ levels for herring for impact piling operations using 914mm diameter pile and blow energy of 125 kJ

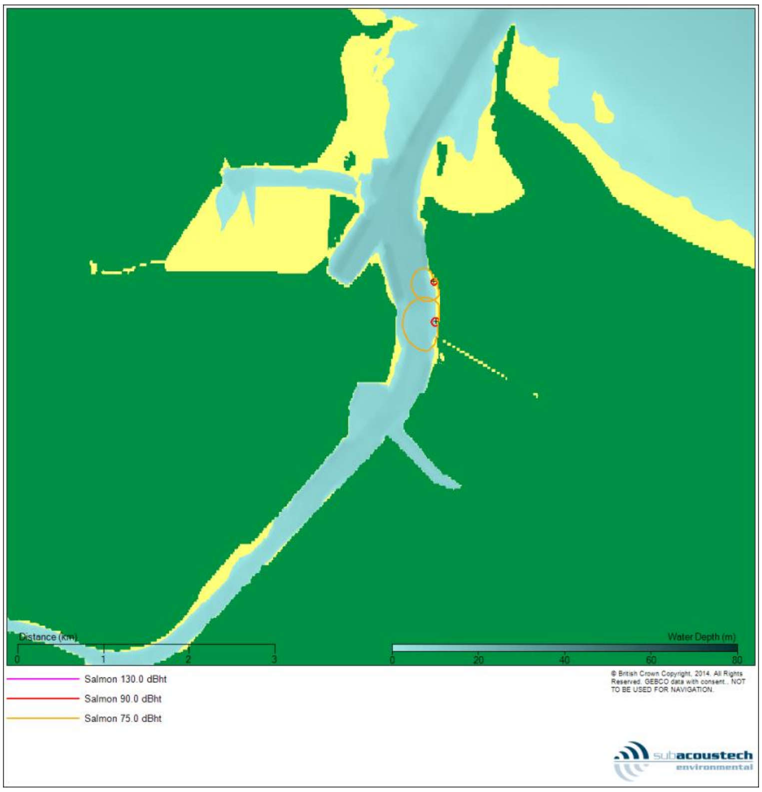

Figure 6-3 Contour plot showing the predicted 90 and 75 dB$_{ht}$ levels for salmon for impact piling operations using 914mm diameter pile and blow energy of 125 kJ

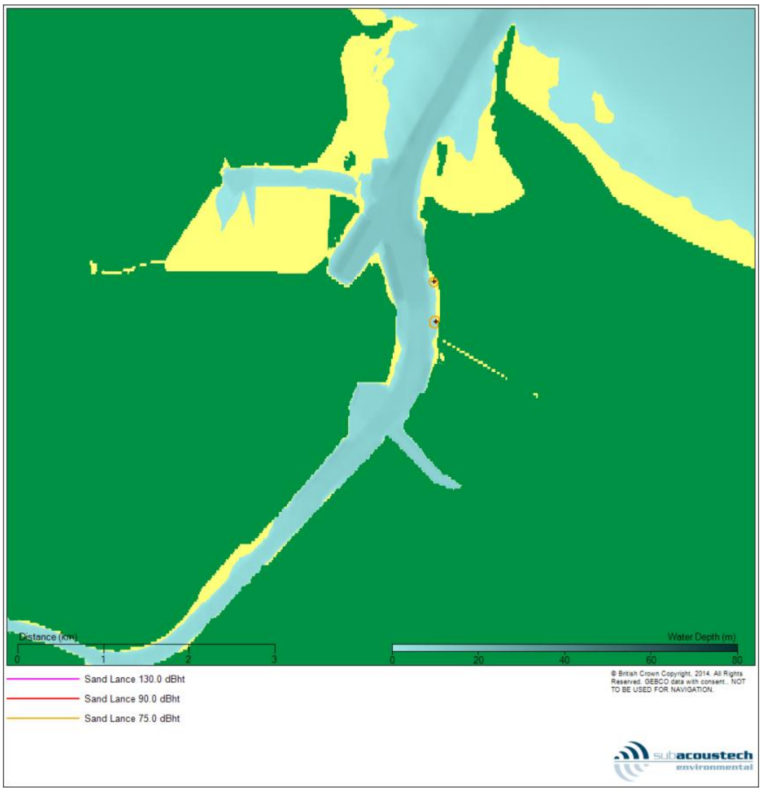

Figure 6-4 Contour plot showing the predicted 90 and 75 dB$_{ht}$ levels for sand lance for impact piling operations using 914mm diameter pile and blow energy of 125 kJ

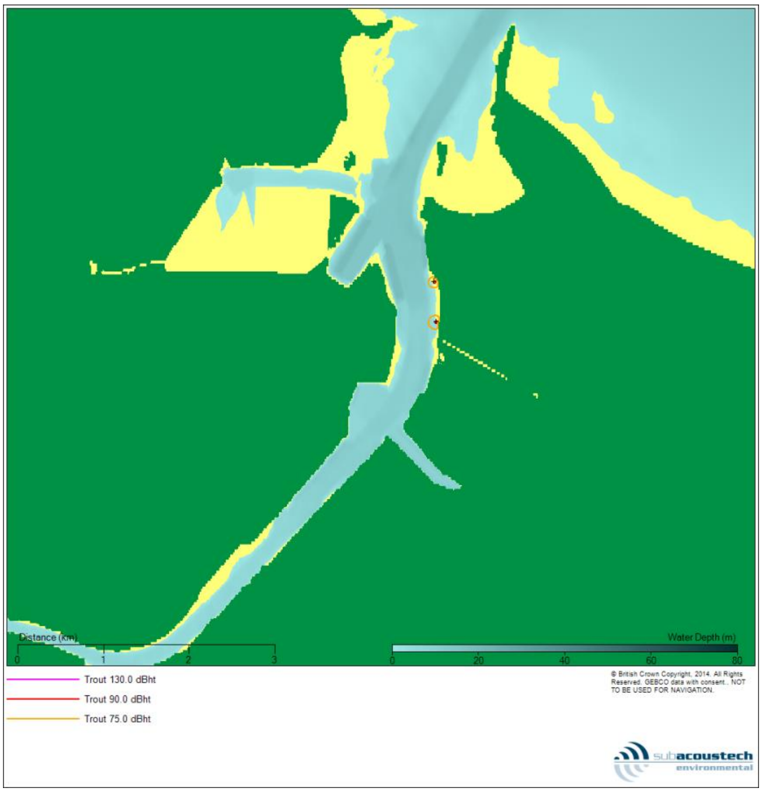

Figure 6-5 Contour plot showing the predicted 90 and 75 dB$_{ht}$ levels for trout for impact piling operations using 914mm diameter pile and blow energy of 125 kJ

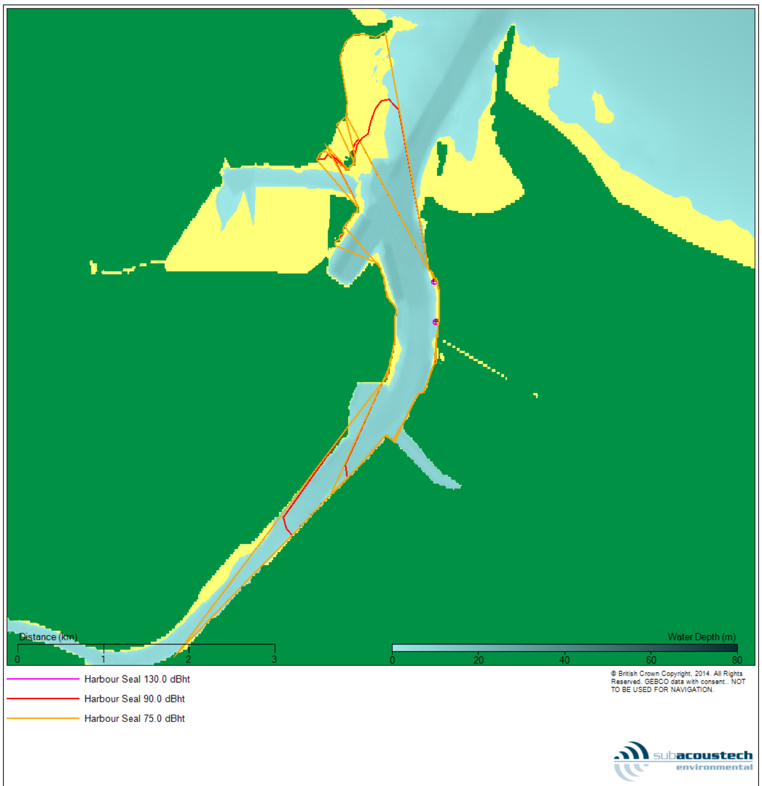

Figure 6-6 Contour plot showing the predicted 130, 90 and 75 dB$_{ht}$ levels for harbour seal for impact piling operations using 914mm diameter pile and blow energy of 125 kJ

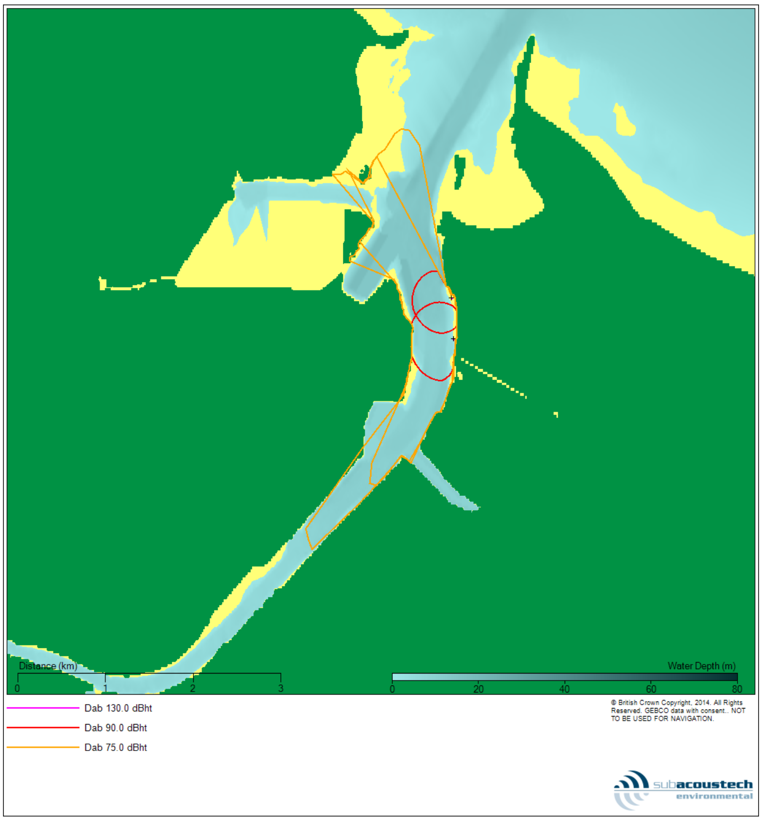

Figure 6-7 Contour plot showing the predicted 90 and 75 dB$_{ht}$ levels for dab for impact piling operations using 2000mm diameter pile and blow energy of 305 kJ

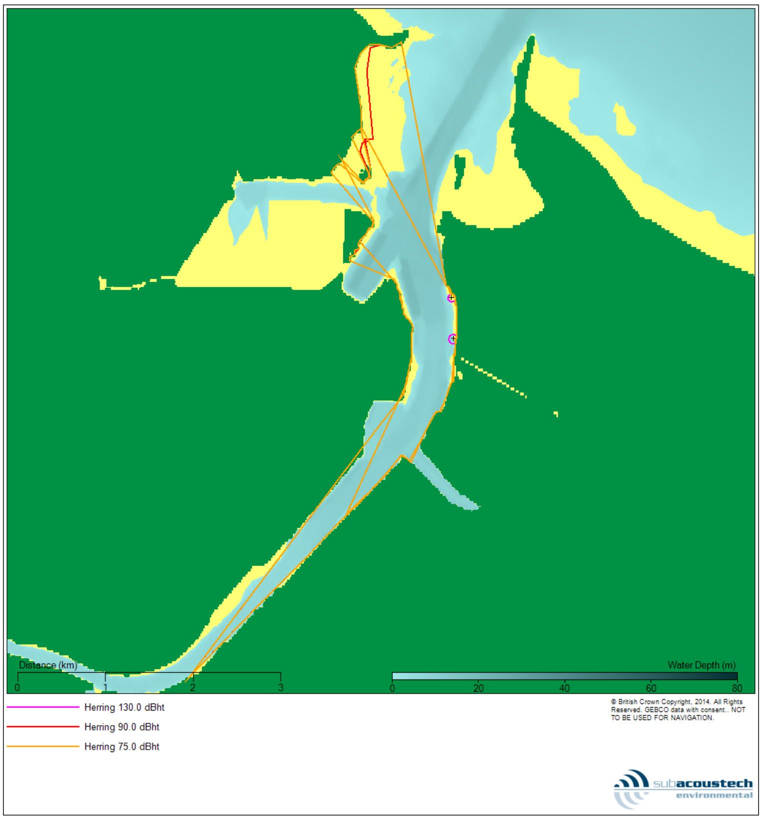

Figure 6-8 Contour plot showing the predicted 130, 90 and 75 dB$_{ht}$ levels for herring for impact piling operations using 2000mm diameter pile and blow energy of 305 kJ

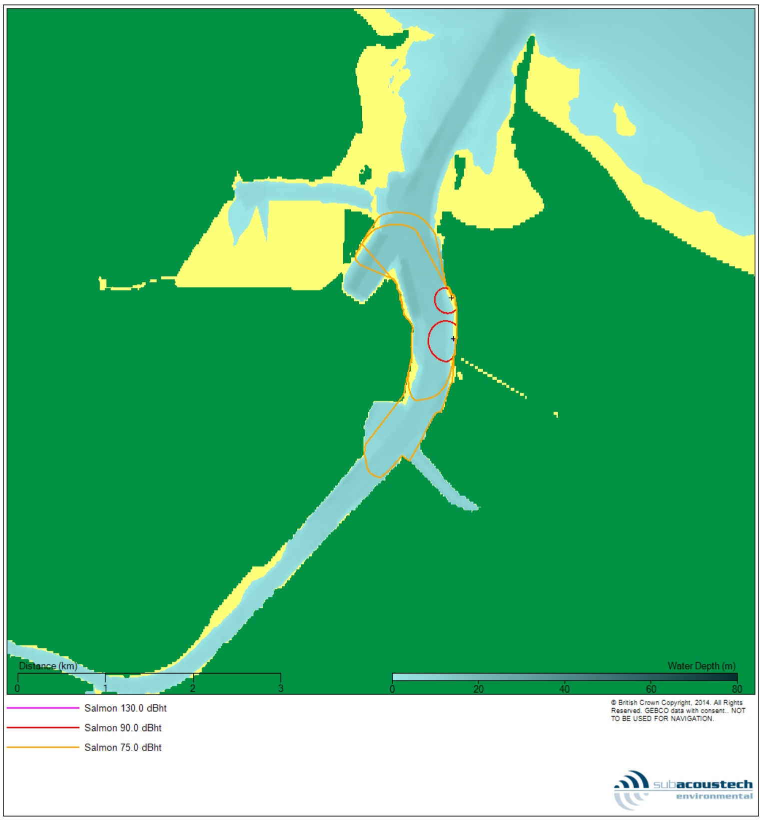

Figure 6-9 Contour plot showing the predicted 90 and 75 dB_{ht} levels for salmon for impact piling operations using 2000mm diameter pile and blow energy of 305 kJ

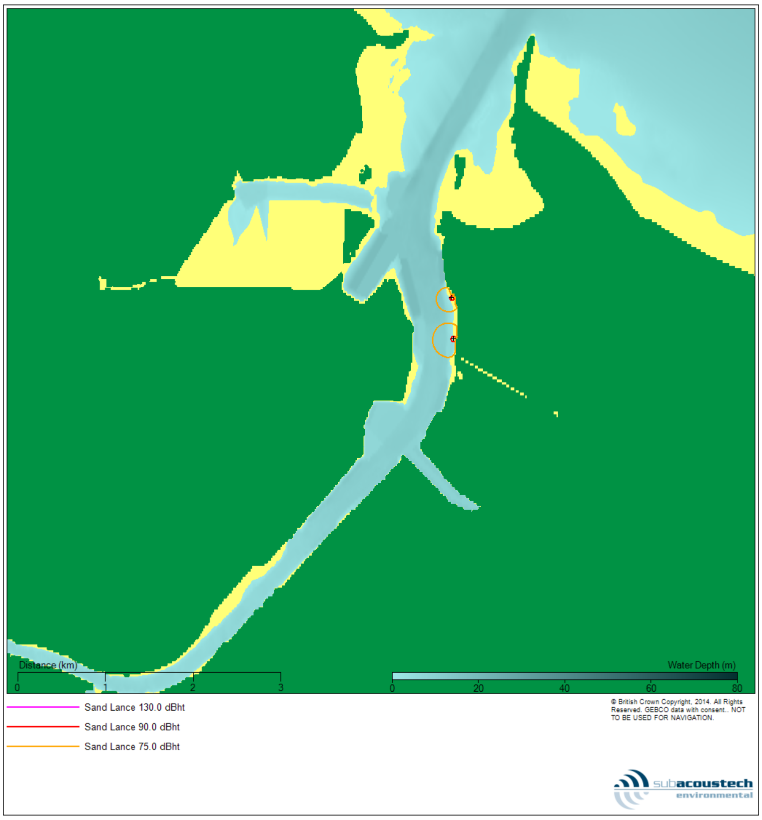

Figure 6-10 Contour plot showing the predicted 90 and 75 dB_{ht} levels for sand lance for impact piling operations using 2000mm diameter pile and blow energy of 305 kJ

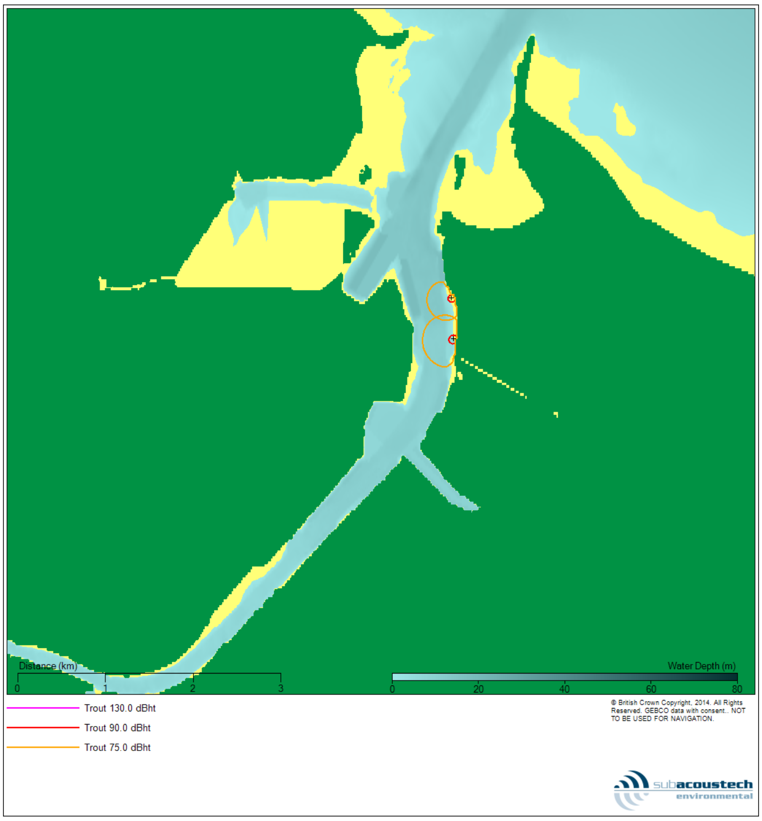

Figure 6-11 Contour plot showing the predicted 90 and 75 dB$_{ht}$ levels for trout for impact piling operations using 2000mm diameter pile and blow energy of 305 kJ

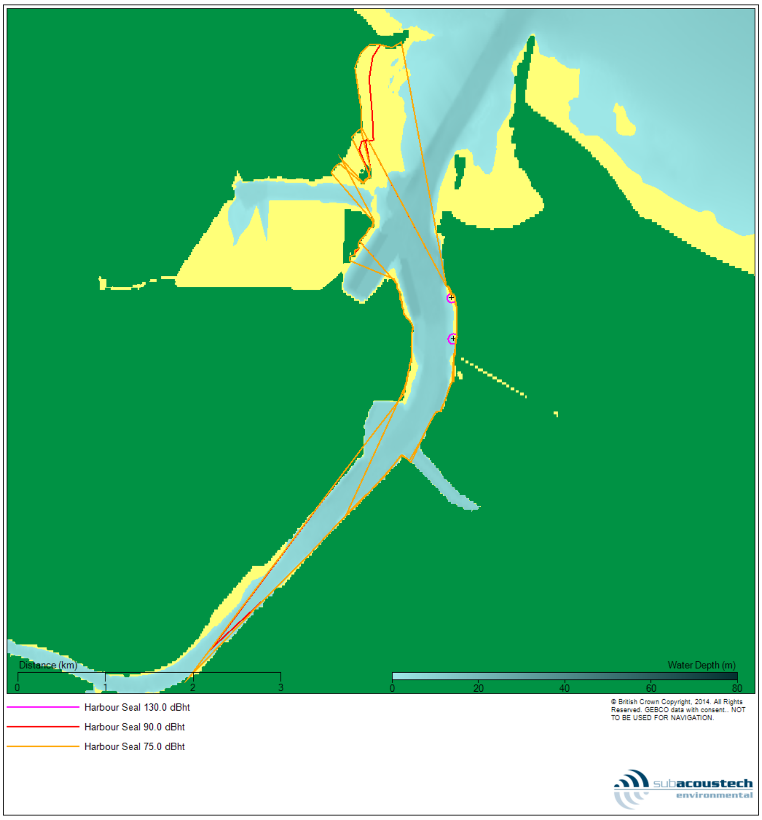

Figure 6-12 Contour plot showing the predicted 130, 90 and 75 dB$_{ht}$ levels for harbour seal for impact piling operations using 2000mm diameter pile and blow energy of 305 kJ

6.3.3 Behavioural response: backhoe and suction dredging noise

Table 6-6 presents a comparison of estimate for 90 dB_{ht} and 75 dB_{ht} impact ranges for behavioural response for the species of interest from dredging activities using a backhoe dredger and a suction dredger. Maximum, minimum and mean ranges are presented for both dredging types. The impact ranges for backhoe dredging are all seen to be 10m or less. The impact ranges for suction dredging are similar for all species except herring. The maximum 75 dB_{ht} impact range for herring where significant avoidance may occur is estimated to be 330m.

Figure 6-13 and Figure 6-14 show the perceived dredging noise level versus ranges for each species along each of the three modelled transects.

Table 6-6 Summary of the modelled ranges for 90 and 75 dB_{ht}(Species) levels for backhoe and suction dredging operations

		Backhoe Dredging		Suction Dredging	
		90 dB_{ht}	75 dB_{ht}	90 dB_{ht}	75 dB_{ht}
Dab	Max	< 5 m	< 5 m	< 5 m	15 m
	Min	< 5 m	< 5 m	< 5 m	10 m
	Mean	< 5 m	< 5 m	< 5 m	13 m
Herring	Max	< 5 m	10 m	30 m	330 m
	Min	< 5 m	10 m	30 m	165 m
	Mean	< 5 m	10 m	30 m	250 m
Salmon	Max	< 5 m	< 5 m	< 5 m	10 m
	Min	< 5 m	< 5 m	< 5 m	10 m
	Mean	< 5 m	< 5 m	< 5 m	10 m
Sand Lance	Max	< 5 m	< 5 m	< 5 m	10 m
	Min	< 5 m	< 5 m	< 5 m	5 m
	Mean	< 5 m	< 5 m	< 5 m	8 m
Sea Trout	Max	< 5 m	< 5 m	< 5 m	< 5 m
	Min	< 5 m	< 5 m	< 5 m	< 5 m
	Mean	< 5 m	< 5 m	< 5 m	< 5 m
Harbour Seal	Max	< 5 m	< 5 m	< 5 m	10 m
	Min	< 5 m	< 5 m	< 5 m	10 m
	Mean	< 5 m	< 5 m	< 5 m	10 m

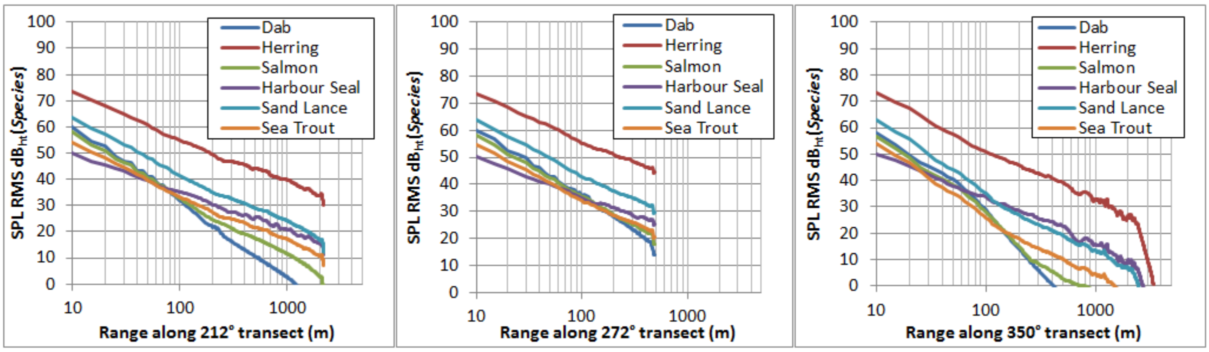

Figure 6-13 Level versus range plots showing the predicted dB_{ht}(Species) levels from backhoe dredging along the three modelled transects

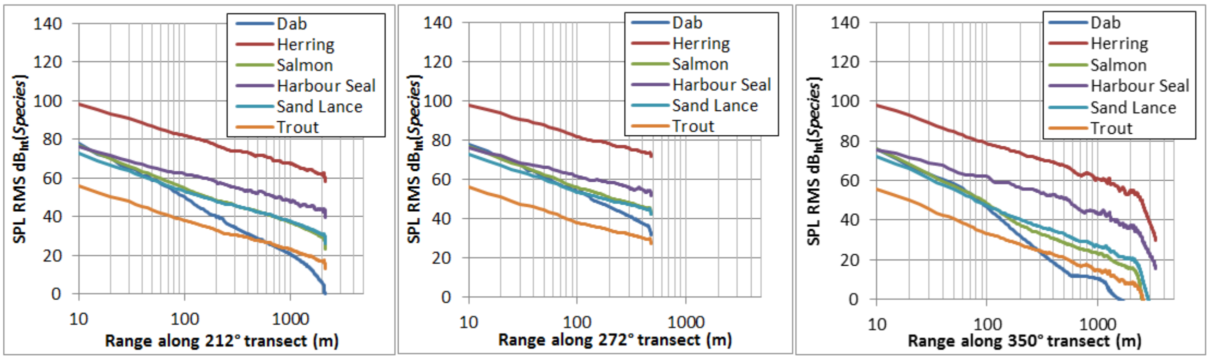

Figure 6-14 Level versus range plots showing the predicted dB$_{ht}$(Species) levels from suction dredging along the three modelled transects

6.4 M-Weighted SELs

The accumulated exposure to sound leading to the potential onset of auditory injury for marine mammals has been assessed using the criteria proposed by Southall *et al* (2007), using M-Weighted SELs. The multiple pulse results have been created by assuming a receptor flees from the noise source at speed of 1.5m/s. It has been assumed herein that one pile will take 90 minutes to install, with six piles being installed in a 12 hour period.

Table 6-7 shows the ranges to which 186 dB re 1 µPa^{2}s for pinnipeds (in water) are likely to extend, for single pulse exposure and for exposure over multiple pulses, based on the assumptions above, for the impact piling of a 914mm diameter pile. The maximum range for single pulse is seen to be 6m at both positions for the 914mm diameter pile. The maximum range for an exposure to multiple pulses, assuming the animal is fleeing, is 310m at the south position. Table 6-8 shows the ranges for the impact piling of a 2000mm diameter pile. The maximum range for single pulse of a 2000mm pile is seen to be 16m at the south position. For an exposure to multiple pulses, assuming a fleeing animal, the maximum range is 880m at the south position.

Table 6-7 Summary of impact ranges from impact piling operations for a 914mm diameter pile using Southall criteria SEL of 186 dB for pinnipeds (in water)

Pinnipeds (in water) 186 dB re 1 µPa^{2}s (M_{pw}) (914 mm/125 kJ)	North position		South position	
	Single pulse	Multiple pulse	Single pulse	Multiple pulse
Maximum Range	6m	130m	6m	310m
Minimum Range	4m	100m	4m	100m
Mean Range	5m	110m	5m	130m

Table 6-8 Summary of impact ranges from impact piling operations for a 2000mm diameter pile using Southall criteria SEL of 186 dB for pinnipeds (in water)

Pinnipeds (in water) 186 dB re 1 µPa^{2}s (M_{pw}) (2000 mm/305 kJ)	North position		South position	
	Single pulse	Multiple pulse	Single pulse	Multiple pulse
Maximum Range	14m	460m	16m	880m
Minimum Range	12m	100m	12m	100m
Mean Range	13m	190m	15m	260m

7 Summary and conclusions

Subacoustech Environmental Ltd has undertaken a study on behalf of Haskoning DHV UK Ltd to assess the potential impacts of underwater noise during construction activities associated with the proposed York Potash Harbour Facilities project in the Tees Estuary. The construction activities that have been assessed include impact piling, suction dredging and backhoe dredging. The modelling of underwater noise has been carried out using Subacoustech Environmental's INSPIRE model and the RAMSGeo acoustic model. Underwater noise during the operational phase from increased vessel movements has also been considered. However, it has been shown to have minimal impact in raising the average SPL as there will be a maximum increase in vessel movements of less than 1.8% per year, equivalent to one vessel movement every two days.

Modelling of underwater noise form impact piling operations show that, using unweighted SPL_{peak} noise criteria, noise levels are not predicted to be high enough such that marine species will suffer a lethal effect. For the impact piling of a 914mm diameter pile physical traumatic injury could occur out to 4m for all marine species and 10m for species of fish with a maximum range of 22m at which a startle response is likely to be invoked in fish. For the impact piling of a 2000mm diameter pile physical traumatic injury could occur out to 8m for all marine species and 36m for species of fish, and a maximum range of 84m at which a startle response in fish is likely to be caused. Modelling of underwater noise from dredging operations shows that noise levels are not sufficient to reach the unweighted criteria for lethal effect, physical injury or behavioural response.

The largest estimated ranges out to which traumatic hearing damage may occur from impact piling using the 130 dB_{ht}(*Species*) criteria have been calculated to be a maximum of 18m for herring and 34m for harbour seal based on impact piling of a 914mm diameter pile. The maximum range for the impact piling of a 2000mm diameter pile was calculated to be 56m for herring and 62m for harbour seal. The dB_{ht} source levels for the remaining fish species are not estimated to exceed the 130 dB_{ht} criteria. The modelled dB_{ht}(*Species*) sound propagation for backhoe and suction dredging are not estimated to reach the level at which a traumatic hearing damage could occur.

The impact ranges for behavioural response are indicated using the 90 and 75 dB_{ht} perceived level criteria, where 90 dB_{ht} signifies a strong avoidance reaction of a species and 75 dB_{ht} signifies some avoidance, depending on context. Modelling for behavioural response, with respect to the 914mm diameter pile, shows that the largest impact ranges from impact piling are predicted to be for herring and harbour seal with ranges of 2.37km and 3.01km respectively, for 90 dB_{ht}. For 75 dB_{ht} the maximum range reached 4.89km for both herring and harbour seal, as all modelled transects reached the riverbank at this distance before falling below 75 dB_{ht} for these two species. The estimated behavioural impact ranges from impact piling operations are expected to be considerably lower for dab, salmon, sand lance and sea trout, with all dB_{ht} impact range less than 400m. For the impact piling of a 2000mm diameter pile, the estimated impact ranges are seen to reach a maximum of 2.89km for dab and 1.80km for salmon with the maximum ranges for sand lance and sea trout not exceeding 250m. The largest impact ranges are predicted for herring and harbour seal of 4.89km, where 75 dB_{ht} impact ranges extend to the river bank for all modelled transects

The 90 and 75 dB_{ht} impact ranges for backhoe dredging are all seen to be 10m or less. The impact ranges for suction dredging are similar for all species except herring. The maximum 75 dB_{ht} impact range for herring where significant avoidance may occur is estimated to be 330m.

Using the M-Weighted SEL for assessing auditory injury in marine mammals from impact piling of a 914m diameter pile, the ranges have been calculated for the 186 dB criteria for pinnipeds (in water) where the single pulse SEL impact range is calculated to be a maximum of 6 m. The maximum impact range for the multiple pulse SEL over the full piling duration is estimated to be 310 m, for an animal fleeing from the noise, where six piles are driven over the duration of 12 hours. Using the same criteria, the impact ranges for the modelled installation of a 2000mm diameter pile have been calculated to be 16m for the single pulse SEL and 880m for the multiple pulse SEL with the same assumptions made above.

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E473R0200	02	05/06/2014	Internal review
E473R0200	03	06/06/2014	Amendments
E473R0201	-	06/06/2014	First issue to client
E473R0201	02	17/06/2014	Addition of operational noise from vessel movements
E473R0201	03	23/06/2014	Comments addressed
E473R0202	-	23/06/2014	Second issue to client
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E473R0202	02	10/07/2014	Comments addressed
E473R0203	-	12/07/2014	Third issue – response to comments
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Appendix 15

Tern survey data

Table 1 Numbers of common terms recorded during the timed surveys and snapshots (expressed as a mean) in the Tees engaged in directional flight, foraging / feeding with no clear direction and resting / socialising at each survey location on each sampling occasion in the Teesmouth and Cleveland Coast area (Natural England, 2016).

Survey location	Sampling occasion	Count from timed survey				Mean snapshot count			
		Directional flight	Foraging without direction	Resting	Total	Directional flight	Foraging without direction	Resting	Total
Tees Barrage	18/06/15	20	3	0	23	0.355	0.774	0.000	1.129
	02/07/15	7	4	3	14	0.097	0.387	0.290	0.774
	22/07/15	12	26	0	38	0.000	3.774	0.000	3.774
A19 road bridge	18/06/15	16	0	0	16	0.097	0.097	0.000	0.194
	02/07/15	11	5	1	17	0.258	0.161	0.258	0.677
	22/07/15	15	8	0	23	0.290	0.129	0.000	0.419
Newport Bridge	18/06/15	12	2	0	14	0.097	0.290	0.000	0.387
	02/07/15	13	4	0	17	0.226	0.839	0.000	1.065
	22/07/15	3	8	0	11	0.097	0.645	0.000	0.742
Pinky and Perky Towers	18/06/15	6	0	0	6	0.097	0.000	0.000	0.097
	02/07/15	17	5	0	22	0.516	0.097	0.000	0.613
	22/07/15	9	10	0	19	0.097	0.806	0.000	0.903
OSB warehouse slipways	18/06/15	14	0	0	14	0.129	0.258	0.000	0.387
Transporter Bridge	18/06/15	8	2	0	10	0.000	0.161	0.000	0.161
	02/07/15	21	5	0	26	0.419	1.032	0.000	1.452
	22/07/15	12	11	0	23	0.226	0.613	0.000	0.839
Middlesbrough Dock	18/06/15	6	0	0	6	0.000	0.000	0.000	0.000
	02/07/15	7	1	0	8	0.000	0.097	0.000	0.097

Survey location	Sampling occasion	Count from timed survey				Mean snapshot count			
		Directional flight	Foraging without direction	Resting	Total	Directional flight	Foraging without direction	Resting	Total
	22/07/15	15	14	2	31	0.097	1.742	0.484	2.323
Outfall channel	18/06/15	9	0	0	9	0.065	0.000	0.000	0.065
	02/07/15	7	0	0	7	0.000	0.129	0.000	0.129
MPI jack-up vessels	18/06/15	4	0	0	4	0.000	0.000	0.000	0.000
	02/07/15	5	0	0	5	0.065	0.032	0.000	0.097
	22/07/15	17	6	0	23	0.226	0.290	0.000	0.516
Mudflat lagoon	18/06/15	10	1	0	11	0.065	0.065	0.000	0.129
Oil refinery	18/06/15	11	1	0	12	0.065	0.129	0.000	0.194
	02/07/15	11	0	0	11	0.065	0.000	0.000	0.065
	22/07/15	18	7	0	25	0.387	0.129	0.000	0.516
Tees Dock	18/06/15	1	0	0	1	0.000	0.032	0.000	0.032
	02/07/15	3	6	0	9	0.000	0.355	0.000	0.355
	22/07/15	4	8	0	12	0.065	0.194	0.000	0.258
Dabholm Gut	18/06/15	6	10	0	16	0.065	0.484	0.000	0.548
	02/07/15	9	11	0	20	0.129	0.226	0.097	0.452
	22/07/15	11	14	0	25	0.677	3.484	0.000	4.161
Bran Sands cranes	18/06/15	17	1	0	18	0.323	0.000	0.000	0.323
	02/07/15	4	5	0	9	0.032	0.097	0.000	0.129
	22/07/15	17	10	0	27	0.323	0.290	0.000	0.613
Seaton Channel	18/06/15	31	2	0	33	0.419	0.097	0.000	0.516
	02/07/15	96	49	0	145	1.194	2.226	0.000	3.419
	22/07/15	18	128	0	146	0.097	27.000	0.000	27.097

Table 2 Numbers of Sandwich terms recorded during the timed surveys and snapshots (expressed as a mean) in the Tees engaged in directional flight, foraging / feeding with no clear direction and resting / socialising at each survey location on each sampling occasion in the Teesmouth and Cleveland Coast area (Natural England, 2016).

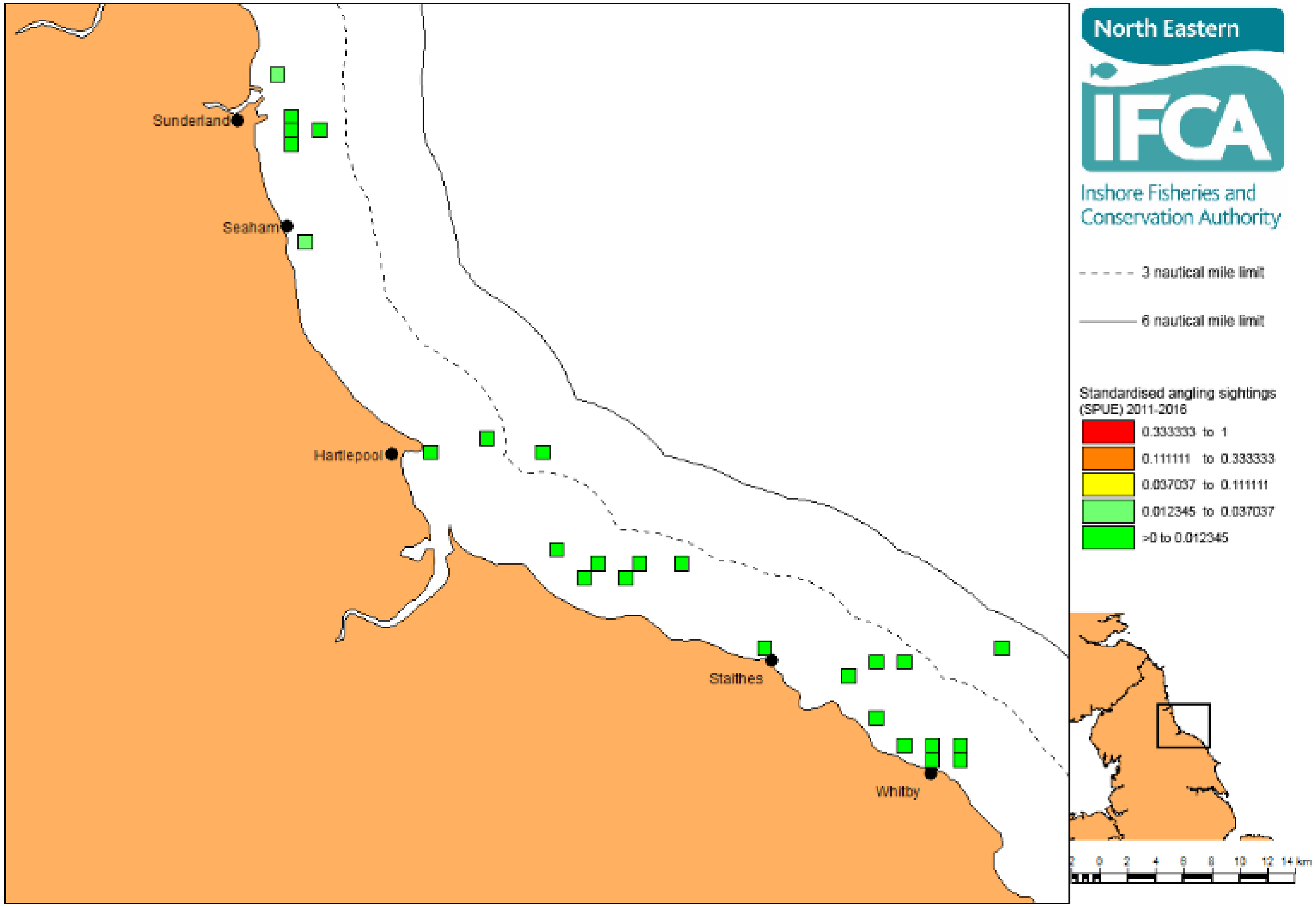
Survey location	Sampling occasion	Count from timed survey				Mean snapshot count			
		Directional flight	Foraging without direction	Resting	Total	Directional flight	Foraging without direction	Resting	Total
Tees Barrage	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000
	22/07/15	0	0	0	0	0.000	0.000	0.000	0.000
A19 road bridge	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000
	22/07/15	0	0	0	0	0.000	0.000	0.000	0.000
Newport Bridge	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000
	22/07/15	0	0	0	0	0.000	0.000	0.000	0.000
Pinky and Perky Towers	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000
	22/07/15	0	0	0	0	0.000	0.000	0.000	0.000
OSB warehouse slipways	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
Transporter Bridge	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000
	22/07/15	0	0	0	0	0.032	0.000	0.000	0.032
Middlesbrough Dock	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000

Survey location	Sampling occasion	Count from timed survey				Mean snapshot count			
		Directional flight	Foraging without direction	Resting	Total	Directional flight	Foraging without direction	Resting	Total
	22/07/15	0	0	0	0	0.000	0.000	0.000	0.000
Outfall channel	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000
MPI jack-up vessels	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000
	22/07/15	0	0	0	0	0.000	0.000	0.000	0.000
Mudflat lagoon	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
Oil refinery	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000
	22/07/15	0	0	0	0	0.065	0.065	0.000	0.129
Tees Dock	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000
	22/07/15	0	0	0	0	0.000	0.000	0.000	0.000
Dabholm Gut	18/06/15	4	0	0	4	0.129	0.000	0.000	0.129
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000
	22/07/15	0	0	0	0	0.000	0.000	0.000	0.000
Bran Sands cranes	18/06/15	0	0	0	0	0.000	0.000	0.000	0.000
	02/07/15	0	0	0	0	0.000	0.000	0.000	0.000
	22/07/15	2	13	0	15	0.226	1.032	0.000	1.258
Seaton Channel	18/06/15	5	3	0	8	0.032	0.097	0.000	0.129
	02/07/15	8	1	0	9	0.161	0.000	0.000	0.161
	22/0/15	0	11	84	95	3.290	0.323	0.000	3.613

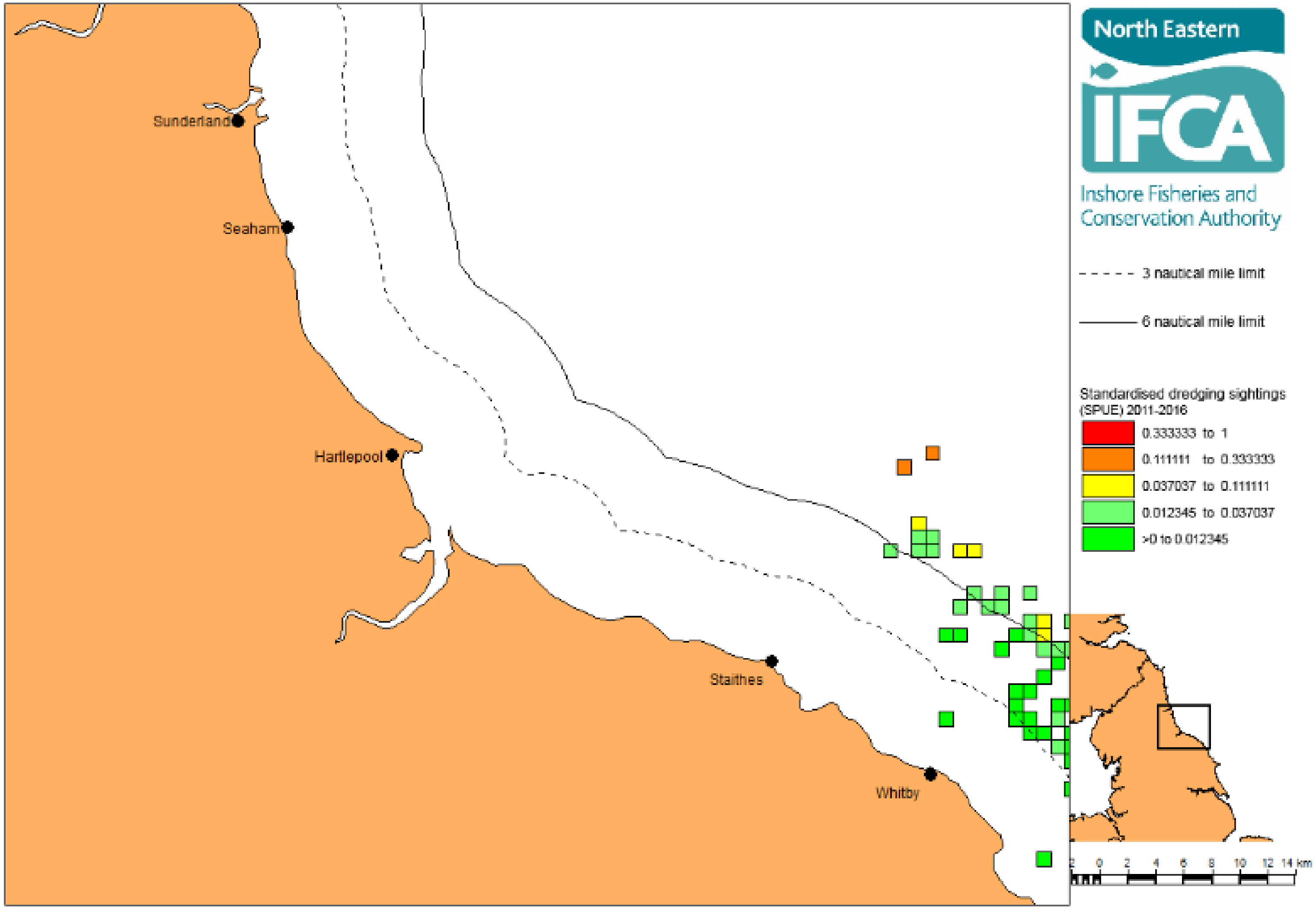
Appendix 16

Fishing effort

Table 1 Fishing effort within the coastal waters beyond the mouth of the Tees estuary (2011 to 2016) (NEIFCA, 2016)

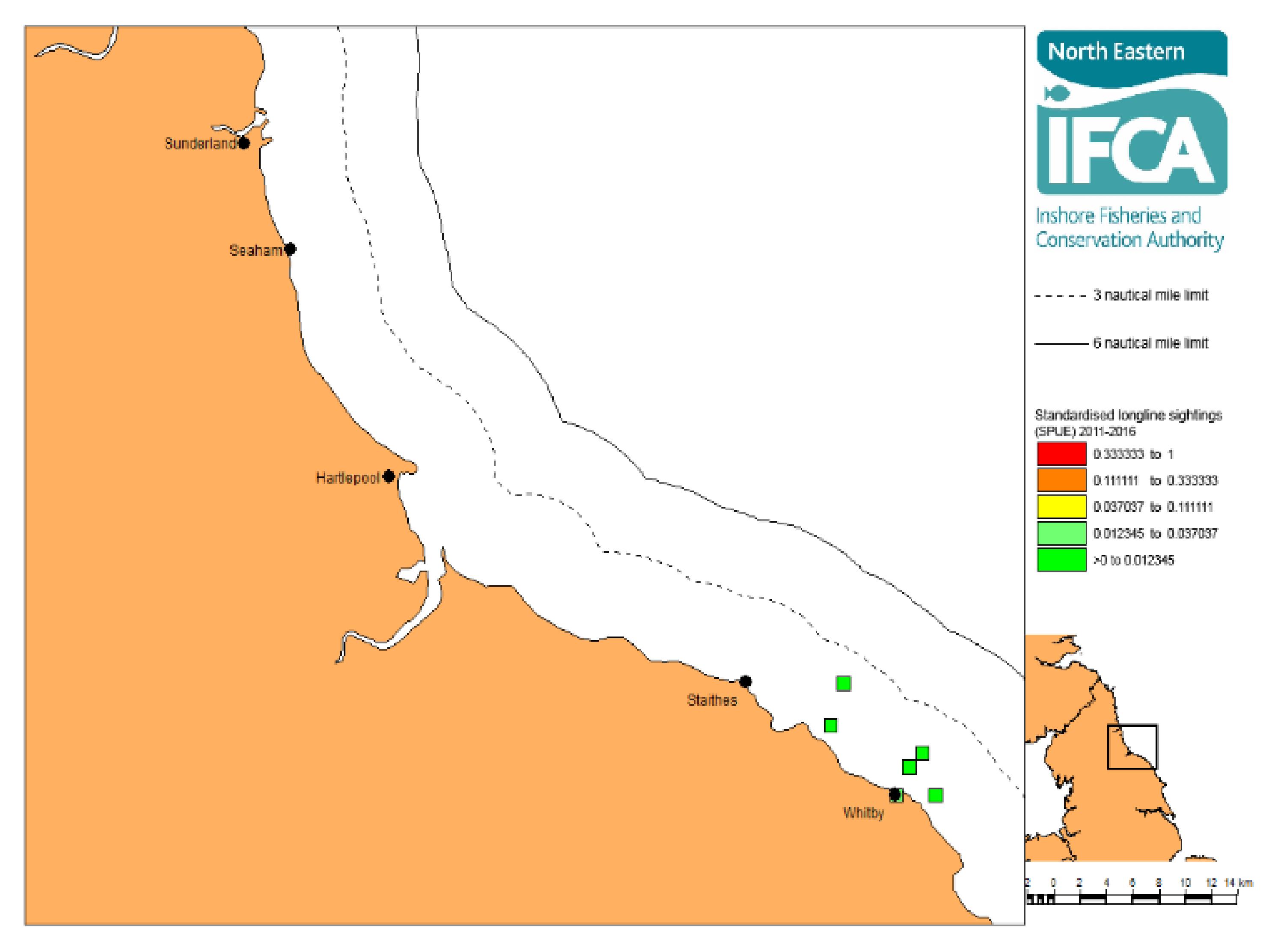
Angling


Dredging



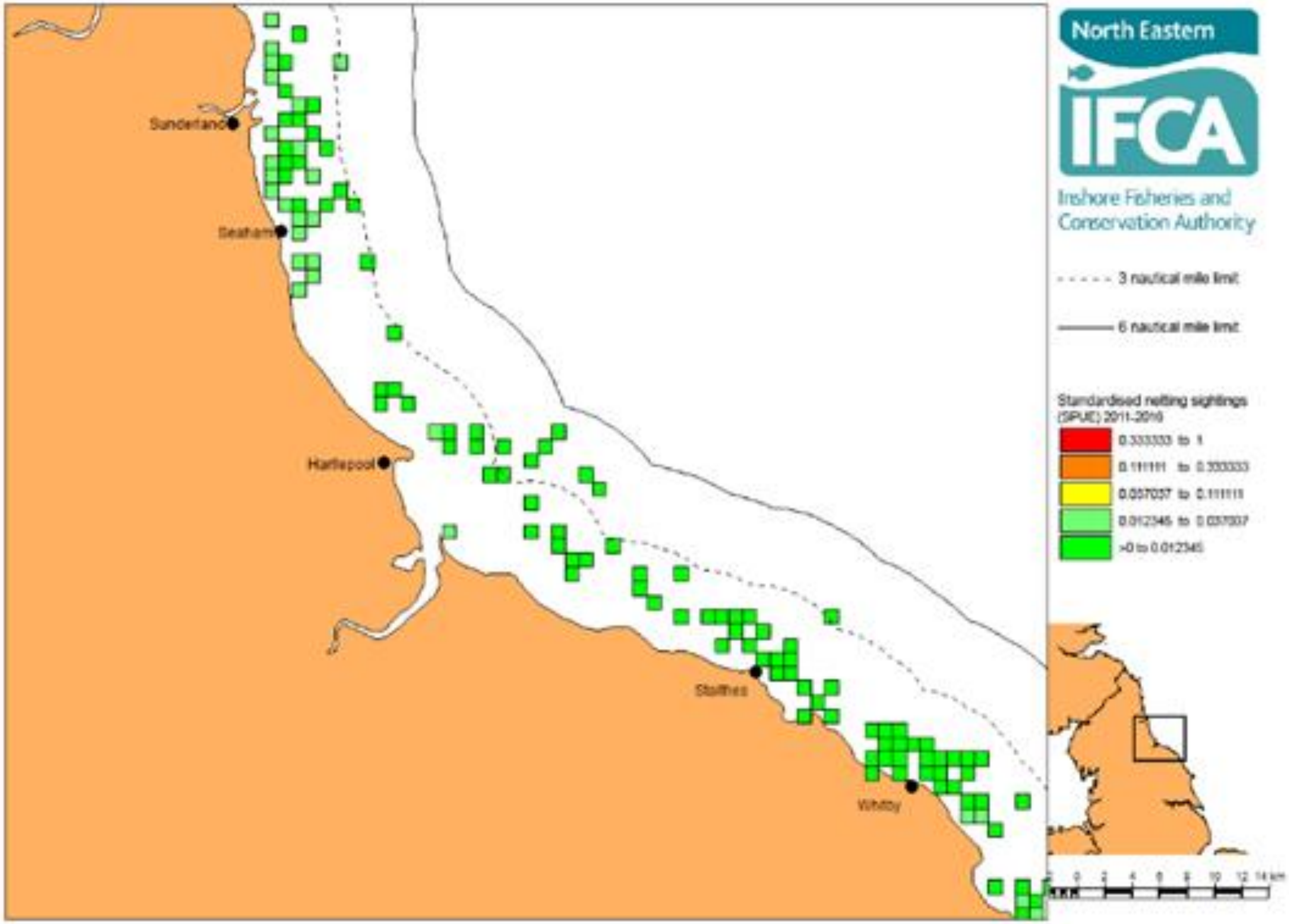
North Eastern
IFCA
Inshore Fisheries and Conservation Authority
3 nautical mile limit
6 nautical mile limit
Standardised dredging sightings (SPUE) 2011-2016
0.333333 to 1
0.111111 to 0.333333
0.037037 to 0.111111
0.012345 to 0.037037
>0 to 0.012345
Sunderland
Seaham
Hartlepool
Staithes
Whitby
0 2 4 6 8 10 12 14 km

Line



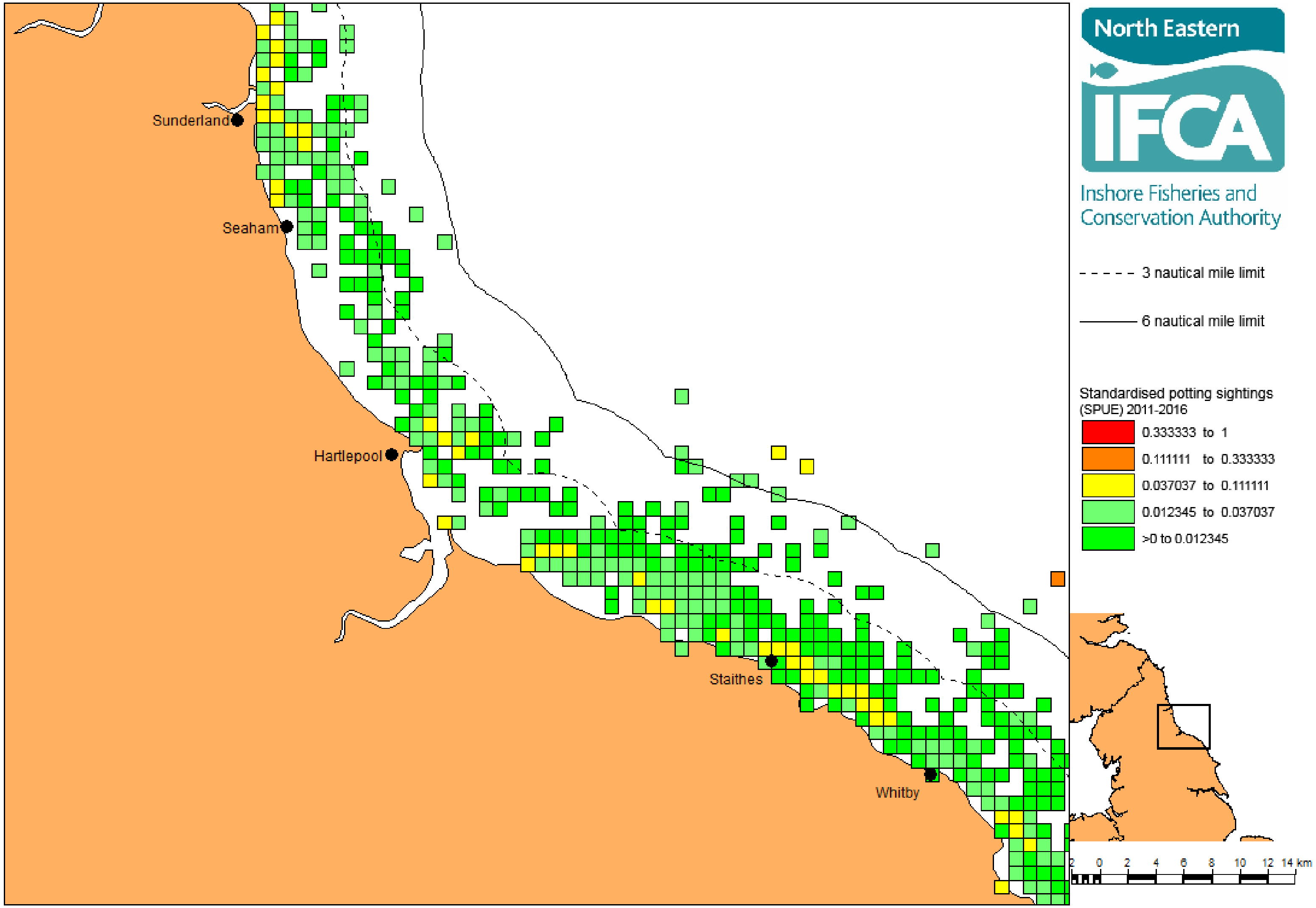
Sunderland
Seaham
Hartlepool
Staithes
Whitby
North Eastern
IFCA
Inshore Fisheries and Conservation Authority
3 nautical mile limit
6 nautical mile limit
Standardised longline sightings (SPUE) 2011-2016
0.333333 to 1
0.111111 to 0.333333
0.037037 to 0.111111
0.012345 to 0.037037
>0 to 0.012345
2 0 2 4 6 8 10 12 14 km

Netting



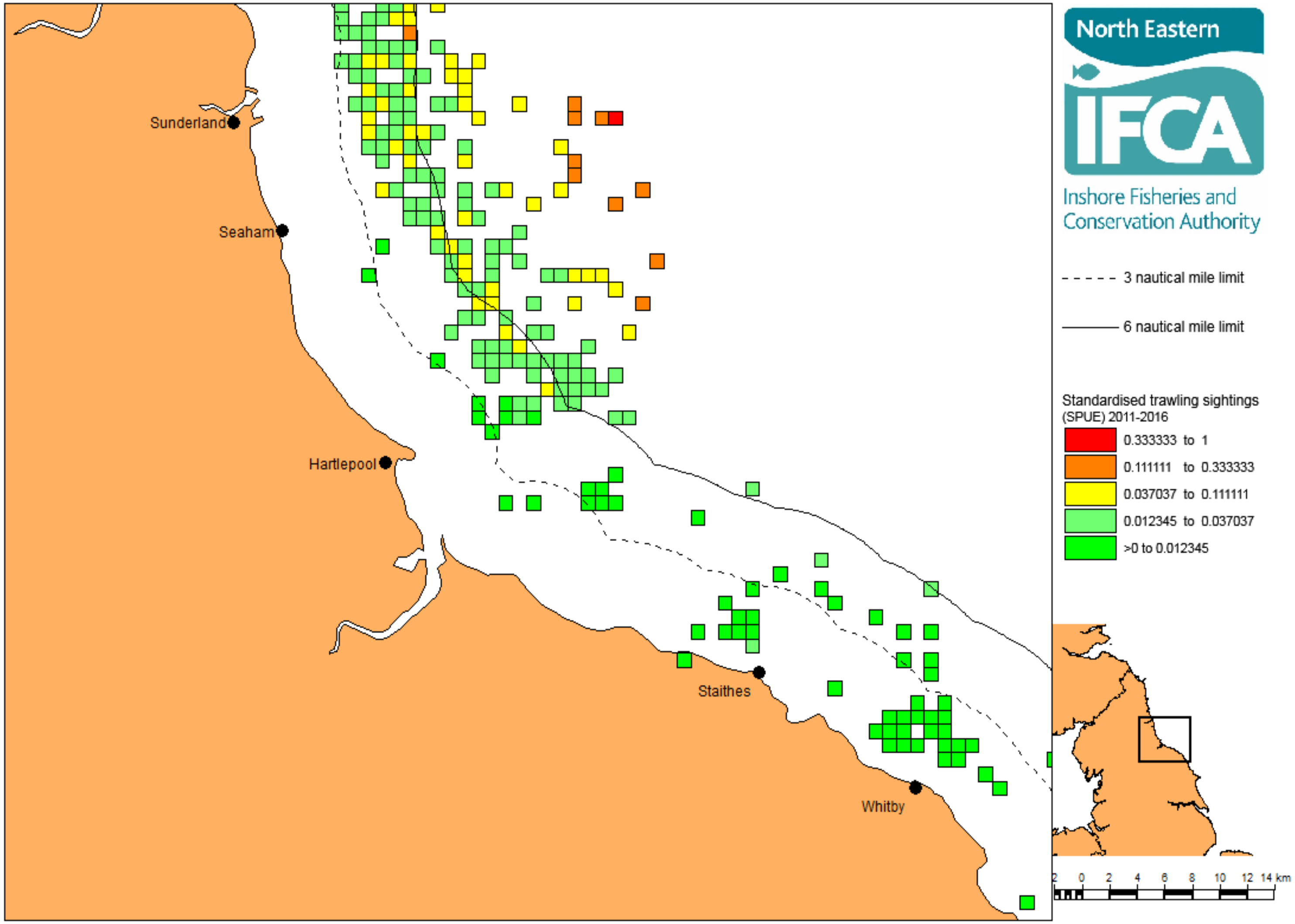
Sunderland
Seaham
Hartlepool
Staithes
Whitby
North Eastern
IFCA
Inshore Fisheries and Conservation Authority
3 nautical mile limit
6 nautical mile limit
Standardised netting sightings
0.333333 to 1
0.111111 to 0.333333

Potting



Sunderland
Seaham
Hartlepool
Staithes
Whitby
North Eastern
IFCA
Inshore Fisheries and Conservation Authority
3 nautical mile limit
6 nautical mile limit
Standardised potting sightings (SPUE) 2011-2016
0.333333 to 1
0.111111 to 0.333333
0.037037 to 0.111111
0.012345 to 0.037037
>0 to 0.012345
2 0 2 4 6 8 10 12 14 km

Trawls



Sunderland
Seaham
Hartlepool
Staithes
Whitby
North Eastern
IFCA
Inshore Fisheries and Conservation Authority
3 nautical mile limit
6 nautical mile limit
Standardised trawling sightings (SPUE) 2011-2016
0.333333 to 1
0.111111 to 0.333333
0.037037 to 0.111111
0.012345 to 0.037037
>0 to 0.012345
2 0 2 4 6 8 10 12 14 km

Appendix 17

Transport Statement

REPORT

Northern Gateway Container Terminal

Transport Statement

Client: PD Teesport

Reference: T&PPB6776R001F1.0

Revision: 1.0/Final

Date: 18 December 2017

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Enhancing Society Together

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Date / initials:	15.12.17 / SAJ

Classification
Project related

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

Disclaimer

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Royal HaskoningDHV

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1 Introduction

1.1 Preamble

1.1.1 This Transport Statement (TS) has been prepared by Royal HaskoningDHV on behalf of PD Teesport (PDT) in support of an extension to the Harbour Revision Order (HRO) for the consented Northern Gateway Container Terminal (NGCT).

1.2 Background

1.2.1 PDT secured planning permission from Redcar and Cleveland Borough Council (RCBC) for the NGCT on land at Teesport, Grangetown in October 2007 (Reference number: R/2006/0433/OO).

1.2.2 The planning application was part of a wider Environmental Impact Assessment (EIA) which was supported by a series of documents. From a transport perspective, the relevant documents included:

- A Transport Assessment and subsequent revision (TA) – this document established the traffic demand and distribution for the operational phase and considered how this impacted upon junction capacity and road safety. The traffic demand was predicated on an assessment of rail freight capacity.
- An Environmental Statement and subsequent supplement (ES) – this document was informed by the Transport Assessment and established the impact of the construction and operational phases of the NGCT.

1.2.3 Mitigation was secured by condition. The transport related conditions specified by RCBC included:

- **Condition 16**: A Business Travel Plan shall be agreed with the Local Planning Authority.
- **Condition 28**: Phase 2 of the terminal development shall not operate until the new rail terminal has been completed.
- **Condition 33**: The development hereby granted consent shall not be brought into use unless and until the highway improvement works have been completed.

1.2.4 Full details of these transport conditions are set out in **Section 3.3** of this TS.

1.3 Scope

1.3.1 It is noted that the development description has not changed from that covered by the 2007 permissions and, therefore, the established NGCT transport demand remains identical.

1.3.2 The objective of the TS is to establish if the baseline environment that informed the consents have been subject to a material change that would lead to a significant change in the assessed impacts.

1.3.3 With regard to the construction phase of the project, the 2006 ES established that the traffic demand (40 HGV/ready-mix truck movements and approximately 225 car movements) will represent an impact of **negligible** significance. Therefore, the scope of this TS is confined to the operational phase of the development.

1.3.4 The original TA contained the mode share forecasts and baseline conditions that informed the capacity, road safety and ES assessments.

1.3.5 To meet the TS objective the scope of this assessment has been defined as:

- A review of 'present day' transport policy to establish the compliance of the development.
- A review of the TA baseline conditions that informed the impact assessment conclusions for the operational phase of the project. Namely:
  - mode share;
  - traffic generation and assignment;
  - highway capacity;
  - road safety; and
  - cumulative impact.

1.4 Transport Statement Structure

1.4.1 Following this introduction, the TS is structured as follows:

- **Section 2**, provides a description of the development.
- **Section 3**, provides a review of the policy framework.
- **Section 4**, describes the baseline conditions.
- **Section 5**, provides an evaluation of impacts.
- **Section 6**, provides a summary and conclusion.

2 Description of the Development

2.1 Introduction

2.1.1 The development assessed within this TS is defined by the original consented development proposals and no amendments are considered.

2.1.2 The following section provides a brief re-cap of the NGCT as set out in the 2007 consents.

2.2 Northern Gateway Container Terminal

2.2.1 The NGCT will serve the deep sea container market through the development of a terminal on the site of existing Container Terminal No. 1, the redundant ex-Shell Jetty and the Riverside Ro-Ro No.3 at Teesport.

2.2.2 The NGCT will be able to handle very large container ships and the full build out of 1000m of quay will have a capacity of 1.5million TEU per annum. The NGCT will be constructed in two phases:

- Phase 1 (700m of quay) will have capacity to handle 1million TEUs per annum.
- Phase 2 (100m of quay) will have capacity to handle 1.5million TEUs per annum.

2.2.3 Target modal shares provided by PDT in 2017 for the transportation of containers are shown below:

- Rail – 20% of capacity.
- Road – 70% of capacity.
- Transhipment – 10% of capacity.

2.2.4 The original TA was based on an 80% transfer by road to represent a ‘worst case’ scenario.

2.2.5 The NGCT initially will be served by the expansion of Teesport’s existing rail facilities. A new rail terminal will be commissioned as part of the Phase 2 works which will provide a dedicated connection to Network Rails running lines as shown.

2.2.6 The development can be seen graphically in **Appendix A**.

2.2.7 A secondary access to the NGCT for the emergency services will be provided.

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3 Policy Framework Review

3.1 Historic Policy Framework

3.1.1 Since the NGCT was consented in 2007, there has been a step change in national and local transport planning policy. In 2007 the focus on planning was to achieve a 'nil-detriment' impact on the highway network. In essence, this policy could lead to over provision of infrastructure to secure baseline capacity and was expunged with the introduction of the National Planning Policy Framework (NPPF) in March 2012.

3.1.2 The launch of NPPF led to a change in emphasis to enabling sustainable economic growth. With regard to transport this is captured by the following policy imperative:

"Development should only be prevented or refused on transport grounds where the residual cumulative impacts of the development are severe."

3.2 Current Policy Framework

3.2.1 **Table 3.1** sets out the salient transport policy applicable to the development.

Table 3.1 Transport Policy

Policy	Section/Policy Reference
National Policy	
NPPF March 2012	**Paragraph 32:** *"All developments that generate significant amounts of movement should be supported by a Transport Statement or Transport Assessment. Plans and decisions should take account of whether:* • *The opportunities for sustainable transport modes have been taken up depending on the nature and location of the site, to reduce the need for major transport infrastructure;* • *Safe and suitable access to the site can be achieved for all people; and* • *Improvements can be undertaken within the transport network that cost effectively limits the significant impacts of the development. Development should only be prevented or refused on transport grounds where the residual cumulative impacts of development are severe."*
	Paragraph 34: *"Plans and decisions should ensure developments that generate significant movement are located where the need to travel will be minimised and the use of sustainable transport modes can be maximised."*
	Paragraph 35: *"Plans should protect and exploit opportunities for the use of sustainable transport modes for the movement of goods and people. Therefore, developments should be located where practical to accommodate the efficient delivery of goods and supplies."*
The Strategic Road Network and the Delivery of Sustainable Development September 2013	Under the heading of Environmental Impact, 02/2013 notes that: *"…developers must ensure all environmental implications associated with their proposals, are adequately assessed and reported so as to ensure that the mitigation of any impact is compliant with prevailing policies and standards. This requirement applies in respect of the environmental impacts arising from the temporary construction works and the permanent transport solution associated with the development, as well as the environmental impact of the existing trunk road upon the development itself."*

Policy	Section/Policy Reference
Local Policy	
Redcar and Cleveland, Local Development Framework February 2015.	**Policy CS26 Managing Travel Demand** notes that development proposals will be supported that, improve transport choice, reduce the distance people need to travel, contribute towards a demand management strategy and encourage park and ride at public transport interchanges. The policy notes that the Council will support the implementation of Travel Plans to encourage sustainable transport.
Redcar & Cleveland Publication Local Plan November 2016	**Policy TA 2 – Travel Plans:** Development proposals will be required to support the Redcar and Cleveland Local Transport Plan. Proposals will be supported that: a) improve transport choice and encourage travel to work and school by public transport, cycling and walking; b) minimise the distance people need to travel; c) contribute positively to a demand management strategy to address congestion, environmental and safety issues including managing car parking provision and prioritising bus routes in urban areas; and d) encourage park and ride at public transport interchanges.
Redcar and Cleveland, Local Transport Plan (LTP3) 2011-2021	The following policies have been identified as being critical in achieving the goals of the LTP3 and are considered to be of particular relevance to the application: *PEG2 – Manage the demand for travel, in particular during peak periods. The package of measures will include car parking restraint and enforcement; providing informed travel choices; considerate land use planning.* *PEG4 – Address localised congestion issues, in particular through the development of Workplace Travel Plans and through localised traffic management schemes.* *PEG5 – Manage freight transport in the borough to provide reliability of journey times and minimise adverse environmental impacts.*
Middlesbrough Council Local Development Framework February 2008	**Policy CS18** notes that for development proposals it is necessary to include measures which look to improve mode share. The policy prioritises the use of a balanced car parking strategy, the promotion of car sharing, the exploration of Park and Ride feasibility, the promotion of cycling and walking, advancements in the accuracy of journey time prediction and the use of travel plans and transport assessments for all major developments. **Policy CS19** seeks to improve road safety and environmental quality with partner organisations in both residential and commercial areas. This includes the use of work-place travel plans at new developments.

3.3 Policy Evaluation

3.3.1 A review of the present day transport policy framework indicates the key policy directives can be summarised as managing demand and assigning trips to sustainable modes. Following full consideration of sustainable modes, infrastructure solutions are to be considered to mitigate residual impacts.

3.3.2 It is considered that these policy directives are secured through the transport conditions applied to the 2007 consent. Full details are as follow:

- **Condition 16**: A Business Travel Plan shall be agreed with the Local Planning Authority and the detailed provisions of the Travel Plan shall be implemented immediately following the commencement of development of the first building of the development hereby approved.
- **Condition 28**: Phase 2 of the terminal development shall not operate until the new rail terminal has been completed and is available for use and the Shell Sidings Rail Spur has been reconnected and completed to satisfaction of the Local Planning Authority.
- **Condition 33**: The development hereby granted consent shall not be brought into use unless and until the highway improvement works [full details are set out in **Section 4.4**] have been completed to the written satisfaction of the Local Planning Authority and Highways Agency.

4 Baseline Conditions

4.1 Introduction

4.1.1 This section of the TS considers and updates the baseline conditions and derived traffic assignments which informed the original TA.

4.2 Study Area

4.2.1 The original TA considered a number of discrete lengths of road 'link' that potentially will be impacted by the NGCT traffic. These links are described below in numerical order for ease of reference. **Figure 1** depicts the wider highway network surrounding the study area, providing a graphical overview of the existing highway network.

Link 1

4.2.2 Teesport Link Road is a private road which connects the Strategic Road Network of the A66 and A1053 with Teesport and the site location of the NGCT. The road is predominately a dual lane single carriage road interspersed with dual lane dual carriageway sections.

Link 2 & Link 3

4.2.3 The A1053 links the A66 to the north with the A174 to the south. The road is a dual carriageway and subject to the national speed limit. The A1053 forms part of the strategic road network.

Link 4, 5 and 6

4.2.4 The A174 from its junction with the A1053 heading west is a modern dual carriageway and connects to the A19 to the west, where it connects to the wider highway network. The road is subject to the national speed limit and forms part of the strategic road network.

Link 7

4.2.5 The B1380 Eston Road is a dual lane single carriage road which connects the residential areas of Eston, Normanby and Teesville with the wider highway network, specifically the A174 and A1053. The road is subject to a 30mph speed limit.

Link 8

4.2.6 The A66 is the main west to east traffic route through Teesside from its junction to the east with the A19 and terminating at A1053/A1085 roundabout to the west. Within the study area the A66 is a high speed dual carriageway with two lanes in each direction.

Link 9 and 10

4.2.7 The A19 connects York to the south with Newcastle upon Tyne to the north passing the North York Moors to the east. The A19 is a high speed modern dual carriageway with two lanes in each direction widening to three and four lanes within the Middlesbrough region. The road is subject to the national speed limit and forms part of the strategic road network.

Link 11

4.2.8 The A66 west of the A19 connects Teesside to Workington on the west coast. To the west the A66 passes through Darlington and providing wider links to the A1(M) and M6. Within the study area the A66 is a high speed dual carriageway with two lanes in each direction.

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4.3 Background Traffic Flows

4.3.1 The original TA presented 2005 24hr AADT flows for the study area and utilised these flows to derive a 2029 forecast baseline year (representing 15 years after the completion of Phase 2 of the NGCT).

4.3.2 2016 traffic count data has been obtained from the DfT Traffic Count website for the 11 links within the study area. In addition, for Link 8, one of four manual classified turning count surveys, which were undertaken in support of this assessment in November 2017, has been utilised. **Table 4.1** details daily flows expressed as Annual Average Daily Traffic (AADT).

Table 4.1 Traffic Flows

Link Id	Location	2005 Background Consented TA Traffic Flows		2029 Consented TA Forecast Traffic Flows	2017 Background TS Traffic Flows			
		24hr AADT (two-way)	% HGV	24hr AADT (two-way)	24hr AADT (two-way)	% HGV	+/- 2005 (%)	+/- 2029 (%)
1	Teesport Link Road	5,400	34.3	6,000	4,848	32	-10.2%	-19.2%
2	A1053, A66 to A1085	22,800	8.8	26,100	21,404	7.2	-6.1%	-18.0%
3	A1053, A1085 to A174	17,300	7.8	19,900	16,770	7.5	-3.1%	-15.7%
4	A174, West of A1053	34,500	4.6	39,600	29,693	5.1	-13.9%	-25.0%
5	A174, A172 to A171	26,800	6.9	30,900	23,273	5.9	-13.2%	-24.7%
6	A174, east of A19	48,600	7.2	54,400	43,654	5.4	-10.2%	-19.8%
7	B1380 Eston Road	11,200	4.5	12,900	9,411	3.5	-16.0%	-27.0%
8	A66, east of Cargo Fleet Lane	26,900	9.6	30,100	26,223	9.9	-2.5%	-12.9%
9	A19, north of A66	83,400	9.9	93,200	111,866	5.5	34.1%	20.0%
10	A19, south of A174	33,300	16.7	37,300	31,163	14.1	-6.4%	-16.5%
11	A66, west of A19	68,300	7.2	76,400	69,216	3.4	1.3%	-9.4%

4.3.3 From **Table 4.1** it can be observed that, with the exception of Link 9, all links show a significant decrease in 24hr AADT traffic flows over both the 2005 baseline flows and the +15 future year forecast traffic flows.

4.3.4 It is not clear why A19 (Link 9) is such a departure from the general trend; however, such a deviation relative to the wider network gives rise to concern regarding the sampling method.

4.4 Highway Network Improvements

4.4.1 Condition 33 directed that the development shall not be brought into use unless and until the highway improvement works have been completed. **Table 4.2** details the scope of the highway improvements required and their status.

Table 4.2 Highway Network Improvement Schemes

Scheme No.	Junction	Proposed Infrastructure Enhancements	Completed

1	A66/A1053	Widen entry width from 9.0m to 10.0m	No
		Extend flare length from 26.0m to 30.0m	
2	A1053/A1085	Full-time signal control on each of the A1053(s), A1053(n) and A1085(e) approaches.	Yes - December 2010
		Widening of the circulatory carriageway to four lanes passing the works exit and to three lanes at the A1053(s) approach.	
3	A1053/A174	Extend flare to 3 lanes on A174(w) approach to 90 metres	Yes - December 2010
		Widen A1053 approach from 7.3m to 9.0m	
		Revised circulatory carriageway markings between A1053 and A174(e) arms	
		Widen A174(w) exit from 2 to 3 lanes for a distance of 110m from the roundabout	
		Revise signal timings at each of the A174 approach arms and convert to fulltime operation	
4	A174/A19	Signal control on the A174 approach	Yes - circa 2014

4.4.2 As can be seen from **Table 4.2**, three of the four highway improvement schemes had been completed by the end of 2014. Only relatively minor improvements to the A66/A1053 are pending.

4.4.3 From investigation, it has been determined that the main reason for implementing schemes 2 and 3 early was to co-ordinate roadworks with the construction and completion of Phase 1 of the Teesport Logistics Park. To facilitate the early implementation, PDT entered into an agreement with Gazely Ltd for the purpose of funding and delivering the works. The Teesport Logistics Park currently accommodates distribution centres for Tesco and Asda-Walmart, covering a combined area of 117,100m^2 of warehouse space.

4.4.4 Scheme 4 was incorporated into a Highways England 'pinch point' scheme implemented circa 2014.

4.5 Road Safety

4.5.1 To inform the predicted impacts on road safety, the original TA undertook a review of Personal Injury Collisions (PIC). Five year data sets were obtained from both RCBC and Middlesbrough Council, covering the main highway network in the study area between 2000 and 2005.

4.5.2 To compare the original TA datasets with the existing situation, a 'like for like' comparison of the PIC search areas was undertaken via Crashmap[1]. **Table 4.3** provides details the original TA data sets in comparison with the most recent five year data available on Crashmap. Where the consented TA search area extents were not clearly defined, no further comparisons have been undertaken.

Table 4.3 Road Safety Review

Location	Location	Consented TA (2000 - 2005)	Crashmap (2013 – 2017)

[1] *www.crashmap.co.uk – provides high level open source data including the location, date and severity of collisions.*

	Type	Slight	Serious	Fatal	Totals	Slight	Serious	Fatal	Totals	% +/- over Consented TA
Redcar & Cleveland										
A1053	Link	4	1	0	5	1	0	0	1	-80%
A1053 West of A1053 Junction	Link	17	5	1	23	22	6	0	28	22%
A1053 East of A1053 Junction	Link	9	2	0	11	5	3	0	8	-27%
A174 West of A1053 Junction	Link	9	1	0	10	4	0	0	4	-60%
A174 East of A1053 Junction	Link	23	2	0	25	10	2	0	12	-52%
B1380 Eston Road/High Street	Link	53	0	0	53	9	1	0	10	-81%
A66 West of Teesport Junction	Link	17	1	0	18	16	2	0	18	0%
Normanby Road	Link	40	10	0	50	13	6	0	19	-62%
Local Roads	Link	Not reviewed due to undetermined extent of PIC search areas								
Greystones Roundabout (A1053/A174)	Junction	Severity of collisions not reviewed due to undetermined extent of individual search areas			36	10	0	0	10	-72%
A1053/A66 Teesport Roundabout	Junction				3	2	0	0	2	-33%
A1053/A1085 Roundabout	Junction				6	2	0	0	2	-67%
A174/A1042 Kirkleatham Roundabout	Junction				17	1	1	0	2	-88%
Middlesbrough										
A66 between A19 and Hartington	Link	19	4	0	23	13	0	1	14	-39%
A66, Hartington and Riverside	Link	Severity of collisions not reviewed due to undetermined extent of individual search areas			20	17	2	0	19	-5%
A66 Riverside to Cargo Fleet Lane	Link				3	5	0	0	5	67%
A66/A19 Interchange	Junction				11	15	4	0	19	73%
A66/Riverside Junction	Junction				23	1	0	0	1	-96%
A66/Cargo Fleet Lane Interchange	Junction				52	15	1	0	16	-69%
				Totals	**389**			**Totals**	**190**	**-51%**

4.5.3 As shown by **Table 4.3**, there has been a fall of 51% of total PICs during the period 2013 to 2017 (inclusive), when compared to the data sets presented in the original TA.

4.5.4 Two search areas have identified a percentage increase in PICs, however, this is not considered to be significant when considered relative to the study area conditions.

4.6 Employee Travel

Employee Demand

4.6.1 The development was assessed based on the Port having a handling capacity of 1 million TEU per annum in Phase 1 and 1.5 million TEU handling capacity per annum in Phase 2. 4,472 employees and 5,142 employees will be involved in Phase 1 and Phase 2 respectively.

4.6.2 **Table 4.4** provides a break down of peak hour employee trips arrivals/departures during each phase of the employment.

Table 4.4 Employee Demand

	Existing (2004)	Phase 1 (2010)	Phase 2 (2014)
Employee Numbers	3,642	4,742	5,142
AM Peak INBOUND	131	171	185
AM Peak OUTBOUND	26	34	37
PM Peak INBOUND	26	34	37
PM Peak OUTBOUND	119	155	168

Mode Assignment

4.6.3 To inform a strategy for managing employee vehicle movements, the original TA undertook a review of existing sustainable travel options local to the Proposed Development Area. The review concluded that accessibility to bus and rail options was poor and the quality of the cycle and pedestrian links was 'mixed'.

4.6.4 On this premise, the original TA assigned all the employee trips to single occupancy car trips to facilitate a robust assessment of highway impact.

4.6.5 A review of the current (December 2017) sustainable transport options indicates little change from 2007 baseline and, therefore, the original mode assignment remains a robust starting point for the highway impact assessment.

Employee Distribution

4.6.6 The original TA used the travel patterns of the existing workforce at PDT to distribute the additional staffing requirements forecast for the NGCT. The resultant distribution is detailed in **Table 4.5**.

Table 4.5 Employee Trip Distribution

Origin	Distribution %
Middlesbrough	48.0%
Redcar/Marske	9.8%
Guisborough	7.4%
Stockton	7.1%
Yarm/Ingleby/Eaglescliffe	7.1%
Hartlepool	6.4%
Saltburn/Skelton	6.4%
Darlington	2.7%

Origin	Distribution %
Billingham	2.2%
Lazenby	2.2%
Durham	0.5%
Sunderland	0.2%

4.6.7 It is considered that the socio-economic conditions that influence employee distribution have not been subject to material change and, therefore, the distribution patterns remain valid for a 2017 baseline.

4.7 Freight Movements

4.7.1 The original TA was predicated on the rail assessment in which it was suggested that the NGCT could achieve a maximum rail mode share of 20% due to infrastructure limitations. The limitations influenced:

- train length;
- gauge clearance; and
- available paths.

4.7.2 It is noted that there are commitments from Network Rail in the Control Period 4 (CP4) Delivery Plan for the W10 and W12 gauge clearance from Teesport to the ECML, however, there is no evidence of significant improvements to date that would improve the rail mode share. It is, therefore, considered that the rail capacity assessment which predicated the highway impact assessment remains valid.

HGV Demand

4.7.3 The increase in HGV movements was attributed to the increase in TEU capacity in which a factor of 1.63 TEU/unit was estimated. As established, HGV forecasts are predicated on Road Haulage having an 80% mode share of land based freight movements.

4.7.4 The resultant forecast of HGV numbers to be generated by each phase of the NGCT is provided in **Table 4.6**.

Table 4.6 Forecast HGV Trip Generations

Phase	Daily Trips	AM Peak		PM Peak	
		Arr	Dep	Arr	Dep
Full Phase 1 (1.0m TEUs)	2,137	51	64	87	93
Full Phase 2 (1.5m TEUs)	3,205	76	96	131	139

HGV Distribution

4.7.5 The original TA assumed that container traffic would predominately follow fixed routes utilising the A174 or A66 to access the A19 and onwards to destinations outside of the Teesport area. **Table 4.7** details the predicted distribution for HGVs.

Table 4.7 HGV Container Traffic Distributions

Destination	Sub-Destination	Route	Proportion
Scotland		A66 to A19 (north)	10%

West Yorkshire		A174 to A19 (south)	19%
North West	30%	A66 to A19 (north)	8.7%
North West	70%	A174 to A19 (south)	20.3%
Midlands		A174 to A19 (south)	23%
Other (South West)		A174 to A19 (south)	10%
Local	Billingham	A66 to A19 (north)	5.4%
	Stockton	A66 to A19 (west)	1.8%
	Redcar	A1085	0.9%
	Middlesbrough	A66 to Marton road	0.9%

4.7.6 It is considered the market conditions that informed the HGV distribution have not been subject to material change and, therefore, the distribution shown above remains valid for 2017.

5 Impact Evaluation

5.1 Introduction

5.1.1 This section draws on the comparison of baseline transport conditions contained in **Section 4** to evaluate if the assessed impacts are subject to a material change.

5.2 Traffic Generation and Assignment

5.2.1 It has been evidenced in **Section 4** that there are no material changes to employee and freight mode share, and traffic demand and distribution, in 2017 by comparison to the information used in the original TA.

5.2.2 Noting the 'no change' traffic scenario, it is therefore necessary to establish if changes to baseline highway conditions may influence the findings of the original TA, with particular regard to the conditioned mitigation measures.

5.3 Highway Capacity and Road Safety

5.3.1 **Table 4.1** provides a comparison of 2005 baseline flows to 2017. It has been demonstrated that ten of the 11 links have similar 2017 baseline flows to that of 2005. This indicates that the highway network is stable within the study area and could accommodate the proposed development with the same mitigation strategy proposed within the original TA.

5.3.2 **Table 4.2** indicates that three of the four conditioned highway improvements have been implemented in advance, effectively 'capturing' much of the additional highway capacity required to accommodate the proposed development.

5.3.3 **Table 4.3** compares the 2006 and 2017 baseline road safety conditions and demonstrates a positive reduction in PICs within the study area. This positive trend could be partly attributable to the early implementation of conditioned highway improvements.

5.4 Cumulative Impact

5.4.1 The consented development secured the forecast traffic demand and became a material consideration for all subsequent applications.

5.4.2 Planning consents post the 2007 consent will have been determined in full consideration of the forecast traffic flows. It therefore follows that, in demonstrating no material change in traffic demand, the requirement to assess the cumulative impact of other projects has been satisfied.

6 Summary and Conclusion

6.1 Summary

6.1.1 This TS has been prepared by Royal HaskoningDHV on behalf of PDT in support of an extension to the HRO for the NGCT.

6.1.1 The objective of the TS was to establish if the baseline environment that informed the 2007 consents have been subject to a material change that would lead to a significant change in the assessed impacts.

6.1.2 With regard to the construction phase of the project, the 2006 ES established that the traffic demand will have an impact of **negligible** significance. Therefore the scope of this TS was confined to the operational phase of the proposed development.

6.1.3 The original TA set out the mode share forecasts and baseline conditions that informed the capacity, road safety and ES assessments.

6.1.4 To meet the objective of this TS, its scope was defined as:

- A review of 'present day' transport policy to establish the compliance of the development.
- A review of the TA baseline conditions that informed the impact assessment conclusions for the operational phase of the project.

6.1.5 A review of the present day transport policy framework indicated that the key policy directives can be summarise as managing demand and assigning trips to sustainable modes. Following full consideration of sustainable modes, infrastructure solutions are to be considered to mitigate residual impacts. These policy directives were secured through the transport conditions applied to the 2007 consent.

6.1.6 A comparison of 2007 and 2017 transport baseline conditions evidences that there are no material changes to the employee and freight mode share, thus no material change to the traffic demand. It is also considered that the development traffic distribution that informed the original TA has not been subject to material change.

6.1.7 Noting the 'no change' traffic scenario, a review was undertaken of 2017 highway conditions to ascertain if any changes could influence the findings of the original TA.

6.1.8 It has been demonstrated that ten of the 11 links have similar 2017 baseline flows to that of 2005. This indicates that the highway network is stable within the study area and could accommodate the 2017 proposed development with the same mitigation strategy proposed within the original TA.

6.1.9 Three of the four conditioned highway improvements have been implemented in advance, effectively 'capturing' much of the additional highway capacity required to accommodate the proposed development.

6.1.10 Comparison of the 2006 and 2017 baseline road safety conditions demonstrates a positive reduction in PICs within the study area. This positive trend could be partly attributable to the early implementation of conditioned highway improvements.

6.1.11 The consented development secured the forecast traffic demand and became a material consideration for all subsequent applications. Planning consents post the 2007 consent will have been determined in full consideration of the forecast traffic flows. It follows, therefore, that in demonstrating no material change in traffic demand the requirement to assess the cumulative impact of other projects is satisfied.

6.2 Conclusion

6.2.1 It has been demonstrated that the 2017 NGCT renewal application is policy compliant and the impacts on the transport network are consistent with those assessed in the 2006 TA.

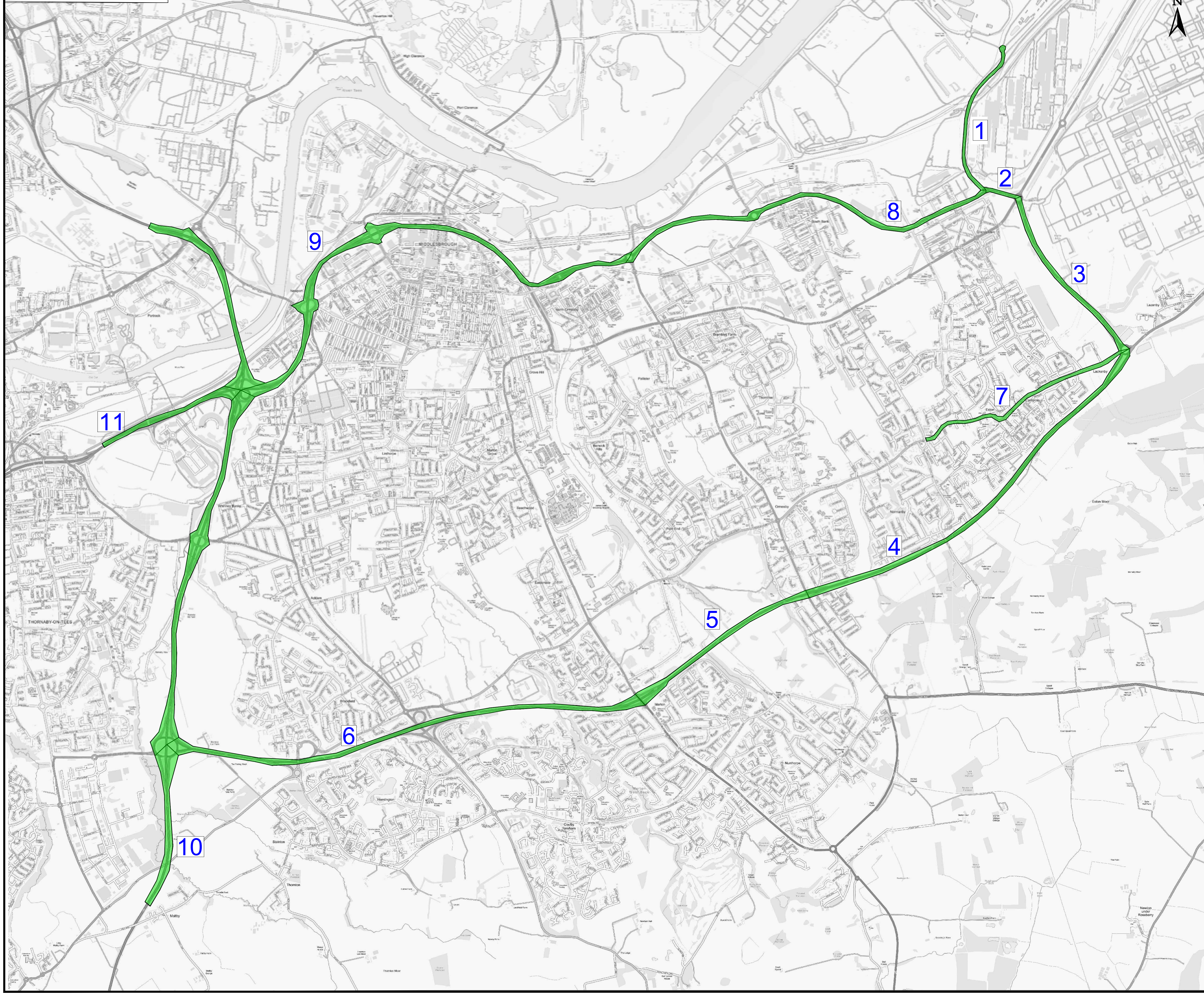
6.2.2 Noting that the TA informed transport effects in the ES, it follows that the 2017 NGCT renewal application is consistent with the assessed environmental impacts also.

6.2.3 It is, therefore, concluded that the 2006 transport impact assessments and mitigation remain valid and there should be no impediment to the renewal of the NGCT planning permissions on transport grounds.

Figures

DRG No. FIGURE 1

DO NOT SCALE



NOTES

KEY

Link

1 Link ID

Royal HaskoningDHV
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NOTHERN GATEWAY CONTAINER TERMINAL

TRANSPORT STATEMENT

STUDY AREA

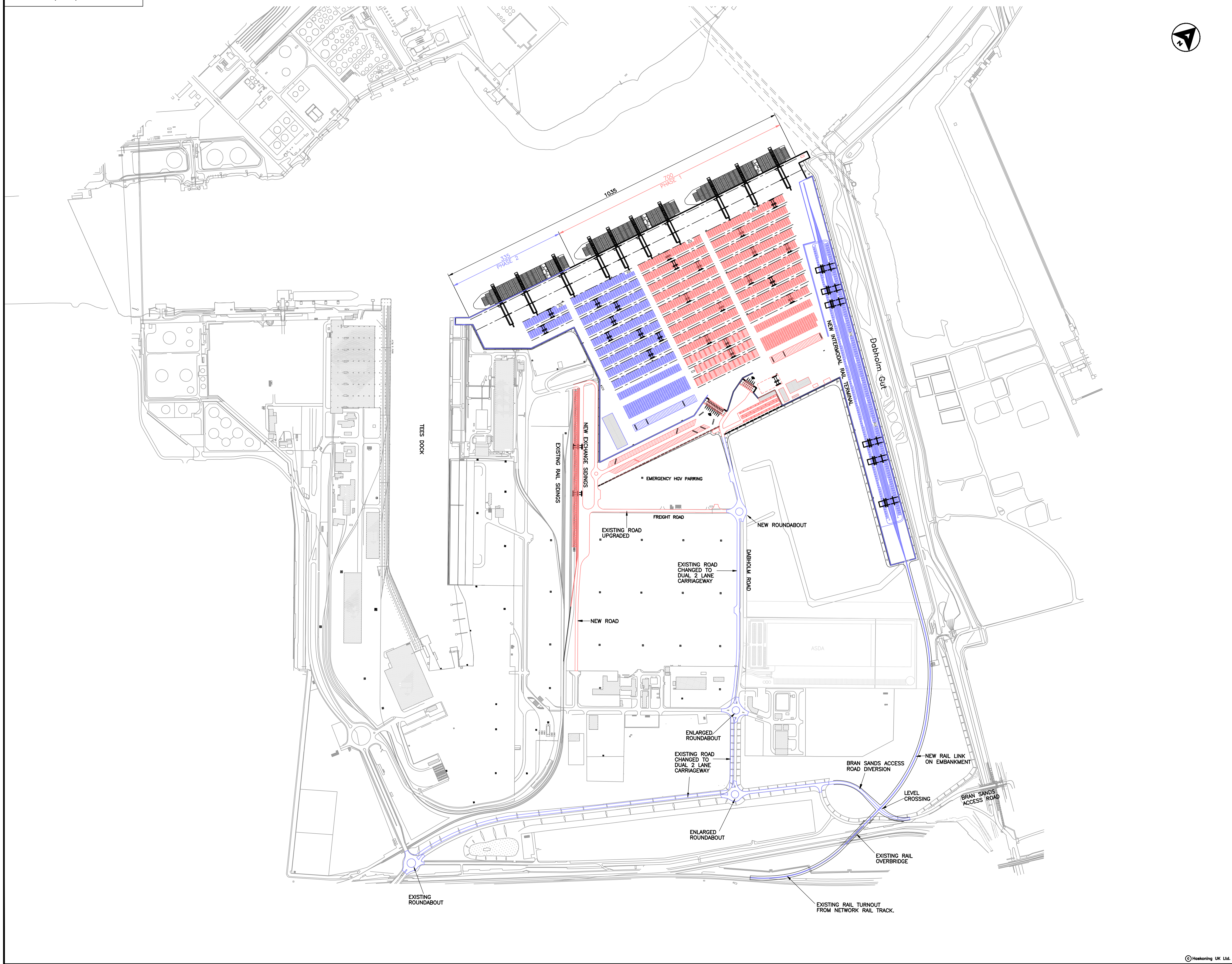
FIGURE 01

Appendix A

Site layout

DRAWING No.
9R0155/PA/1000

DO NOT SCALE



NOTES:

1. PHASE 1 WORKS SHOWN IN RED.
2. PHASE 2 WORKS SHOWN IN BLUE.

REV	DATE	DESCRIPTION	BY	CHK	APPD
4	28/02/07	REISSUED FOR PLANNING BRAN SANDS ACCESS ROAD DIVERSION CHANGED	IT	JDE	TJF
3	20/04/06	ISSUED FOR PLANNING	MC	JDE	TJF

REVISIONS

CLIENT

PD TEESPORT

PROJECT:

THE NORTHERN GATEWAY

DRAWING TITLE:

MASTER PLAN LAYOUT

ROYAL HASKONING

HASKONING UK LTD
NEWCASTLE

DRAWN M.C.	DATE FEB '06
JOB No. 9R0155	AUTOCAD REF. 9R0155 PA 1000.DWG
SCALE AT A1 1:5000	
DRAWING No. 9R0155/PA/1000	REVISION 4

Appendix 18

Archaeological WSI

Royal HaskoningDHV
Enhancing Society Together

REPORT

Northern Gateway Container Terminal

Archaeological Written Scheme of Investigation

Client: PD Teesport

Reference: IEMPB3751R001D01

Revision: 02/Final

Date: 19 November 2015

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Document short title:	Northern Gateway WSI
Reference:	IEMPB3751R001D01
Revision:	02/Final
Date:	19 November 2015
Project name:	Northern Gateway Container Terminal
Project number:	PB3751
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Checked by:	Freddie Scadgell
Date / initials:	19/11/15 - *FS*
Approved by:	Matt Simpson
Date / initials:	19/11/15 - *MS*

Classification
Open

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Executive Summary

PD Teesport is proposing to construct a deep sea container terminal known as the Northern Gateway Container Terminal. Royal HaskoningDHV (Royal Haskoning) prepared an Environmental Statement in 2006 in support of the scheme, and planning permission was received in February 2008 and a Harbour Revision Order was granted.

A desk based assessment for the project was undertaken by AOC Archaeology in 2005. This demonstrated that there were no extant cultural heritage assets within the area proposed for development and that impacts to unknown buried archaeology would be unlikely due to the location of the development upon an area of land reclaimed in the 20th century. The only extant buildings are all of 20th century industrial origin and due to the industrial nature of the site, and the wider area, there would be no impact on settings or the historic character of the site from the development.

The assessment by AOC did identify that the channel dredging, deep water berth and construction of the quay wall may impact archaeological deposits, if present, comprising peat and alluvial deposits associated with the prehistoric environment. As such, a programme of archaeological coring was recommended to assess whether any buried archaeological deposits were present. These aspects of the development were also considered to potentially have an impact on the remains of wrecks or other archaeological material associated with the former maritime use of the River Tees that may be present. The potential for impact, however, was considered low due to the levels of historic dredging that has taken place within the exiting approach channel.

This desk based study has been revisited in light of the recent assessment undertaken for the York Potash Harbour Facilities, located immediately adjacent to the north of the site of the proposed Northern Gateway Container Terminal development. The assessment revealed no further evidence for impacts to cultural heritage sites, and a settings assessment undertaken by Cotswold Archaeology supported the conclusion that, due to the existing industrial nature of the area, there would be no impact to the setting of designated heritage assets within the wider area.

A programme of ground investigation for the York Potash project included vibrocores and boreholes. A broad sedimentary sequence was identified with a sediment unit of peat and estuarine alluvium identified in the boreholes. However, due to the infrequent and slight nature of the peat deposit within this unit (Unit 2) no further work was recommended. This was agreed in consultation at the time with English Heritage (North-East Region) during December 2014.

This current document comprises a summary of the above assessments and a Written Scheme of Investigation for archaeological works to prevent impacts to cultural heritage assets within the footprint of the Northern Gateway Container Terminal.

The scheme of investigations addresses:

- Geoarchaeological assessment in the event that further ground investigation is carried out for the development;
- Archaeological Interpretations of marine geophysical data that may be acquired for the development;
- Ground truthing and possible associated works in the event that significant cultural heritage assets are revealed; and
- A finds reporting protocol to address discoveries encountered during the course of construction.

1 Project Background

PD Teesport is proposing to construct a deep sea container terminal on the site of the existing Teesport Container Terminal 1, the redundant former Shell jetty and the Riverside Ro-Ro No. 3 at Teesport. Capital dredging of the approach channel will be undertaken to provide the required access to the proposed terminal for container vessels. The proposed development is known as the Northern Gateway Container Terminal (NGCT).

Royal HaskoningDHV (RHDHV) has been contracted by PD Teesport to compile an archaeological Written Scheme of Investigation (WSI) setting out the archaeological requirements for NGCT, and to undertake consultation with the Local Planning Authority (LPA) in order to agree the content of the WSI.

An Environmental Statement (ES) was submitted for the proposed scheme by Royal Haskoning (now RHDHV) in 2006. Planning permission and a Harbour Revision Order were granted in 2008. Due to the national economic downturn, the development was subsequently postponed. PD Teesport are now looking to address certain planning conditions in advance of works commencing.

Archaeology and the historic environment were addressed by planning condition 14, set out below:

- Pre-development - written scheme of archaeological investigation to be approved by LPA. Reason: To enable the identification and recording of archaeological and palaeoecological remains.

This document constitutes the draft WSI as required by planning condition 14.

In accordance with Section 106 of the Town and Country Planning Act 1990 (as amended) specific mitigation works with regard to Marine Archaeology included the requirement for a sampling strategy to be submitted to Redcar and Cleveland Borough Council before the commencement of development. This requirement is included in the scheme of investigations presented below (see **Section 6.2**).

A Marine Licence will be required for works below high water (MHWS). This WSI addresses archaeological works within the marine environment and will be updated subsequent to the granting of the Marine Licence, as necessary.

2 Location

A plan showing the location of the proposed development within the Tees Estuary is shown in **Figure 1** (Drawing 9T3867/PLN/1000).

The site of the proposed development is located within the Teesport Estate. The river frontage within the existing Teesport Estate comprises approximately 2000m of quay with seven general cargo berths, three tidal Ro-Ro ramps and two container terminals.

Details of the boundaries of capital dredging for the approach channel and the locations of the disposal areas will be set out in a subsequent iteration of this WSI that will be produced and updated with respect to the required Marine Licence for the NCGT project.

3 Overview of Development

3.1 Construction Phase

The main features of the construction phase are summarised as follows:

- Capital dredging within the existing dredged approach channel to deepen the channel by 0.4m from 14.1m below CD to 14.5m below CD, with deepening from 10.4m below CD to 14.5m below CD for the final (approximately) 1km of the approach to the proposed terminal;
- Realignment of the existing approach channel in the vicinity of the proposed terminal and deepening of the two existing turning circles (Tees Dock turning circle and Seaton Channel turning circle) in the Tees Estuary;
- Construction of a 1000m quay face with a proposed quay deck level of 9.0m above CD (+6.15m OD). It is proposed that the terminal construction would be undertaken in two phases (700m followed by 300m);
- Pumping suitable dredged material ashore for use in the reclamation works and for locally raising land levels within the proposed terminal area;
- Disposal of the balance of the capital dredged material at existing offshore disposal grounds in Tees Bay;
- Relocation of the existing Riverside Ro-Ro facility to accommodate the new container terminal;
- Capital dredging of deep water berthing areas alongside the proposed quay face (dredged to 16m below CD);
- Paving the terminal area (approximately 55ha);
- Provision of an area outside of the terminal fence for emergency parking of heavy goods vehicles (HGVs) (approximately 6ha);
- Construction of a new intermodal rail terminal;
- Installation of cargo handling equipment;
- Modifications to the existing roads within the Teesport Estate to provide vehicular access to the new terminal;
- Entrance and exiting gateways to the terminal;
- Buildings and workshops within the proposed terminal area; and,
- Installation of a surface water drainage system, a pumped foul drainage system, a power supply system (including floodlighting) and installation of a water supply system (including firefighting supply).

With respect to the disposal of dredged material, it is proposed to dispose of the majority of the dredged material offshore (i.e. the balance of material remaining following the reclamation work).

3.2 Operation Phase

The total container throughput of the terminal will be approximately 1.5 million TEU per annum. The terminal will operate 365 days per year, 24 hours per day.

At present, maintenance dredging of the navigation channel and various berthing areas is required throughout the lower Tees Estuary. As a result of the proposed development, it is not expected that the existing maintenance dredging strategy will need significant adjustment. It is proposed that maintenance dredgings will be disposed of at the existing disposal sites in Tees Bay, as currently occurs.

4 Existing Environment

4.1 Desk Based Assessment

The existing environment and impact assessment of the archaeology and cultural heritage resource for the ES was based on an archaeological desk-based assessment (DBA) undertaken by AOC Archaeology Group (AOC, 2005).

The following sources of data were consulted to ascertain the existing baseline environment:

- Museum of Hartlepool, Museum Service (Clarence Road, Hartlepool): For old Ordnance Survey maps (1st & 2nd Edition, small- and large-scale) and pre-Ordnance Survey historical maps;
- Sites and Monuments Records (curated by Tees Archaeology, Hartlepool): For data pertaining to archaeological sites, Listed Buildings and Scheduled Ancient Monuments and World Heritage Sites within the study area;
- Teesside Archives (Middlesbrough): For tithe and enclosure maps pertaining to the proposed development area;
- National Monuments Record (Swindon): For vertical aerial photographs; and
- A site walkover.

The DBA demonstrated that there are no cultural heritage sites within the proposed development area (**Figures 2** and **3**). Details of heritage assets within a 1km buffer (study area) of the site are included in **Appendix I**, as listed in the AOC report.

The DBA report concluded that there would be no impact to buried archaeology from onshore aspects of the development (i.e. the ground breaking works associated with the container terminal, intermodal rail terminal, road modification and offices and workshops). These works will all be located within an area of made ground and land reclaimed in the 20th century and, as such, it is unlikely that they will disturb any previously unknown archaeology. Consequently, no mitigation was deemed to be required in these areas.

The proposed development area does contain the remains of a number of 20th century structures, including industrial remains relating to its use as a docking terminal, some of which were still in use. However, the site visit undertaken by AOC in support of the DBA confirmed that these structures are modern and unremarkable and relate solely to the later 20th century port operations. As such, AOC concluded that Historic Building Recording would not be required prior to demolition.

The construction of the deep water berth and quay wall and capital dredging, however, were considered likely to impact potential archaeology that may be present. The berth and quay wall could disturb peat and alluvial deposits that may be present and that may preserve evidence of the early use of the Tees.

Cartographic evidence reviewed by AOC showed that the area of the site once formed part of the intertidal zone of the River Tees. Similarly, the proposed dredging works will in part impact upon previously undisturbed buried sediments within the Tees Channel, which have the potential to preserve important information relating to early use of the channel, as well as sea level change and the palaeoenvironment. As such, a programme of archaeological coring was recommended to assess whether buried archaeological deposits are present.

The documented losses of several ships in the River Tees also indicate the potential for remains associated with former maritime use to be present. These documented losses are discussed in more details below (**Section 4.2**). The potential impact to maritime remains, however, was considered to be low given that capital dredging will primarily take place within an existing dredged channel.

With regard to potential effects on the setting of cultural heritage assets, AOC concluded that, as there are no designated buildings and monuments within 2km of the site, and as the nearest listed buildings are in Redcar, shielded from the site by mature trees, industrial factories and topography, impacts to setting are unlikely to occur.

4.2 Additional Assessment (York Potash Harbour Facilities)

In 2015 York Potash Limited (YPL) submitted an ES in support of their application for a Development Consent Order (DCO) to develop a harbour facility on Teesside for the export of polyhalite bulk fertilizer (RHDHV, 2015).

The site of the York Potash Harbour Facilities is located immediately adjacent to the north of the NGCT site (**Figure 4**). A 1km study area established for the purposes of the assessment of archaeology and heritage for the York Potash project overlaps the site and study area for the NGCT. Consequently, aspects of the assessment undertaken for the YPL project can also inform current understanding of impact to archaeology and heritage for NGCT.

Data from the Redcar and Cleveland HER acquired for the YPL project include new records of cultural heritage sites in addition to the DBA produced by AOC archaeology in 2005. Three of these are located within the NGCT site and study area. However, these do not relate to extant sites, and comprise of:

- **Site No. 60**
Name: Beacon
HER UID: 6054
Location (BNG): 454650 523910
Description: O.S. 1895. 6" Yorkshire Sheet VI N.E. & 25" Yorkshire Sheet VI.8. 2nd Edition show a River Tees navigation light. Not shown on modern mapping.

- **Site No. 61**
Name: Beacon
HER UID: 6055
Location (BNG): 454680 523910
Description: O.S. 1895. 6" Yorkshire Sheet VI N.E. & 25" Yorkshire Sheet VI.8. 2nd Edition show a River Tees navigation light. Not shown on modern mapping.

- **Site No. 62**
Name: Eighth Buoy Scarp Beacon
HER UID: 6056
Location (BNG): 454840 524350

Description: O.S. 1895. 6" Yorkshire Sheet VI N.E. & 25" Yorkshire Sheet VI.4. 2nd Edition show a River Tees navigation light. Not shown on modern mapping.

Data from the National Record of the Historic Environment (NRHE) acquired for the YPL project did not demonstrate the presence of further monuments within the NGCT site, with the exception of providing further details on the documented losses of vessels in the vicinity of the development.

Maritime records from the NRHE comprised 20 vessels documented as lost within the Tees Estuary. Nineteen of these are grouped by the NRHE at a 'Named Location' adjacent to the NGCT site within the River Tees. Nine of the vessels were lost following collision, nine foundered or were stranded and one was lost after striking a mine during WWI. The date of loss of the nineteen vessels ranges from 1751 to 1921 with a general distribution as follows:

- 1750-1799: 2 records;
- 1800-1849: 4 records;
- 1850-1899: 9 records; and
- 1900-1949: 4 records.

The remaining record is that of the 'wherry' *Heckler* (NRHE 908826/HER 3119), a type of boat traditionally used for carrying cargo or passengers within rivers or canals, that sank in River Tees in the fairway in the vicinity of Teesport in 1960. The current location of the wreck is unknown although the documented location of loss lies adjacent to the Bran Sands lagoon, within the River Tees.

It should be noted that a 'Named Location' is an arbitrary point on the seabed at which the NRHE groups reported losses and the points do not, except by chance, correspond to actual remains on the seabed. Nonetheless, the number of vessels located at this Named Location is a useful indicator of the high potential for the presence of previous unidentified wreck remains within the River Tees. The use of the Estuary as a historic shipping, transport and trade route, and also as a port from at least the medieval period onwards, points to the potential for greater numbers of vessels to have been lost within the Tees, but perhaps not officially reported, and for which surviving wreck material may potentially be present.

4.3 Geoarchaeological Assessment

A *Geoarchaeological Stage 1 Vibrocore and Borehole Assessment* was conducted in October and November 2014 for the YPL project by Cotswold Archaeology (2014a). A programme of marine vibrocoring was undertaken and the vibrocore logs were analysed along with boreholes from the edge of the Tees Estuary. The locations of these boreholes are listed below (**Table 1**) and shown on **Figure 5**.

Table 1: Locations of Vibrocores and Boreholes Acquired for the York Potash Harbour Facilities Assessment (Cotswold Archaeology 2014a)

Vibrocore/Borehole ID	Easting	Northing
VC01A	454598	524826
VC02A	454737	525000
VC03A	454862	524849
VC04	454832	524969
VC05A	454814	525102

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Vibrocore/Borehole ID	Easting	Northing
VC06	454814	525237
VC07	454826	525327
VC08A	454829	525427
BHP2	454964	524966
BHP3	454964	525106
BH4PA	454961	525193
BHP5B	454958	525260
BHP6	454946	525358

The logs revealed five broad sedimentary units. These are summarised in **Table 2**.

Table 2: Summary of Sedimentary Units Identified in Vibrocores and Boreholes for the York Potash Harbour Facilities Assessment (Cotswold Archaeology 2014a)

Sedimentary Unit	Description	Interpretation	General Depth
Unit 5	Silty, sandy gravel with cobbles and inclusions of slag, concrete and brick	Made ground (20th century)	Up to 9.3m thick
Unit 4	Gravelly sandy Clay	Estuarine alluvium/ polluted fluvial sediments	Generally 1 to 2m thick in vibrocores and 0.5m thick in boreholes
Unit 3	Gravelly Sand and slightly silty and clayey Sand	Marine sediments/ Estuarine alluvium	Up to 12m thick in boreholes, basal unit in vibrocores
Unit 2	Sandy/ silty/ gravelly Clay	Estuarine alluvium and peats (possible mid-Holocene sediments)	From 16.7m, generally c. 2m in extent
Unit 1	Extremely weak Mudstone	Weathered Bedrock	Generally present from c. 20m

Only Unit 2 was assessed as having the potential to contain *in situ* prehistoric archaeological material associated with mid-Holocene (broadly covering the late Mesolithic to early Iron Age) seasonal use of the estuary / marshland. Coal was recorded within Unit 2 within borehole BHP3, between 16.7 and 18.2m. In addition, pseudo-fibrous peat lenses/ pockets and fragments of wood and organic material within a clay context were recorded within borehole BHP6, between 20.8 and 21.8m. The development of peat within a clay context indicates temporary marshland/ terrestrial conditions within the estuarine environment.

None of the vibrocores reached a depth to which Unit 2 was encountered and no retained borehole samples included material from Unit 2 that would be suitable for further analysis. Due to the infrequent and slight nature of the peat deposit within Unit 2 (within BHP6 only), Cotswold Archaeology concluded that it would not be guaranteed that further borehole survey would encounter these deposits again and no further work was recommended. This was agreed in consultation with English Heritage (North-East Region) during December 2014 (RHDHV, 2014).

4.4 Settings Assessment

A settings assessment was carried out by Cotswold Archaeology (2014) in relation to a proposed overhead conveyor system, linking to the proposed Harbour Facilities, for the YPL project.

The assessment identified an extensive modern industrial landscape, along the southern bank of the Tees Estuary, comprising:

- Large funnels, vent shafts and stacks associated with the coal, gas and biomass powered generators of the wider Wilton Works Complex;
- Flare stacks, which are regularly set aflame in order to burn off waste emissions;
- Concentrations of large industrial buildings forming the various works' principle units, processing plants and storage facilities;
- Large warehouses and container units;
- Dumps of coal and other combustible fuels; existing material conveyor systems;
- Pipework clusters and grids; pipelines, pylons and power cables;
- Tanks, ponds and cisterns; roads; small areas of waste ground;
- Dumps of industrial waste materials; and
- Emissions (smoke, steam and other gases) produced by the various facilities, which are manifest as coalescing plumes of white, grey and black vapour.

In addition to visual considerations, noise, smell and heat also contribute to the experience of the landscape.

The settings assessment concluded that the addition of the overhead conveyor system (another modern engineering feature) to this landscape would be in keeping with the intensive modern industrial nature of the area and that there would be no change to character of the landscape. Consequently there would be no material change to the setting of heritage assets in the wider area, including:

- Kirkleatham Conservation Area and all of the Listed Buildings within it (including the Grade I Listed Church of St. Cuthbert, the Grade I Listed Sir William Turner's Hospital and Grade II* Listed Old Hall Museum);
- Foxrush Farm and other associated Grade II Listed Buildings;
- Westfield House, Grade II Listed Building;
- Marsh Farmhouse and other associated Grade II Listed Buildings;
- Yearby Conservation Area and other Grade II Listed Buildings within and within proximity to it;
- Manor Farm and other associated Grade II Listed Buildings; and
- Coatham Conservation Area and Listed Buildings within and proximate to it.

As the NCGT development is located in the same industrial complex, and as structures are expected to be of lower height in comparison to the proposed maximum height for the YPL overhead conveyor system, it is similarly concluded that there will be no impact to the setting of these heritage assets from the NCGT development.

Royal HaskoningDHV

5 Impact Assessment and Mitigation Summary

With consideration of the DBA carried out by AOC in 2005, and additional work carried out for the YPL project, potential impacts to the historic environment with respect to the NGCT are summarised as follows.

There are no extant cultural heritage assets within the area of the NGCT development. Therefore, there will be no impact and no mitigation is required.

With regard to the modern industrial structures, the AOC (2005) site visit demonstrated that the structures are modern and unremarkable and relate solely to the later 20th century port operations. Consequently, no mitigation is recommended prior to demolition.

Similarly, there will be no impact to buried archaeology from onshore aspects of the development (i.e. the ground breaking works associated with the container terminal, intermodal rail terminal, road modification and offices and workshops). These works are located within an area of made ground and land reclaimed in the 20th century and, as such, it is very unlikely that they will disturb any previously unknown archaeology. Consequently, no mitigation is recommended.

The construction of the deep water berth and quay wall and capital dredging may impact as yet undiscovered archaeology surviving within the footprint. Potential archaeological remains may comprise wrecks or crashed aircraft and other evidence relating to the former maritime use of the River Tees. There is also the possibility of encountering palaeogeographic features and deposits relating to prehistoric activity and the palaeoenvironment.

Maritime, aviation and prehistoric finds encountered during the course of works, other than those discovered through specific archaeological investigation, will be reported through the finds reporting protocol (see **Appendix II**). In addition, if further ground investigations or geophysical surveys are carried out in advance of capital dredging within the approach channel or the deep water berth area, or in advance of the construction of the quay wall, then archaeological objectives will be included as part of the survey methodology (See **Sections 6.2** and **6.3** respectively).

If significant archaeological remains are identified through geoarchaeological assessment of ground investigation data, or archaeological interpretation of the marine geophysical survey data, then ground truthing to establish the nature and extent of these remains may be required. Ground truthing may take place via diver or Remotely Operated Vehicle (ROV) survey. It may also be possible to combine archaeological objectives within any such survey undertaken for the purposes of identification of Unexploded Ordnance (UXO).

If diver or ROV survey is required, and the presence of significant archaeological remains is confirmed, then further works may be necessary to record archaeological material prior to removal (i.e. preservation by record) or to establish Archaeological Exclusion Zones (AEZs) to ensure preservation *in situ* and to prevent damage or destruction to significant archaeological remains during construction and operational works.

Due to the existing industrial character of the area, there will be no impact to the setting or historic character of the area or to heritage assets in the wider vicinity, as a result of the development, and as such no mitigation is recommended.

The draft outline methodology for proposed mitigation is included as a Scheme of Investigation below.

6 Scheme of Investigation

6.1 Roles, Responsibilities and Communications

RHDHV has been contracted by PD Teesport to produce this WSI and to undertake consultation to agree the WSI with the Local Planning Authority (LPA). RHDHV are responsible for:

- Compiling, reviewing and updating this WSI following consultation with PD Teesport, the LPA and the archaeological curators;
- Advising PD Teesport on their current responsibilities regarding the implementation of the WSI;
- Advising PD Teesport on the necessary interaction with the LPA and archaeological curators and other third parties for the purposes of agreeing this WSI; and
- To consult with the LPA to agree this WSI.

The archaeological curators (LPA) responsible for heritage matters onshore are Redcar and Cleveland Borough Council.

The archaeological curators responsible for heritage matters offshore are Historic England.

PD Teesport will retain the services of a suitably qualified and experienced archaeological contractor (the Retained Archaeologist) to ensure the effective implementation of this WSI. The specific individual nominated by the developer will act as a point of contact with the archaeological curators throughout the currency of the WSI and the work carried out under its terms.

The responsibilities of the Retained Archaeologist will include:

- Advising PD Teesport on their responsibilities regarding the ongoing implementation of the WSI and finds reporting protocol;
- Advising PD Teesport on further necessary interaction with the archaeological curators and other third parties;
- Preparing detailed method statements for all archaeological activities (if required);
- Procuring, monitoring the work of, and liaising with specialist archaeological sub-contractors (if required);
- Monitoring the preparation and submission of archaeological reports, as appropriate, and making them available to the archaeological curators for review and approval; and
- Advising PD Teesport on any final requirements and arrangements for further analysis, archive deposition, publication and popular dissemination.

All contractors engaged in the construction of the project will need to:

- Familiarise themselves with the requirements of the WSI and make the contents available and accessible to their staff;
- Adhere to legal obligations in respect of 'wreck' and 'treasure' under the Merchant Shipping Act 1995 and the Treasure Act 1996 respectively;
- Assist and afford access to archaeologists employed by PD Teesport;
- Inform the Retained Archaeologist of any environmental constraint or matter relating to health, safety and welfare of which they are aware, that is relevant to the archaeologists' activities; and

- Implement and strictly adhere to the finds reporting protocol.

It is not the responsibility of the Retained Archaeologist to implement the requirements of this WSI but rather to advise PD Teesport on their overall responsibility for the implementation of this WSI and the finds reporting protocol.

6.2 Geoarchaeological Assessment

The ES for NGCT recommended that a programme of archaeological coring be conducted in order to further assess whether the potential for any buried prehistoric deposits exists, and to help substantiate the presence or absence of any such deposits.

A vibrocore and borehole survey undertaken for the YPL project revealed a single unit (Unit 2: Estuarine Alluvium and Peats) of archaeological potential. However, due to the infrequent and slight nature of the peat deposit within the unit no further work was recommended at that stage. This was agreed in consultation with English Heritage at the time (December 2014). It was recommended, however, that, suitable samples should be taken if future works are found to impact upon any peat deposits.

In accordance with the recommendation by AOC, and with consideration of the results of the geoarchaeological assessment undertaken for the YPL project, if any further ground investigations are undertaken in advance of construction and dredging for NGCT, all collected cores and samples will be subject to geoarchaeological assessment.

If further ground investigations are required, PD Teesport and/or their appointed representative will procure a suitably qualified and experience geoarchaeological contractor to undertake the work, as advised by the Retained Archaeologist and agreed in further consultation with the archaeological curators.

The principal objective of any geoarchaeological assessment would be to determine whether any significant archaeological, palaeoenvironmental or geoarchaeological remains are present within the footprint of the approach channel, deep water berths and area of the quay wall.

If required, geoarchaeological assessment would take place via a staged approach:

- **Stage 1:** Integration of archaeological objectives into any planned borehole/vibrocore surveys:
  - PD Teesport and the geotechnical contractor would take into account the advice of the Retained Archaeologist and geoarchaeological sub-contractor in planning ground investigation surveys;
  - Advice would be provided on the suitability of the planned survey methodology and equipment for archaeological purposes;
  - Consideration would be given to the archaeological potential of areas in planning the location of the boreholes/vibrocores;
  - Consideration would be given to requirements for onsite subsampling, recording and logging of cores, including provision for a geoarchaeological watching brief during the acquisition of cores and subsamples if required; and
  - The planned survey would be designed to allow for non-archaeological objectives and archaeological objectives to be combined within one survey, if it is not possible to take one core that covers both, two cores may be necessary at each location.
- **Stage 2:** Initial assessment of borehole/vibrocore logs:
  - PD Teesport would ensure that the core logs are available to the geoarchaeological contractor;

- The geoarchaeological contractor would review the core logs to provide an overview of the sedimentary sequence within the area of study and identify the archaeological potential of identified sediment units; and
- On the basis of the review the geoarchaeological contractor would identify the requirements for Stages 3 to 5, to be presented in a report and agreed with the archaeological curators and PD Teesport.

- **Stage 3:** Geoarchaeological assessment of cores:
  - If sedimentary units with archaeological potential are identified during Stage 2 then PD Teesport would ensure that undisturbed cores and associated samples are available to the geoarchaeological contractor for further assessment;
  - The geoarchaeological contractor would undertake archaeological recording and subsampling in accordance with, and allowing for, the objectives of the geotechnical contractor, as agreed in Stage 1). One undisturbed half of each core containing archaeological deposits would be required for geoarchaeological recording;
  - Each selected core sample would be cleaned and recorded, noting sediment colour, type and inclusions;
  - Sub-samples would be collected for palaeoenvironment analysis, if required;
  - On the basis of the review the geoarchaeological contractor would identify the requirements for Stages 4 and 5, to be presented in a report and agreed with the archaeological curators and PD Teesport.
- **Stage 4:** Palaeoenvironmental analysis and dating:
  - As appropriate, palaeoenvironmental assessment for some or all of the following indicators of past environments would be carried out by the geoarchaeological contractor:
    - Plant macro-fossils;
    - Pollen;
    - Diatoms;
    - Ostracods;
    - Foraminifera;
    - Insects and molluscs; and
    - Charcoal.
  - Assessment may also include some scientific dating of samples;
  - The results of palaeoenvironmental analysis would be presented in a report and would inform the requirements for stage 5 and any recommendations for further work.
- **Stage 5:** Production of a geoarchaeological deposit model and recommendations for further mitigation, if required:
  - The results from stages 1 to 4 would be collated in a database and used to generate a deposit model of the buried deposits and landscape features present within the area of study;
  - The deposit model will also include relevant results from other surveys including:
    - Geoarchaeological assessment of vibrocores/boreholes by Cotswold Archaeology for the YPL project; and
    - The results of any seismic (sub-bottom) survey undertaken for the purposes of NGCT.

- A geoarchaeological assessment report would be produced to collate the results for stages 1 to 5 and to outline any recommendations for further work.

If ground investigations are carried out for NGCT, and geoarchaeological assessment is required, a detailed methodology would be set out in a Method Statement to be agreed with the archaeological curators and PD Teesport, as advised by the Retained Archaeologist, prior to the commencement of works. The methodology for geoarchaeological assessment would be carried out in accordance with best practice as set out in available industry standards and guidance, including:

- English Heritage, forthcoming, The Historic Environment in Ports and Harbours in England: Practical Approaches for the Assessment and Management of Marine Archaeology During Port and Harbour Development, English Heritage (EH 6801);
- English Heritage, 2011, Environmental Archaeology: A Guide to the Theory and Practice of Methods, from Sampling and Recovery to Post-excavation (second edition, English Heritage (51644));
- Gribble, J. and Leather, S. for EMU Ltd., 2011, Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector. Commissioned by COWRIE Ltd (project reference GEOARCH-09); and
- English Heritage, 2007, Geoarchaeology: Using earth sciences to understand the archaeological record, English Heritage (50848).

The Method Statement would include detailed requirements for reporting and archiving associated with this package of archaeological works. Reports will be made available to the archaeological curators for review and comment prior to final issue.

6.3 Marine Geophysical Survey Assessment

The DBA by AOC (2005) concluded that the potential impact to maritime remains was considered to be low given that capital dredging will primarily take place within an existing dredged channel.

In order to confirm this, any marine geophysical survey data acquired prior to the commencement of construction, specific to the NGCT scheme, will be subject to archaeological interpretation by a suitably qualified and experienced archaeological contractor.

The principal objective of any geophysical assessment would be to determine whether any significant archaeological and palaeogeographical features are present within the footprint of the approach channel, deep water berths and the area of the quay wall.

It is envisaged that geophysical survey may be required for NGCT in order to inform the dredging methodology for the channel and deep water berths and the construction methodology for the quay wall. Geophysical survey may also be required to inform the risk from Unexploded Ordnance (UXO) that may be present within the footprint of proposed dredging activity.

If marine geophysical survey is required then archaeological objectives will be incorporated within the methodology for planned surveys, as advised by the Retained Archaeologist and in agreement with the archaeological curators and PD Teesport.

Potential surveys and their relevance to the assessment of archaeology and paleogeography include:

- Sidescan sonar:

- Applies to the identification of wrecks and crashed aircraft that may be present on the surface of the seabed, including materials and debris fields associated with these sites.
- High resolution sidescan sonar data suitable for archaeological interpretation is usually acquired through a combination of high frequency and short range (e.g. 500 kHz at a range of 50m or 75).
- Coverage of 200% is ideal for archaeological interpretations (100% overlap of swaths of sonar data) with a minimum of 100% coverage.

- Multibeam bathymetry:
  - Can assist in the identification of wrecks and crashed aircraft that may be present on the surface of the seabed, although the technique is less effective than sidescan sonar in detecting smaller sites with little vertical expression.
  - Higher resolution data is obtained through a shorter distance between the multibeam echo sounder and the seabed.
- Magnetometry:
  - Used to detect ferrous material lying on, or buried within, the seabed.
  - Unlike sidescan and multibeam, magnetometers can detect buried material and can identify a wreck as either wooden or metal hulled, for example.
- Sub-bottom profilers:
  - Seismic surveys are used to profile the sub-seabed geology.
  - Used in combination with ground investigation surveys (cores) to facilitate the identification of sub-surface palaeogeographic features, such as palaeochannels, associated with prehistoric submerged landscapes.
  - Choice of line spacing determines the level of the detail recorded, the smaller the line spacing the greater the detail recorded.
  - Seismic data may also detect the presence of buried wrecks if the system passes directly over the site.

Marine geophysical data acquired by a geophysical contractor will be provided in raw format to the appointed archaeological contractor, together with vessel track plots and details of the survey (i.e. equipment used, weather conditions etc.). The data would then be processed using specialist software by the archaeological contractor according to different settings that allow for the appropriate enhancement of the geophysical data for archaeological interpretation. Individual anomalies are assessed, grouped and characterised according to their archaeological potential. The assessment would also be integrated with pre-existing records of wrecks and obstructions from the area of study and any other relevant information that helps facilitate the archaeological identification and interpretation of identified anomalies in the data (e.g. secondary sources or the results of similar surveys or archaeological studies in the area of the River Tees).

The results would be presented in a report that will include any recommendations for further work, such as ground truthing using divers or ROV survey, to be agreed by the archaeological curators and PD Teesport.

If geophysical surveys are carried out for NGCT, and archaeological assessment is required, a detailed methodology would be set out in a Method Statement and would be agreed with the archaeological curators and PD Teesport, as advised by the Retained Archaeologist, prior to the commencement of works. The methodology for assessment would be carried out in accordance with best practice as set out in available industry standards and guidance, including:

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- English Heritage, forthcoming, The Historic Environment in Ports and Harbours in England: Practical Approaches for the Assessment and Management of Marine Archaeology During Port and Harbour Development, English Heritage (EH NHPP project ref: 6801);
- Plets R., Dix J. and Bates R. (2013) Marine Geophysics Data Acquisition, Processing and Interpretation, Guidance Notes, published by English Heritage (product code:51811); and
- Chartered Institute of Archaeologists (CIfA), 2014a, Standard and Guidance for archaeological geophysical survey.

The Method Statement would include detailed requirements for reporting and archiving associated with this package of archaeological works.

6.4 Diver/ROV Survey and Associated Works

If remains of archaeological potential are identified during the review of marine geophysical data then ground truthing using divers or ROV survey may be required to clarify the nature and extent of the remains prior to the commencement of works.

If diver/ROV survey is planned in relation to the identification and clearance of UXO within the prosed footprint then archaeological objectives may be incorporated within the proposed UXO works. If no UXO related ground truthing is required then PD Teesport and/or their appointed representative would, as required, procure a suitably qualified and experience diving or ROV contractor to undertake the work, as advised by the Retained Archaeologist.

If the presence of significant archaeological remains was confirmed then measures for recording significant archaeological remains may be required prior to removal (preservation by record) or for their preservation *in situ* (through AEZs). This would be discussed and agreed with the archaeological curators and PD Teesport prior to dredging and construction works commencing.

The requirement and objectives for any diver or ROV survey would need to be informed by the results of the marine geophysical survey assessment with an agreed methodology detailed in a survey specific Method Statement to be agreed through further consultation with the archaeological curators and PD Teesport.

6.5 Finds Reporting Protocol

Any archaeological discoveries that come to light during the course of the NGCT dredging and construction phases ,other than those discovered through specific archaeological investigation, will be addressed by the implementation of an archaeological reporting protocol.

The main objective is to reduce any adverse effects on heritage by enabling people working on the NGCT project to report archaeological discoveries in a manner that is conducive to their everyday work and that allows for efficient reporting so that archaeological advice can be provided in a timely manner.

Expected archaeological works would comprise:

- Toolbox talks to ensure understanding of and adherence to the reporting protocol by NGCT staff and contractors; and
- Operation of the protocol throughout the construction phase.

Specific objectives are to:

- Ensure all staff and contractors are fully aware of the mechanisms for reporting discoveries through the protocol and are provided with advice on identifying finds, 'first-aid for finds' and initial recording;
- Ensure that all discoveries are addressed in an efficient and proportionate manner to prevent adverse effects from further impacts associated with the proposed scheme; and
- Ensure that details of the discovery are forwarded to Historic England, the appropriate Local Government Archaeology Officer(s), the Receiver of Wreck, if required, and other stakeholders, as relevant.

The proposed archaeological reporting protocol for NGCT is included as **Appendix II**. The proposed protocol is set out in accordance with the methodology adopted for the Marine Aggregates Industry (MAI) and set out in the British Marine Aggregate Producers Association (BMAPA) and English Heritage Protocol for reporting finds of archaeological interest (Wessex Archaeology, 2005).

The proposed protocol will be agreed in advance of works with the archaeological curators and PD Teesport.

Responsibility for the implementation of the Protocol rests with PD Teesport.

The services of an appropriately qualified contractor will be secured by PD Teesport and/or their appointed representative to operate the protocol during the pre-construction and construction phases of the project. The contractor will carry out toolbox talks for PD Teesport staff and contractors in advance of work commencing on site. The number and frequency of these talks will be agreed by PD Teesport with the archaeological curator prior to works commencing.

Reporting on individual discoveries will occur in accordance with the terms of the protocol and will comprise:

- A summary data sheet report outlining the circumstances of the discovery, an interpretation of the find and actions taken to address the discovery; and
- A MIDAS compliant heritage report for submission to national and local authority heritage data archives.

MIDAS is the UK Historic Environment Data Standard for recording cultural heritage information established by The Forum on Information Standards in Heritage (FISH) (2012). The data standard suggests the minimum level of information needed for recording heritage assets and covers the procedures involved in understanding, protecting and managing these assets. It also provides guidelines on how to support effective sharing of knowledge, data retrieval and long-term preservation of data.

Throughout the pre-construction and construction phases, PD Teesport will submit notification of the date from which the protocol is active with monthly reports if finds are made and an annual report to summarise the implementation of the protocol to the curators (Historic England and Redcar and Cleveland Borough Council) so that the effectiveness of the protocol can be monitored.

Following the completion of the proposed scheme a final report will be produced summarising the results of the protocol. Even if no discoveries are reported a "nil discovery" report will be issued to demonstrate adherence to the protocol throughout the pre-construction and constructions phases of NGCT.

6.6 Reporting and Archive

As outline above, stand-alone reporting will be produced for each stage of fieldwork. Each report would include a clear statement of the archaeological value (importance) of the results, and their significance in the context of relevant research agendas, as appropriate.

Archaeological reports will be prepared in accordance with the guidance given in the relevant CIfA and English Heritage guidance documents. Reports will typically include:

- A non-technical summary;
- The aims and methods of the work;
- The results of the work including finds and environmental remains;
- A statement of the potential of the results;
- Proposals for further analysis and publication; and
- Illustrations and appendices to support the report.

A digital version of the reports once fully reviewed and approved by PD Teesport and the LPA and/or Historic England, will be placed with OASIS (Online Access to the Index of Archaeological Investigations) at - www.oasis.ac.uk. This will be arranged for by the Retained Archaeologist. The project records will include technical details for each technique used in the project. Subject to any contractual requirements on confidentiality, copies of the OASIS record would be integrated into the relevant local and national records and published through the Archaeology Data Service – ArchSearch catalogue. This will include an uploaded .pdf version of each fieldwork report (a paper copy will also be included with the archive).

Final reports will also be submitted to the Redcar and Cleveland HER for inclusion in their database of archaeological events.

On completion of the project and if merited by the significance of the findings, articles would be published in a range of journals and publications, again suitable to the significance of the findings, and in accordance with recommendations made in the post-excavation assessment, analysis and reporting. All publication matters will be discussed and agreed in advance with PD Teesport and the archaeological curators.

The project archive will consist of all written, drawn, photographic and digital records and artefacts/ecofacts related to and generated by the NGCT archaeological works. The archive will be prepared for long-term storage in accordance with Archaeological Archives: A Guide to Best Practice in Creation, Compilation, Transfer and Curation (Brown, 2007) and Standard and Guidance for the creation, compilation, transfer and deposition of archaeological archives (CIfA, 2014b).

Detailed provisions for reporting and archiving will be set out in the Method Statements for each package of archaeological works (geoarchaeological assessment, marine geophysical survey, diver/ROV survey and associated works), if required.

6.7 Resources and Timetabling

The timetable for construction works is not yet finalised and, once known, the details of the timetabling for proposed works will be set out in the Method Statement for each package of works. Due to the phased construction of the NGCT, the overall timetable for works is expected to take a number of years to complete.

The geoarchaeological assessment, marine geophysical survey, diver/ROV survey and associated works, if required, will be undertaken by appropriately qualified and experienced archaeological contractors. The archaeological contractors will provide staff CVs of the Project Manager, Project Officer and any proposed specialists. Such staff will be able to demonstrate an appropriate level of experience and expertise and should preferably, where appropriate, be Members of the CIfA.

All equipment and tools (including computer hardware and software) required by the archaeological contractors are to be supplied by the archaeological contractors.

The archaeological contractor(s) must give immediate warning should any agreed programme date not be achievable, due to for example unforeseen access issues, and early warning must be given on any costing and/or budget concerns.

6.8 Confidentiality and Copyright

Although certain information regarding the development is in the public domain, the construction works, including archaeological works, may attract interest.

In the event of any enquiries by the public, the archaeological contractor(s) will refer all enquiries to the Principal Contractor, PD Teesport and/or their representatives without making any unauthorised statements or comments.

The archaeological contractor(s) will not disseminate information or images associated with the project for publicity or information purposes, without the permission of PD Teesport and/or their representatives.

The archaeological contractor(s) shall assign copyright in all reports and documentation/images produced as part of this project to PD Teesport. The contractor shall retain the right to be identified as the author/originator of the material.

The archaeological contractor(s) may apply in writing to use/disseminate any of the project archive or documentation (including images), and any such permission will not be unreasonably withheld.

Following submission of the final approved reports to Redcar and Cleveland HER, the information within them will be publicly accessible under the Freedom of Information Act (2000) and the Environmental Information Regulations (2004).

6.9 Health and Safety

The archaeological contractor(s) will adhere to risk assessments and any project specific health and safety plan prepared by or for PD Teesport and the Principal Contractor.

The archaeological contractor(s) will provide details of their public and professional indemnity insurance and all other insurances required by law.

The archaeological contractor(s) will have their own Health and Safety policies compiled using national guidelines, which conform to all relevant Health and Safety legislation. A copy of the sub-contractor's Health and Safety policy will be submitted to PD Teesport and/or their representatives prior to works commencing.

If it is necessary to visit site, as a minimum the following PPE will be worn at all times:

- High visibility vest / jacket;
- Approved work wear (e.g.: overalls/trousers/long-sleeved tops/no shorts).
- Hard hat; and
- Safety boots with reinforced toes and mid-sole, with ankle support.

Where appropriate and necessary, additional PPE including safety glasses and gloves will be utilised.

In undertaking all work the contractors, archaeologists and other staff (as applicable) are to abide by all statutory provisions and by-laws relating to the work in question, especially the Health and Safety at Work Act 1974.

No lone working will be permitted at any time.

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Appendix I

Cultural Heritage Sites within the 1km site buffer identified by AOC (2005)

Site No. 1
Name: Bran Sands QL/QF Site
Type of remains: Bombing Decoy Site
Grid reference: NZ 5590 2360
SMR ID no: 4365
Description: Former WWII bombing decoy QL/QF site. QF component was a fire based decoy. Fires were lit to represent sites already under attack thus diverting the enemy fire away from the real target. QL site was designed to replicate furnace glow and railway marshalling yards of the Cleveland Ironworks. The first reference to Bran sands QL site is 2nd October 1942, to QF it is 1st May 1943. The last reference to both sites is 1st May 1943 (Dobson 1996). The site is now built over.

Site No. 2
Name: Eston Grange (Grangetown)
Type of remains: Railway Station
Grid reference: NZ 5490 2180
SMR ID no: 4360
Description: Station at Grangetown formerly known as Eston Grange opened November 1885, replacing Eston Junction Station (SMR 4358) to the West. The name change to Grangetown occurred in 1902, bringing it in line with the community which it served (Crow 2000) A well-built ashlar subway is the only survival of the station (RCHME 1993).

Site No. 3
Name: South Bank
Type of remains: Railway Station
Grid reference: NZ 5266 2112
SMR ID no: 4359
Description: A station was opened at South Bank in 1882, on the site which it occupied for the next 102 years. Today's station is approximately 750 yards east of the former site. Not to be confused with SMR 4358 (Site 4). The Station is now disused and is superseded by the modern South Bank (Crow 2000).

Site No. 4
Name: Eston Junction
Type of remains: Railway Station
Grid reference: NZ 5386 2137
SMR ID no: 4358
Description: Former station at Eston Junction. The station was sited on the Middlesbrough - Redcar railway at the junction with the Eston railway between South Bank and Grangetown. The station was built in 1850 at the time of the construction of the Eston Branch. The Station was substantial. One of three to have the name of Eston Station. The station was renamed South Bank in December 1877, but for only five years.

Site No. 5
Name: Warrenby
Type of remains: Spear

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Grid reference: NZ 5650 2450
SMR ID no: 239
Description: Early Medieval iron spearhead with leaf shaped blade and closed socket. Length 36cm and blade width 3.1cm. Socket and blade have been made separately with a hammered joint. The tip of the spear is missing from a recent break. There are the remains of the shaft in the socket. The spear was found at a slag tip in the 1930s on the site of an old blast furnace by Mr G E Dickinson of Redcar.

Site No. 6
Name: West Coatham Marsh
Type of remains: Saltmound, Medieval
Grid reference: NZ 5681 2358
SMR ID no: 3750
Description: Sub triangular salt mound marked on O.S 1st edition Map. Not now extant.

Site No. 7
Name: West Coatham Marsh
Type of remains: Saltmound, Medieval
Grid reference: NZ 5736 2380
SMR ID no: 3751
Description: Large ovate salt mound marked on 1st edition O.S. Map Not now extant.

Site No. 8
Name: West Coatham Marsh
Type of remains: Saltmound, Medieval
Grid reference: NZ 5736 2380
SMR ID no: 3752
Description: Large ovate salt mound marked on 1st edition O.S with a trig point on the summit. Not now extant.

Site No. 9
Name: West Coatham Marsh
Type of remains: Saltmound, Medieval
Grid reference: NZ 5714 2400
SMR ID no: 3753
Description: Marked on 1st edition O.S. Map Not now extant.

Site No. 10
Name: West Coatham Marsh
Type of remains: Saltmound, Medieval
Grid reference: NZ 5714 2400
SMR ID no: 3754
Description: Ovate salt Mound marked on 1st edition O.S. Map Not now extant.

Site No. 11
Name: West Coatham Marsh
Type of remains: Saltmound, Medieval
Grid reference: NZ 5748 2382
SMR ID no: 3755
Description: Ovate salt Mound marked on 1st edition O.S. Map. Not now extant.

Site No. 12
Name: West Coatham Marsh
Type of remains: Saltmound, Medieval
Grid reference: NZ 5744 2391
SMR ID no: 3756
Description: Ovate salt Mound marked on 1st edition O.S. Map Not now extant.

Site No. 13
Name: West Coatham Marsh
Type of remains: Saltmound, Medieval
Grid reference: NZ 5760 2412
SMR ID no: 3758
Description: Ovate salt Mound marked on 1st edition O.S. Map Not now extant.

Site No. 14
Name: West Coatham Marsh
Type of remains: Saltmound, Medieval
Grid reference: NZ 5763 2406
SMR ID no: 3757
Description: Salt mound marked on 1st Edition O.S. two sub-circular mounds with a bridging causeway. Not now extant

Site No. 15
Name: West Coatham Marsh
Type of remains: Saltmound, Medieval
Grid reference: NZ 5739 2418
SMR ID no: 3759
Description: Small sub-circular saltmound marked on 1st edition O.S. Map Not now extant.

Site No. 16
Name: West Coatham Marsh
Type of remains: Saltmound, Medieval
Grid reference: NZ 5670 2340
SMR ID no: 3749
Description: Ovate salt Mound marked on 1st edition O.S. Map Not now extant.

Site No. 17
Name: Grangetown
Type of remains: Signal Box 20th century
Grid reference: NZ 5524 2211
SMR ID no: 4782
Description: Signal box dating to 1954. This box operated a panel frame dating to 1984. The box is still in use and stands on the side line NE of Grangetown Station.

Site No. 18
Name: River Tees
Type of remains: Pottery
Grid reference: NZ 5338 2291
SMR ID no: 651

Description: Found in Tees by Mr Watkinson whilst Dredging. Stone ware flagon. Cracked. There is a hole in the side where it was hit by the bucket of the dredger.

Site No. 19
Name: Coatham Sands Pillbox
Type of remains: Pillbox
Grid reference: NZ 5660 2605
SMR ID no: 1828
Description: Rectangular pillbox with extension at either end. Land use is sand and dump for British Steel waste. In excellent condition in 1997.

Site No. 20
Name: Coatham Sands Pillbox
Type of remains: Pillbox
Grid reference: NZ 5660 2619
SMR ID no: 1829
Description: 3m square Pillbox of brick and concrete in a poor state of repair, bricks inside the pillbox are marked ‘Carlton’ ‘LBC’ ‘Calder’ and others are unmarked. Large entry port on W side appears to be modern addition. Land use is sand dunes and dump for British steel waste.

Site No. 21
Name: River Tees
Type of remains: Stone axe
Grid reference: NZ 5437 2618
NMR ID no: 27759
Description: A Neolithic stone axe head was found in 1892. It was dredged from the River Tees about a mile from its mouth. It was given to the Dorman Memorial Museum Middlesbrough.

Site No. 22
Name: Redcar
Type of remains: Moated sites
Grid reference: NZ 575 243
NMR ID no: 27784
Description: Two possible moated sites. Now destroyed. Earthworks of uncertain type and period.

Site No. 23
Name: River Tees Port sanitary Authority Floating Hospital
Type of remains: Hospital, ship
Grid reference: NZ 536 233
NMR ID no: 1075645
SMR ID no: 2812
Description: Built in 1885 to designs by Head Wrightson and comprised a floating platform on pontoon supporting two wards and an administration block. During World War I the Royal Navy took the hospital over for accommodation. It was sold in 1917.

Appendix II

Northern Gateway Container Terminal Draft Finds Reporting Protocol

Approach

The approach taken in implementing the archaeological reporting protocol for NGCT will follow that set out in the Marine Aggregates Industry (MAI) Protocol for reporting finds of archaeological interest (Wessex Archaeology, 2005).

The MAI Protocol has been operating since 2005 and has proved efficient and successful in addressing discoveries of archaeological interest from dredging within MAI licence areas. Between 2005 and 2014, 330 separate reports have been filed addressing over 1000 finds. The MAI protocol for marine dredging reflects discoveries under similar conditions to the capital dredging for NGCT and the methodology is thus considered applicable to the current scheme.

The approach for NGCT will mirror that of the MAI Protocol comprising the following structure:

- Awareness training provided to staff and contractors in advance of works commencing;
- Discoveries can be made on the seabed, on board a vessel or ashore;
- NGCT staff to provide first aid to finds and record basic details of any discovery;
- Discoveries are reported to the archaeological contractor who will provide initial advice and seek further specialist advice, as necessary;
- Measures to address the discovery are established by the archaeological contractor, in consultation with PD Teesport and the curator, as necessary;
- Measures are implemented by NGCT staff; and
- A summary report is provided to stakeholders by the archaeological contractor and a MIDAS compliant report is forwarded to national and local authority heritage data archives.

Relevant information can also be drawn from The Crown Estate Protocol for Archaeological Discoveries: Offshore Renewables Projects (Wessex Archaeology 2014).

Types of Discovery

Discoveries may comprise finds, seabed obstructions or seabed anomalies.

Finds are categorised as:

- Wreck: all artefacts that have originated from a vessel in accordance with the legal definition of 'wreck' in the Merchant Shipping Act (1995) and which must be reported to the Receiver of Wreck;
- Non-wreck: cultural artefacts that are present within terrestrial contexts and/or on the seabed as a result of having been lost on land, either at times of lowered sea-level or eroded from the shore, for example; and
- Treasure: artefacts above low water that are not 'wreck' and that are considered 'treasure' under the Treasure Act 1996 must be reported to the relevant Coroner's Office, the North and East Yorkshire Finds Liaison Officer (who is the designated treasure co-ordinator for Redcar and Cleveland), PD Teesport and the archaeological curators.

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If discoveries comprise unexploded ordnance (UXO) then the measures put in place by PD Teesport will take precedence. Historic ordnance, however, may still be of archaeological interest and can still be reported under the Protocol once the UXO policy has been fully followed and satisfied.

An obstruction, or 'site', on the seabed may comprise previously undiscovered wrecks or fragments of wrecks, including aircraft, former port and harbour structures or the remains of other structures or installations.

An anomaly is a visual or digital signature that indicates the presence of a possible find or site that may be identified through geophysical or ROV survey, for example.

Circumstances of Discovery

This Protocol will address finds of archaeological interest made on the seabed, on board vessels, in the inter-tidal zone or on land. With regard to the proposed NGCT scheme, discoveries may occur during the following activities:

- Capital dredging within the existing dredged approach channel; to deepen the channel by 0.4m from 14.1m below CD to 14.5m below CD, with deepening from 10.4m below CD to 14.5m below CD for the final (approximately) 1km of the approach to the proposed terminal;
- Realignment of the existing approach channel in the vicinity of the proposed terminal and deepening of the two existing turning circles (Tees Dock turning circle and Seaton Channel turning circle) in the Tees Estuary;
- Construction of a 1000m quay face with a proposed quay deck level of 9.0m above CD (+6.15m OD). It is proposed that the terminal construction would be undertaken in two phases (700m followed by 300m);
- Pumping suitable dredged material ashore for use in the reclamation works and for locally raising land levels within the proposed terminal area; and
- Capital dredging of deep water berthing areas alongside the proposed quay face (dredged to 16m below CD).

Scenarios that may result in discoveries of archaeological interest include, but are not limited to:

- Capital dredging:
  - Obstructions encountered by the draghead or dredge bucket on the seafloor; and
  - Archaeological material observed within dredged material or trapped in the dredge gear.
- Ground Interventions:
  - Obstructions encountered on the seafloor during piling for the quay face, for example.
- Use of dredged material:
  - Finds encountered during deposition of reclamation material and that may be visible on a new ground surface, for example.
- Survey:
  - Previously unidentified anomalies or obstructions seen in any geophysical or diver survey data; and
  - Obstructions encountered during borehole or vibrocore surveys.

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Roles and Responsibilities

PD Teesport

PD Teesport will retain ultimate responsibility for the implementation of the Protocol. Specific responsibilities will include:

- Securing the services of an archaeological contractor to facilitate the implementation of the protocol;
- Assigning staff to the key roles of Nominated Contact and Site Champions and ensuring their awareness of their responsibilities under the Protocol;
- Ensuring the availability of NGCT staff and contractors for tool box talks; and
- Providing annual reports to the curator to demonstrate adherence to the Protocol.

Archaeological Contractor

An archaeological contractor will be secured and contracted by PD Teesport to facilitate the implementation of the protocol.

The archaeological contractor will be responsible for:

- Arranging tool box talks with relevant staff and contractors to ensure awareness of the Protocol and to provide guidance on the types of discoveries that may be encountered;
- Providing initial advice to NGCT staff in the event of a discovery;
- Undertaking an assessment of archaeological potential;
- Seeking specialist advice to inform the interpretation of discoveries, where necessary;
- Consulting with stakeholders (e.g. the archaeological curators) to agree proportionate measures to address discoveries;
- Producing summary reports and MIDAS compliant reports to disseminate data to stakeholders;
- Ensuring that the Receiver of Wreck is informed in the event of discoveries of wreck material; and
- Production of the final report.

Nominated Contact

A member of staff from PD Teesport will be nominated to act as the single point of contact for all communications regarding archaeology.

The Nominated Contact will be responsible for:

- Co-ordinating reports of discoveries from site champions and ensuring that appropriate ‘first aid for finds’ is carried out and that initial data is recorded;
- Reporting discoveries to the archaeological contractor and to the Receiver of Wreck, if required;
- Communicating appropriate measures to site staff as advised by the archaeological contractor; and
- Ensuring that measures are implemented, as appropriate.

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Site Champion

The Nominated Contact will identify a Site Champion, or Champions, as appropriate, to act as a point of contact for staff on site.

The Site Champion will be responsible for:

- Implementing a Temporary Exclusion Zone (TEZ) where the location of a discovery is known;
- Ensuring observation and strict adherence of the TEZ by all staff and contractors;
- Compiling Preliminary Record Sheets for discoveries; and
- Reporting discoveries to the Nominated Contact.

All Staff and Contractors

On making a discovery all NGCT staff and contractors have a responsibility under the terms of the Protocol to:

- Safeguard finds:
  - Handle with care;
  - Leave marine growth, rust, sediment or concretion intact; and
  - Undertake appropriate first aid measures, such as immersing waterlogged finds in seawater in a clean, covered container.
- Undertake initial recording:
  - Record the positon of the discovery;
  - Photograph finds in the condition in which they were recovered; and
  - Label finds with a unique ID number as advised by the archaeological contractor.
- Report the discovery to the Site Champion.

All staff and contractors also have a responsibility to observe mitigation measures agreed by PD Teesport with the curator such as the implementation of a TEZ at the location of a discovery.

Reporting Discoveries

Staff or contractors making a discovery will report the find, obstruction or anomaly to the Site Champion.

If the discovery comprises an obstruction or anomaly on the seabed, and the position is known, then intrusive works (dredging or piling) will need to cease in the vicinity of this position and the position of the obstruction or anomaly will be recorded. Works will not recommence in this vicinity of this position until archaeological advice has been obtained. The Site Champion will implement a TEZ and ensure observation by staff and contractors.

If the discovery comprises archaeological material, the position of the discovery will be recorded. This will be the position of the find itself, if known, or the position of the dredger at the time of the discovery. The find will be photographed in its discovery condition, including an appropriate scale in the photograph. If photographs are not possible then a drawing or other record may be used as an alternative.

Measures will be taken by staff to safeguard the find including first aid conservation:

- Marine growth, rust, sediment or concretion should be left intact;
- Waterlogged finds should be immersed in seawater in a suitable clean and covered container; and
- Dry finds should be placed in a suitable container and stored in a cool, dry, dark place.

The Site Champion will ensure that safeguarding has taken place and will compile a Preliminary Record and pass this, along with any photographs, drawings or other records, to the Nominated Contact.

On receiving the report of a discovery the Nominated Contact will confirm the details of the Preliminary Report with the Site Champion and inform the archaeological contractor as soon as possible. The Nominated Contact will ensure that all PD Teesport and all construction teams that may be required to work in the area are aware of the discovery.

If the find is, or appears to be 'wreck', the Nominated Contact will, as soon as possible, notify the Receiver of Wreck in accordance with the Merchant Shipping Act (1995).

The archaeological contractor will advise the Nominated Contact of any further actions that may be required, such as:

- Advice on first aid conservation or other actions to be taken in respect of a find;
- Advice on the identification of finds and proposals to further evaluate discoveries; and
- Advice to prevent further impacts, such as the implementation of TEZ.

The archaeological contractor will undertake an assessment of the archaeological potential of discoveries and will liaise with the curator, PD Teesport and other stakeholders as relevant, to agree measures to address the discovery, if required. The archaeological contractor will advise PD Teesport on any additional work required to stabilise, conserve or record recovered finds.

Following identification, evaluation and the agreement of measures to address the discovery, if required, the archaeological contractor will compile a summary report for the discovery for distribution to stakeholders, as well as a MIDAS compliant report to submit details of the discovery to national and local authority heritage data archives.

Timing

Action will be taken immediately following a discovery so that the precise position of a discovery can be calculated and recorded (from the vessel track for example) and to minimise disruption to NGCT works.

Measures to safeguard finds, including the application of first aid conservation, will be implemented as soon as possible following discovery, in accordance with both health and safety and practical requirements.

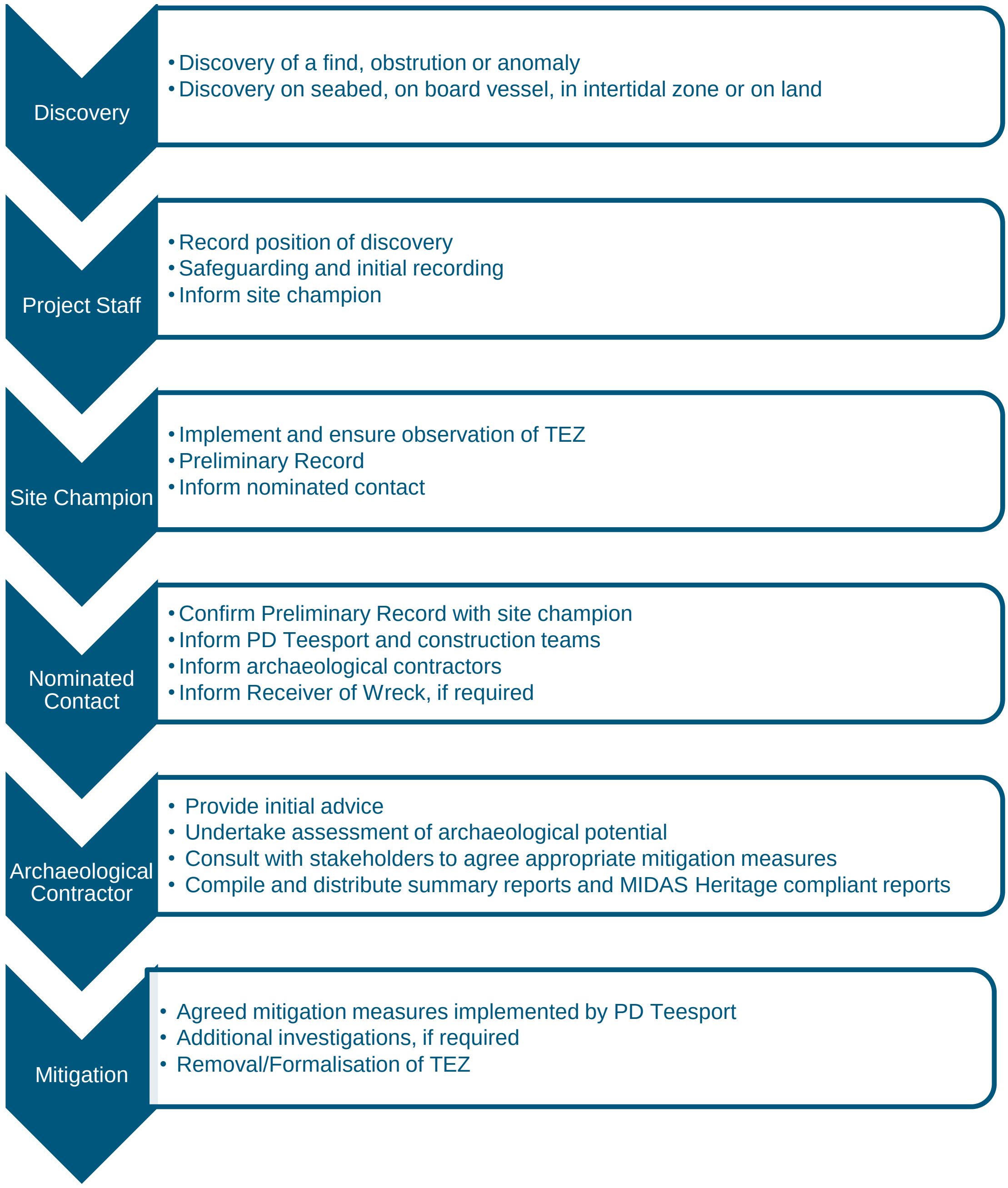
The initial record, including photographs, will be compiled and forwarded by the Site Champion to the Nominated Contact on the same working day that the discovery is made.

On receiving the report the Nominated Contact will report the discovery to the archaeological contractor within two working days.

An initial response will be provided by the archaeological contractor to the Nominated Contact within two working days of receiving the initial report.

A timetable for implementing measures to address the discovery will be agreed following the initial response, as appropriate to the archaeological interest of the discovery.

Diagram 1: Reporting Protocol Flow Chart



Temporary Exclusion Zones (TEZs)

A TEZ will be implemented by the Nominated Contact if the position of an obstruction, anomaly or find is known with reasonable certainty.

A TEZ precludes all activities from taking place in the vicinity of the obstructions, anomaly or find until further archaeological advice has been obtained.

In the event that, following further investigation, it can be reasonably concluded that there is no important wreck or other feature present within the TEZ then it will be revoked.

The TEZ may be formalised as an Archaeological Exclusion Zone (AEZ) if:

- an important wreck or other site or feature is confirmed to be present on the seabed; or
- If PD Teesport does not wish to undertake additional investigation to confirm the nature of the discovery.

The removal or formalisation of a TEZ will occur only following consultation and in agreement with the archaeological curator(s).

Additional investigation may include:

- high resolution geophysical survey;
- diver survey; or
- ROV survey.

Where additional investigations are carried out they will be undertaken in accordance with specifications to be agreed by PD Teesport with the archaeological curator(s), as advised by the archaeological contractor. A report detailing the results of any investigation will be submitted to the curator(s) in order to inform discussions concerning the removal or formalisation of a TEZ.

If archaeological remains are confirmed and it is not possible to implement a formal AEZ then, subject to agreement with the archaeological curator(s), PD Teesport may implement alternative forms of mitigation such as a programme of recording and/or recovery; these measures will be detailed in a method statement and agreed with the archaeological curator(s), as necessary.

All investigative works will be set out in a detailed method statement that will be submitted to the archaeological curator(s) for approval in advance of works commencing.

Northern Gateway Container Terminal Discoveries Preliminary Record Form	
Finder Details	
Vessel/Team/Contractor Name:	
Work Package:	
Date:	Time of compiling information:
Name of compiler (Site Champion):	
Name of finder (if different to above):	
Discovery Details	
Time at which discovery encountered:	
Original position of discovery on seabed/inter-tidal/on land (if known):	
• Latitude:	
• Longitude:	
• Datum (if different from WGS84):	
Position of vessel:	
• Latitude:	
• Longitude:	
• Datum (if different from WGS84):	
Notes on accuracy of position:	
Description of the find/obstruction/anomaly:	
Size/extent:	

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Details of finds recovered:
Details of photographs, drawings or other records:
Details of treatment given to find(s):
Any other notes:
Date and time at which Nominated Contact informed:
Signed: Date:

Appendix 19

WFD compliance assessment

Royal HaskoningDHV

REPORT

Northern Gateway Container Terminal

Water Framework Directive Compliance Assessment

Client: PD Teesport

Reference: I&BPB8270R002F0.1

Revision: 0.1/Final

Date: 07 February 2020

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Document title:	Northern Gateway Container Terminal
Document short title:	WFD Compliance Assessment
Reference:	I&BPB8270R002F0.1
Revision:	0.1/Final
Date:	07 February 2020
Project number:	PB6776
Author(s):	Christa Page
Drafted by:	Christa Page
Checked by:	Steven Rayner
Date / initials:	26 June 2019
Approved by:	Matt Simpson
Date / initials:	26 June 2019

Classification
Project related

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

Disclaimer

Royal HaskoningDHV

Table of Contents

1 Introduction

This Water Framework Directive (WFD) compliance assessment has been produced to support the marine licence application to the Marine Management Organisation (MMO) for the Northern Gateway Container Terminal (NGCT).

Full details of the required works can be found within Section 3 of the Environmental Impact Assessment (EIA) Report (Royal HaskoningDHV, 2019). In summary, the proposed scheme comprises:

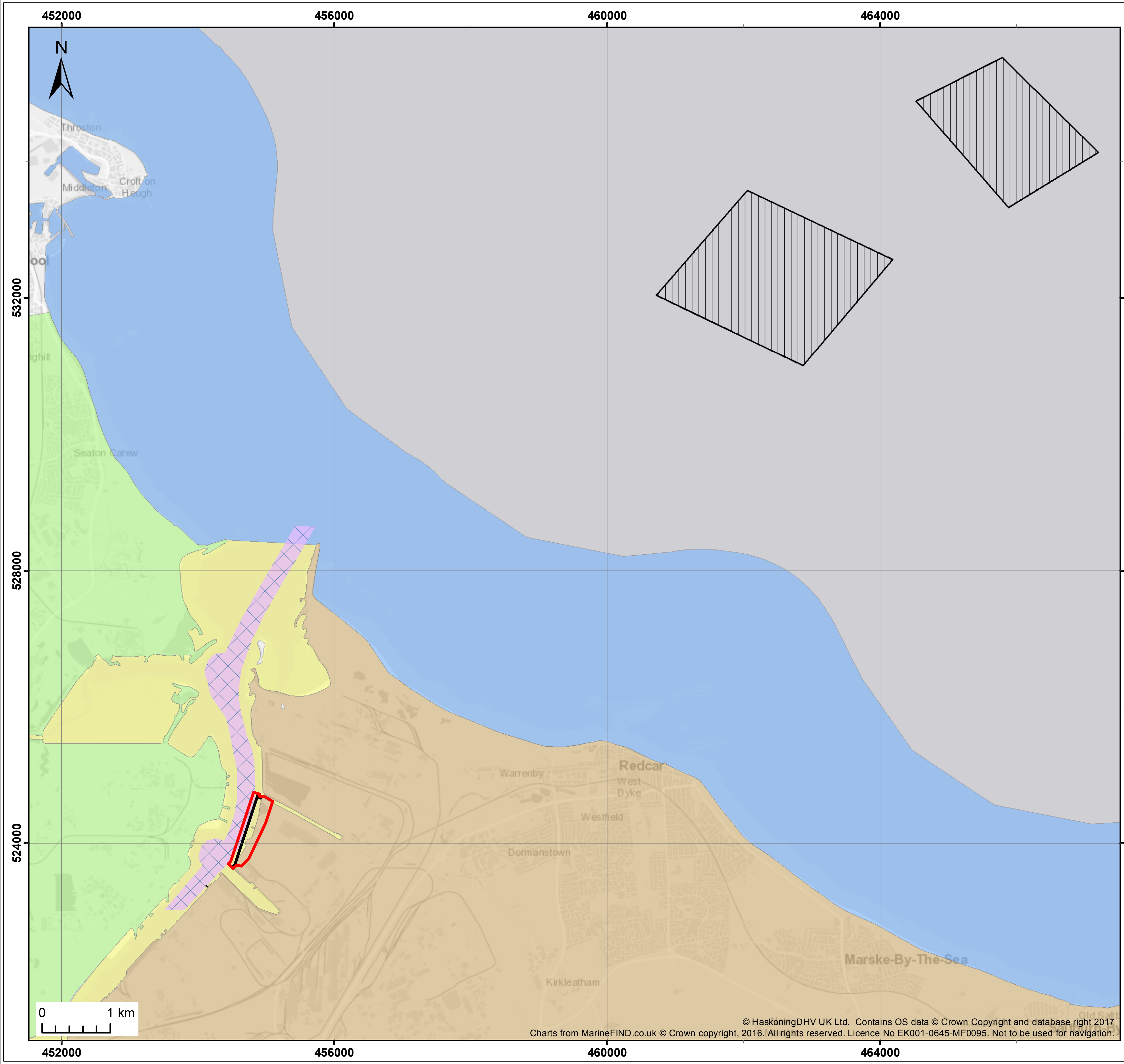
- Capital dredging of the approach channel to the NGCT (equating to approximately 4.8 million m^3 of material).
- Disposal of dredged material (through a combination of beneficial reuse (localised reclamation and raising land levels within the proposed terminal site) and offshore disposal of dredged material).
- Construction of a container terminal facility.
- Construction of various landside elements (buildings, rail terminal, road access, lighting, drainage and a pumping station).

To determine which activities require consideration under the requirements of the WFD, the scheme is shown alongside the outlines of the relevant WFD water bodies in **Figure 1.1**. It can be seen from **Figure 1.1** that all activities (with the exception of sea disposal) fall within the boundaries of WFD water bodies and therefore, for the purposes of the assessment, the proposals have been split into the following activities:

- Capital dredging.
- Construction and the presence of the new container terminal facility. This includes the disposal of dredged material within the reclamation area.
- Construction of various landside elements (to include buildings, rail terminal, road access, lighting, drainage and a pumping station).

In addition to the disposal sites being located outside of a WFD water body, information provided within the EIA Report indicates that all effects will be experienced within or immediately adjacent to the footprint of the disposal sites. As a result, disposal at sea has been screened out from further consideration within this assessment.

As reported in the EIA Report, it is not expected that the existing maintenance dredging strategy will need significant adjustment as a result of the proposed scheme; this has been established through the hydraulic and sedimentary studies undertaken as part of the EIA (see Section 6 of the EIA Report). As a result, maintenance dredging has not been considered further within this WFD compliance assessment.



Legend

- Northern Gateway works
- Line of works
- Dredged channel
- Disposal sites
- WFD Transitional Waterbody: Tees (GB510302509900)
- WFD Coastal Waterbody: Tees Coastal (GB650301500005)
- WFD Ground Waterbody: Tees Mercia Mudstone & Redcar Mudstone (GB40302G701300)
- WFD Ground Waterbody: Tees Sherwood Sandstone (GB40301G702000)

Client:	Project:
PD Teesport	Northern Gateway Container Terminal – HRO extension

Title:

Proposed scheme activities against WFD water bodies

Figure: 1.1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	01/11/2017	TC	CP	A3	1:55,000

Co-ordinate system: British National Grid

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2 WFD Assessment

2.1 Method of assessment

This WFD compliance assessment has been undertaken in accordance with the ‘Clearing the Waters for All’ guidance (Environment Agency, 2016) found at: https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters, for marine water bodies potentially at risk and modified to enable assessment of the groundwater body.

It can be seen from **Figure 1.1** that the relevant water bodies are the Tees transitional water body (GB510302509900), the Tees Coastal water body (GB650301500005) and the Tees Mercia Mudstone & Redcar Mudstone groundwater body (GB40302G701300). Information for these water bodies has been collated from the Environment Agency’s Data Catchment Explorer (Environment Agency, 2017) and is presented in **Appendix A**.

2.2 In-built scheme control measures

During the construction phase there is the potential for pollution from spills or leaks of fuel and oil. The risk of this arising will be minimised by following standard good practice with regard to pollution prevention guidance. The appointed contractor will be required to undertake the construction works in accordance with the Environment Agency’s Pollution Prevention Guidelines PPG No. 5 on works in, near and liable to affect watercourses and PPG No. 6 on working at construction and demolition sites. Whilst it is noted that these have been withdrawn, they still provide good reference material for protection of water courses when working in and around water. It is also recommended that concrete pouring and filling works are monitored by the appointed contractor and in the case of spills in the estuary that appropriate remedial action is taken to clear up spills and avoid pollution.

PD Teesport (PDT) has an oil spill contingency plan in place which has been developed for use in the event of an operational incident. This plan will be modified where appropriate to take account of the risks during the construction phase. Any risks to water quality in terms of accidental spills or leaks, therefore, will be reduced as far as possible and are not considered further within this assessment.

2.3 WFD Scoping

The activities screened in for consideration have been compared to the scoping criteria outlined in the Clearing the Waters for All guidance (Environment Agency, 2016) for the surface water bodies. For the groundwater body, the WFD compliance parameters have been listed and risks to those considered. The output of this assessment is provided in **Appendix B** and a summary is provided in **Table 2.1** and **Table 2.2** for surface water bodies and **Table 2.3** for the groundwater body**.**

Table 2.1 Summary of the findings of the scoping phase for the Tees transitional WFD water body

Activity	Hydromorphology	Biological: Habitats	Biological: Fish	Water Quality	Protected areas	Invasive species
Capital dredging	Yes – the deepened channel could impact on hydromorphological parameters	Yes – the proposed dredging could impact on lower sensitive habitats and the plume could potentially impact on higher sensitivity habitats	Yes – the dredging plume could impact on migratory fish	Yes - the dredging plume could impact on physico-chemical WFD compliance parameters	No	No - control measures will be put in place to reduce the risk
Construction and presence of new container terminal	Yes – the presence of the new quay wall could give rise to changes to hydromorphology	No – the loss of biological habitats under the reclamation is unlikely to constitute to a deterioration in the WFD water body due to very poor species richness (as reported from the 2019 intertidal survey), presence of existing infrastructure and elevated levels of sediment contamination. PDT has held discussions with the Tees Rivers Trust (TRT) regarding the possible beneficial use of maintenance dredged material as part of habitat enhancement works being proposed by the TRT within the Tees estuary. The TRT has identified that there are opportunities to enhance currently degraded areas of intertidal on the east bank of the Tees, downstream of Newport Bridge, located approximately 10km upstream of the proposed NGCT footprint. The TRT is investigating the feasibility of habitat enhancement in a number of areas; the area being discussed between PDT and the TRT has a footprint of approximately 0.5ha, covering approximately 265m of intertidal The works proposed by the Tees Rivers Trust comprise the installation of a 'green-wall' in front of the existing retaining wall. The foreshore would be reprofiled and geotextile bags would be placed at the boundary of the existing intertidal. Maintenance dredged material, supplied by PDT, would then be pumped onto the intertidal. Should the timing of the proposed NGCT scheme and the proposed TRT align, PDT has agreed to supply up to 6,000m3 of maintenance dredged material to the TRT to allow the above habitat enhancement works to be undertaken. In addition to constituting a beneficial use of dredged material, the proposals represent habitat improvement to offset the predicted impact of the NGCT	Yes – the piling could potentially impact on fish, as well as lighting from the presence of the container terminal	No - control measures will be put in place to reduce the potential for effects on water quality as far as possible	No	No - control measures will be put in place to reduce the risk
Construction of landside elements	No – these are all landside works so have no direct effect on	No – these are all landside works so have no direct effect on the WFD water body	No – there is a potential for water quality effects associated with discharge of surface water however		No	No - risk not identified

	the Tees transitional WFD water body		control measures will be in place to reduce this risk as far as possible			

Table 2.2 Summary of the findings of the scoping phase for the Tees coastal WFD water body

Activity	Hydromorphology	Biological: Habitats	Biological: Fish	Water Quality	Protected areas	Invasive species
Capital dredging	No - the deepened channel could impact on hydromorphological parameters, however, the area of channel within this water body is relatively small. As a result, significant changes to hydromorphological parameters are not anticipated	No - the area of capital dredging within this water body is relatively small compared to the size of the water body as a whole.	Yes – the potential plume could impact on water quality and migratory fish		Yes – (bathing water only)	No - control measures will be put in place to reduce the risk
Construction and presence of new container terminal	No – there will be no structures associated with the NGCT within this water body and therefore no potential for effect on this parameter	No – there will be no structures within this water body	No – there will be no structures within this water body		No	No - control measures will be put in place to reduce the risk
Construction of landside elements	No – there will be no structures associated with the NGCT within this water body and therefore no potential for effect on this parameter	No – there will be no structures within this water body	No – there will be no structures within this water body		No	No - risk not identified

Table 2.3 Summary of scoping findings for the Tees Mercia Mudstone & Redcar Mudstone groundwater body (GB40302G701300)

Activity	Quantitative quality elements	Chemical quality elements
Capital dredging	No - dredging will not impact on the WFD groundwater body	No - dredging will not impact on the WFD groundwater body
Construction and presence of new container terminal	No - construction and presence of the quay will not impact on quantitative quality elements	Yes - unintended spillage of fuels and drilling fluids could introduce a new source of contaminants into the subsurface. Piling could introduce a pathway for existing or new soil contaminants to enter the groundwater.
Construction of landside elements	No - landside works will not impact on quantitative quality elements	Yes - unintended spillage of fuels and drilling fluids could introduce a new source of contaminants into the subsurface. Piling could introduce a pathway for existing or new soil contaminants to enter the groundwater.

2.4 Further assessment

The following risks have been identified as requiring further assessment following completion of the scoping exercise:

- Hydromorphological impacts: Capital dredging and the construction/presence of a new quay (all hydromorphological parameters).
- Biological habitats: Capital dredging (removal of habitat/sedimentation).
- Fish: Capital dredging (sediment plume).
- Water quality: Capital dredging (sediment plume).
- Protected areas (one designated bathing water only): Capital dredging.
- Fish: Construction and presence of container terminal (noise).
- Groundwater chemical status: Construction and presence of container terminal/landside elements (i.e. piling).

2.4.1 Hydromorphological effects: Capital dredging and presence of new quay wall

The proposed development has the potential to influence the hydrodynamic regime of the Tees estuary and its approaches, primarily from the proposed approach channel deepening. These potential effects have been assessed in detail as part of the EIA studies, therefore, only a summary of the findings are provided here.

To assess the effects of the proposed scheme on estuary morphology, a 3D sediment transport model has been used to simulate dispersion, deposition and suspension of released sediment in the Tees estuary. A 3D flow model was also set up to simulate currents in the Tees estuary and Tees Bay and provided current and tidal flow information to drive the sediment transport model. To model sand transport, HR Wallingford used SANDFLOW.

To study the implications of the proposed scheme on wave conditions, the SWAN wave transformation model was used. This allows spatial wave distributions to be predicted for a variety of wave conditions and considers reflection, refraction, shoaling, friction, wave breaking and wave-wave interactions. A summary of the findings from such modelling is presented below.

2.4.1.1 Tidal current speeds

Minor changes in current speeds are predicted in the estuary in the vicinity of the proposed scheme and at the mouth of the estuary. In the vicinity of the proposed terminal, a decrease in current speeds of up to 0.10m/s is predicted with localised decreases of up to 0.2m/s. Increases in current speeds of a similar order or magnitude are predicted for areas closer to the shores of the estuary. Further downstream at the mouth of the estuary, very little effect is predicted and decreases in current speeds are in the order of 0.05m/s. The overall effects are described as being of low magnitude. As a result, impacts on current speeds at a water body level are not anticipated.

2.4.1.2 Tidal range

The tidal range is predicted to increase by less than 4mm and the tide time will arrive up to two minutes earlier. Very small effects are therefore anticipated on water levels and therefore a deterioration in hydrodynamic parameters is not anticipated.

2.4.1.3 Wave activity

Wind waves that are generated within the estuary are predicted to be affected by the reflective properties of the proposed terminal but would be unaffected by the increase in channel depth. Swell waves generated offshore do not penetrate far into the estuary and are not affected by the new quay wall. Swell waves however are impacted by the increase in the depth of the channel. Changes to swell waves during predominant wind conditions show a small increase in wave height of less than 10cm due to the proposed development. With stronger south westerly winds, wave height increases of 10cm are predicted (Royal Haskoning, 2006).

In more extreme events, the modelling predicted that waves approaching from a northerly direction with swell height of 6m will be reflected on the side of the dredged channel and reach the area around the ConcocoPhillips Oil Terminal. This is predicted to increase the significant wave height on the western side of the dock by up to 30cm. The reflection within the channel also leads to a decrease in wave height for swell waves on North Gare Sands and Bran Sands.

Much of the predicted changes in wave height at the mouth however, arise from the backlog of maintenance dredging that existed at that location at the time of the modelling assessment. As a result, a sensitivity test was applied to illustrate the difference in impact from the consented depth to the proposed depth. The results showed that about half of the increase in wave height in the channel and reduction of wave heights over North Gare Sands and Bran Sands was due to the re-establishment of the channel edges to the declared depth. The effect therefore of the proposed scheme is actually half that modelled. As a result, the changes are not anticipated to cause a deterioration in water body status.

2.4.1.4 Effects on intertidal areas

The predicted increase in low water has the potential to convert up to 40m^2 of intertidal to shallow subtidal area at North Tees mudflat. However, it should be noted that this area would not be lost, rather, the frequency at which it would be submerged will change. This change in low water level would result in a notional shift of the low water line 10cm towards the river edge, and a narrow strip of presently drying intertidal area remaining wet. No effects on other intertidal areas are predicted given that no change is predicted downstream of the proposed terminal.

The main potential for effect on intertidal areas is predicted at Seal Sands. During the dredging, about 3% of the material dredged in the outer channel is predicted to deposit on Seal Sands at a depth of 1mm. There is also a predicted increase of 10% in supply of fine material from Tees Bay into the estuary as a result of changes to tidal speeds (see above). This will also result in an increased supply of fine material to Seal Sands. The proposed scheme is anticipated to increase the supply by 0.33mm/year from a normal baseline of 3.5mm/yr.

Mitigation measures have been proposed to manage the potential risk of deposition at Seal Sands. The studies undertaken to assess the impact of the scheme on hydraulic parameters indicate that the placement of the dredging barge on the eastern side of the estuary will reduce the potential for material to be transported to Seal Sands. The barge will therefore be preferentially placed on the eastern side of the estuary where possible to reduce the potential for deposition impacts on Seal Sands.

Based on the above, because there are measures that will be adopted during the capital dredging to minimise the risk of impact to intertidal areas, a deterioration of the intertidal habitat is not anticipated.

2.4.2 Biological habitats: Capital dredging

There would be a direct loss of invertebrate resource due to the capital dredging over an area of approximately 120ha, although it should be noted that the vast majority of this area (approximately 116.5ha) comprises soft subtidal sediments that exist within the current navigation channel and are, therefore, already subject to maintenance dredging. The area of seabed that will be dredged that is currently outside of the existing channel comprises 3.5ha and this also consists of subtidal soft sediments.

A benthic ecological survey undertaken during 2019 confirmed that the majority of species within the subtidal sediments are typical of sublittoral microbenthic communities (Ocean Ecology, 2019). As has been observed in previous surveys within the Tees (reported within the EIA Report), annelid taxa, particularly polychaetes, dominated the assemblages in terms of abundance and diversity across all stations. Mollusc taxa generally contributed most to biomass. The EIA Report (Royal HaskoningDHV, 2019) confirms that the following completion of the capital dredge, the benthic community would be expected to recover to one that is similar to that present throughout the existing dredged approach channel across the majority of the proposed dredge footprint.

The deposition of fine sediment resuspended by the dredging process is not anticipated to impact on the subtidal areas and minimal effects are anticipated on the intertidal since the species found in the areas predicted to be impacted are typically found in estuarine environments are therefore are tolerant of fluctuating environmental conditions.

Within the Teesmouth and Cleveland Coast European marine site, saltmarsh is mapped as being present at an isolated location at the eastern end of Seal Sands, in the sheltered location in the lee of the peninsula that extends along the eastern margin of Seal Sands. This is also present on the WFD mapping provided by MAGIC (found at http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx). The numerical modelling undertaken predicts minimal dispersion of fine material within this area, resulting in localised peak deposition of up to 1mm of sediment. Peak deposition of this order of magnitude is not predicted to adversely affect the benthic communities or saltmarsh vegetation and therefore a deterioration in these habitats is not anticipated.

2.4.3 Fish: Capital dredging

The construction phase will result in increases in the suspended sediment concentration of the water column during capital dredging and during the return of water to the estuary from the reclamation process.

Such changes have the potential to impact on fish within and traversing the estuary. The effects are most likely to be predominantly physiological, particularly the blocking of gill structures for example, but fish are also less efficient at hunting prey and avoiding predators.

As part of the hydrodynamic assessment undertaken by HR Wallingford to inform the EIA, the dispersion of sediment plumes during dredging was modelled. The largest rise in peak suspended sediment concentrations above background concentrations occurred within the immediate vicinity of the dredger (up to 1000mg/l). Immediately outside of this zone, the predicted increased in concentrations above background are anticipated to be significantly less (approximately 25mg/l).

It is predicted that the increase in suspended solid concentrations arising during capital dredging would be outside the range of natural variation, particularly in the immediate vicinity of the dredger. The modelling undertaken to inform the EIA has predicted that peak suspended solid concentrations in the main channel are however significantly affected by the location of the dredger. When located in the Tees Dock turning circle or in the area of the proposed quay wall, concentrations of suspended solids decrease significantly outside of the immediate vicinity of the dredger. This occurs both laterally and within the streamlining of the vessel. This significant decrease in suspended solids also occurs when the dredger is located in the main channel adjacent to North Gare Sands, however suspended solid concentrations are predicted to remain above natural variation both laterally and in the streamline of the vessel. Due to the narrow nature of the Tees estuary, there will be a significant cross sectional area of the estuary that will be affected by the plume.

The following measures will be implemented to minimise disruption to water quality:

- Undertaking dredging operations using a trailing suction hopper dredger in long strips along the axis of the estuary rather than dredging along the width of the river. This will reduce both the extent and impact of the plume.
- Locating the cutter suction dredger on either the western or eastern side of the estuary.

As a result of the above measures, deterioration in fish status is not anticipated.

2.4.4 Water Quality: capital dredging

The predicted plume as a result of capital dredging could impact on water quality. However, most of the sediment is anticipated to fall out of suspension within the immediate vicinity of the dredger, particularly in the lower channel where the dredged material is predominantly sand. Although the dredging will give rise to increases in suspended sediment concentrations, the effects are short term and will only occur during periods of dredging (which will not be continuous since the dredger will need to periodically dispose of material from the hopper/barge). Effects on parameters such as dissolved oxygen are not anticipated given the relatively high percentages of mudstone and sand to be dredged.

2.4.5 Capital dredging: Protected areas (bathing waters only)

The proposed capital dredging has the potential to disturb sediment and release sediment-bound bacteria into the water column. Bacteria could therefore be transported to the designated bathing waters located in Tees Bay and potentially impact on compliance with the Bathing Waters Directive. However, sediment data collected during 2006 did not indicate significant levels of bacteria within the sediments (no further analysis into the bacterial concentrations in sediments was undertaken during 2019 as this was not requested by the MMO). Additionally, the distance between the bathing waters and the dredge footprint further reduces any risk to water quality of the bathing waters. As a result, impacts on the designated bathing water are not anticipated.

2.4.6 Construction and presence of container terminal: Fish

Certain aspects of the construction phase have the potential to impact on fish due to the generation of noise and vibration, particularly the piling for the construction of the quay wall. In addition, the container terminal has potential to disturb fish due to lighting omitted from the terminal. As described in the EIA Report, the Tees estuary supports both resident and migratory species. However, there is no significant commercial fishing activity within the region of the estuary from the site of the proposed terminal downstream, due to the high levels of commercial shipping within the navigation channel. The main fisheries interest in the region is in the offshore areas of Tees Bay. It is, however, recognised that the lower estuary may have some importance for estuary-dependent fish and the mouth of the estuary has some importance for sandeels.

However, the overriding consequence of the generation of construction related noise would be for fish to move away from the source of the noise should adverse conditions be experienced and, therefore, the construction works would be expected to result in the localised redistribution of fish.

A detailed underwater noise survey and modelling exercise was used to inform the EIA for the York Potash Harbour Facilities (Royal HaskoningDHV, 2014). As justified in the EIA Report, it is concluded that the findings of the underwater noise assessment carried out to inform the York Potash Harbour facilities EIA could be used to inform the potential disturbance impacts to fish from the proposed NGCT. To summarise, the modelling results predicted that the source noise levels would not result in a lethal effect on fish, however, traumatic injury could arise if fish are located within very close proximity to the source of the impact piling noise. The modelling work predicted that there is greater potential for behavioural response within fish species in comparison with traumatic injury (from impact piling), due to the larger modelled impact range for a behavioural response (particularly in the case of herring).

It should be noted that piling activities would not present a constant noise source and those periods between pile driving (e.g. when repositioning the piling barge) would provide opportunity for unimpeded movement of fish species within the estuary; the impact would also be temporary, lasting for the duration of piling works. It should also be noted that the piling activity would not be undertaken 24 hours a day. There would be a number of hours over the night time period where no piling would be undertaken allowing unimpeded movement of migratory fish. It should also be noted that existing noise generated by shipping and industrial activity on the banks of the Tees estuary are already likely to influence the fish distribution within the estuary. In addition, a soft start approach would be adopted within the piling methodology to reduce the risk of injury to resident fish species.

The EIA Report has assessed the potential disturbance of lighting (during both construction and operation) on fish. The construction phase assessment stated that fish could become attracted to the light spill generated during the construction phase, but the noise generated during the construction would likely counteract this effect to an extent. It was concluded that overall, the lighting required during construction would likely result in a temporary localised redistribution of fish within the area around the proposed scheme. An impact of negligible significance is predicted. The EIA Report concludes that proposed lighting should be directed away from the estuary where possible in order to limit the light spill into the water column.

The design of the NGCT involves minimising upward light output and obtrusive light into the environment (e.g. sky glow, light spill, glare and light intrusion). Nevertheless, the EIA Report states that during operation, it is likely that there will be some light spill into the estuary given the need to light the quayside during night time operations. The EIA Report concluded that the fish populations of the estuary as a whole would not be affected beyond the potential redistribution of individuals in the area affected by light spill and an impact of negligible significance is predicted. No further mitigation measures beyond those built into the scheme design were proposed.

As a result, deterioration in the biological quality element fish is not anticipated.

2.4.7 Construction and presence of container terminal: Risks to groundwater

A site investigation of the land areas required for the proposed scheme was undertaken during 2005. From this investigation, it was concluded that the landside areas of the proposed scheme footprint are mostly composed of made ground, consisting of firm brown sandy gravelly clay containing brick, sandstone, slag cinder and mudstone. Chemical testing of the soil and groundwater was undertaken which showed that levels of copper and zinc were elevated (i.e. in concentrations which breached guidelines). Additionally, tests on the water samples showed that some metals are present in a form which can leach from the soil. The migration of contaminants via the shallow subsurface into the estuarine waters is a risk which must be addressed during the full development of the NGCT. In particular, there is the potential that the installation of any piles may transport contaminated material into the groundwater waterbody and also create pathways between strata unless carefully designed and installed. Therefore, it is recommended that the development is undertaken in accordance with the Model Procedures for the Management of Land Contamination (CLR11) and in particular a piling risk assessment be undertaken prior to the commencement of any piling activities in line with Environment Agency guidelines, as mitigation for this potential impact.

As outlined in the EIA Report, the landside elements of the proposed scheme have commenced, and therefore the planning permission granted by Redcar and Cleveland Borough Council (RCBC) has been implemented. The EIA Report identifies that there are a number of conditions attached to the planning permission (reference R/2006/0433/00) (relating to land quality), which had to be discharged prior to commencement of the landside works. The EIA Report notes that the future development of the wider NGCT (beyond the commencement works) will be subject to additional site investigation, and therefore there are controls in place to manage any risks associated with soil quality and geology (and consequently controlled waters, including the groundwater body).

Upon completion of the development, the site will be covered with buildings and hardstanding, which would be drained to either the surface water sewer or river via a drainage system. This will significantly reduce the amount of rainfall percolation into the made ground, therefore, reducing potential leachate formation. It will also reduce the risk that spillages of contaminant at the surface will migrate vertically into groundwater. The site surfacing and drainage system will reduce the potential for further contaminant migration, both laterally and vertically in the long term. As a result, as long as the temporary risks associated with construction are managed appropriately, no long-term effects are anticipated.

2.5 Overall Findings

Comparison of the proposed activities against the WFD scoping criteria identified several risks to WFD compliance receptors. As a result further assessment was undertaken to consider the potential risks in more detail. The results of the further assessment indicate that, for the majority of risks identified, effects are not anticipated. However a specific risk to fish was a particular concern and therefore several mitigation measures are recommended (and detailed above) in order to reduce this risk as far as possible. A piling risk assessment has also been proposed to ensure no effects on the chemical quality of the groundwater as a result of the proposed scheme. With these mitigation measures in place, the NGCT is deemed to be compliant with the WFD

3 References

Environment Agency, 2004. Model Procedures for the Management of Land Contamination (Contaminated Land Report 11)

Environment Agency, 2016. Clearing the Waters for All. Found at: https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters

Environment Agency, 2017. Data catchment explorer. Found at: http://environment.data.gov.uk/catchment-planning/

Royal Haskoning, 2006. Northern Gateway Container Terminal. Environmental Statement

Royal Haskoning, 2007. Northern Gateway Container Terminal. Supplement to the Environmental Statement

Royal HaskoningDHV, 2017. Northern Gateway Container Terminal. Supplementary Environmental Information Report

Royal HaskoningDHV, 2019. Northern Gateway Container Terminal. Environmental Impact Assessment Report.

Appendix A

WFD Water Body Information

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Surface Water Body Information – Tees transitional water body

Water body	Description, notes or more information
WFD water body name	TEES
Water body ID	GB510302509900
River basin district name	Northumbria
Water body type (estuarine or coastal)	Transitional
Water body total area (hectares)	1144.05
Overall water body status (2015)	Moderate
Ecological status	Moderate
Chemical status	Fail
Target water body status and deadline	Moderate by 2015
Hydromorphology status of water body	Supports good
Heavily modified water body and for what use	Yes (Flood Protection, Navigation Ports and Harbours)
Higher sensitivity habitats present	Saltmarsh (46.24ha); Subtidal Kelp Beds (4.13ha)[1]
Lower sensitivity habitats present	Cobbles, Gravel and Shingle (0.77ha); Intertidal soft sediments (400.13ha); rocky shore (26.93ha); subtidal rocky reef (4.13ha); subtidal soft sediments (610.31ha).
Phytoplankton status	Good
History of harmful algae	Not monitored
WFD protected areas within 2km	See **Figure A1**. Note that European designated sites have been considered within the EIA Report and therefore are not considered further in this assessment.

[1] Further discussion regarding the information provided for the Tees water body and presence of subtidal kelp in the DEFRA Magic mapping system (emails between RHDHV and Natural England dated 9th November 2017), Natural England have since confirmed that subtidal kelp is not present in the area adjacent to Bran Sands Lagoon. The potential impact this has on the area of subtidal kelp quoted for this water body in the Environment Agency data provided as part of the Clearing the Waters For All guidance (2016) is unclear but for the purposes of this assessment, subtidal kelp will not be included as a receptor in this area.

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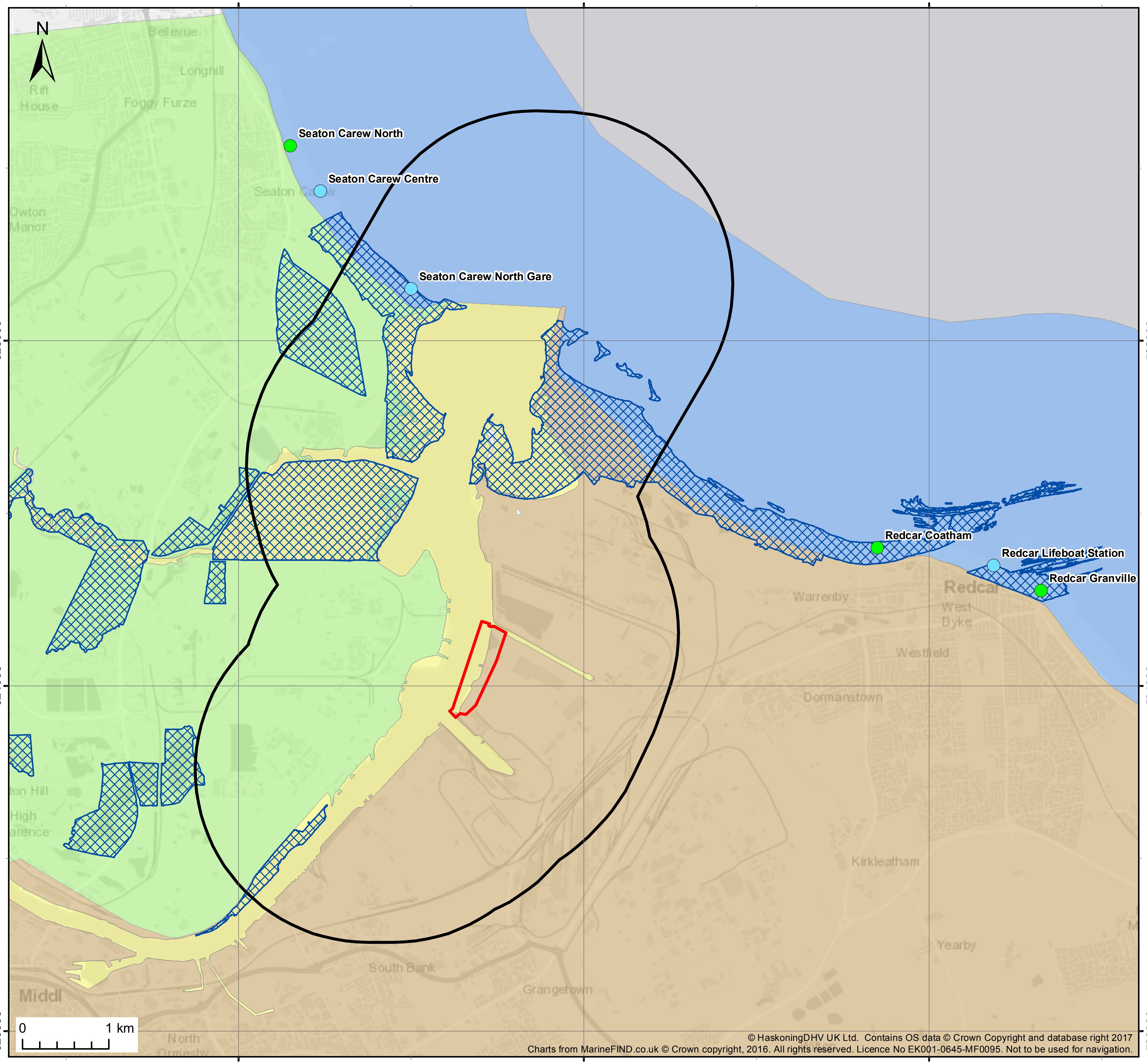
Surface Water Body Information – Tees coastal water body

Water body	Description, notes or more information
WFD water body name	Tees
Water body ID	GB650301500005
River basin district name	Northumbria
Water body type (estuarine or coastal)	Coastal
Water body total area (hectares)	8838.147
Overall water body status (2015)	Moderate
Ecological status	Moderate
Chemical status	Good
Target water body status and deadline	Good by 2027
Hydromorphology status of water body	Not assessed
Heavily modified water body and for what use	Yes (Coastal Protection, Flood Protection, Navigation Ports and Harbours)
Higher sensitivity habitats present	Saltmarsh Mussel beds, including blue and horse mussel (121.9ha); Subtidal Kelp Beds (175.17ha)
Lower sensitivity habitats present	Cobbles, gravel and shingle (3.36ha), Intertidal soft sediment (845.53ha), Rocky shore (184.33ha), Subtidal rocky reef (7170.93ha), Subtidal soft sediments (1219.64ha)
Phytoplankton status	-
History of harmful algae	Not monitored
WFD protected areas within 2km	See **Figure A1**. Note that European designated sites have been considered within the EIA Report and therefore are not considered further in this assessment.

Groundwater Body Information – Tees Mercia Mudstone & Redcar Mudstone groundwater body

Water body	Description, notes or more information
WFD water body name	Tees Mercia Mudstone & Redcar Mudstone
Water body ID	GB40302G701300
River basin district name	Northumbria
Water body type (groundwater, estuarine or coastal)	Groundwater
Water body total area (ha)	49457.045
Overall water body status (2015)	Poor
Quantitative status	Good
Chemical status	Poor (Chemical Dependent Surface Water Body Status)
Target water body status and deadline	Poor by 2015
WFD protected areas within the WFD water body	Drinking Water Protected Area.



Legend

- Northern Gateway works
- 2km buffer
- Teesmouth and Cleveland and Coast Ramsar & SPA
- WFD Transitional Waterbody: Tees (GB510302509900)
- WFD Coastal Waterbody: Tees Coastal (GB650301500005)
- WFD Ground Waterbody: Tees Mercia Mudstone & Redcar Mudstone (GB40302G701300)
- WFD Ground Waterbody: Tees Sherwood Sandstone (GB40301G702000)

Bathing Waters Monitoring Locations

- Excellent
- Good
- Sufficient
- Poor
- Not assessed

Client:	Project:
PD Teesport	Northern Gateway Container Terminal – HRO extension

Title:

Proposed scheme activities against WFD Protected Areas

Figure: A1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	01/11/2017	TC	CP	A3	1:45,000

Co-ordinate system: British National Grid

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Appendix B

WFD Scoping Tables

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Completed scoping tables for activity: dredging

The following tables summarise the information relevant to the consideration of the requirements of the Water Framework Directive for capital dredging (tables taken from Clearing the Waters for All; Environment Agency, 2016) and modified to assess the potential effects for the groundwater body. Note that for dredging, there is no pathway for effect on the groundwater so only the surface water is considered here.

Activity Information

Your activity	Description, notes or more information
Applicant name	PD Teesport
Application reference number (where applicable)	TBC
Name of activity	Capital dredging
Brief description of activity	Capital dredging within the existing dredged approach channel to deepen the channel by 0.4m from 14.1m below CD to 14.5m below CD, with deepening from 10.4m below CD to 14.5m below CD for the final (approximately) 1km of the approach to the proposed terminal. Realignment of the existing approach channel in the vicinity of the proposed terminal and deepening of the two existing turning circles (Tees Dock turning circle and Seaton Channel turning circle) in the Tees estuary. Capital dredging of deep water berthing areas alongside the proposed quay face (dredged to 16m below CD). For different parts of the dredging it will be necessary to use a trailing suction hopper dredger, cutter suction dredger or backhoe.
Location of activity	See **Figure 1.1**
Footprint of activity	Approximately 120ha, although it should be noted that the vast majority of this area (approximately 116.5ha) comprises the existing navigation channel and is therefore, already dredged.
Timings of activity (including start and finish dates)	Due to the differences in the material to be dredged, it is likely that dredging in the lower reaches and dredging in the upper reaches will take place using different types of dredger. Consequently, there is the possibility that both dredgers could be operating simultaneously. Dredging the mudstone in the upper reach of the channel using a CSD or backhoe is likely to take approximately 33 weeks. It is anticipated that the timing of the CSD dredging operation will be managed so that mudstone can be pumped ashore for reclamation on top of the sand.

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Your activity	Description, notes or more information
	The time required to dredge 1,100,000 m3 of granular material and clays will be between approximately 4 and 11 weeks Dredging activity would be undertaken 24 hours a day.
Extent of activity (for example size, scale frequency, expected volumes of output or discharge)	As above
Use or release of chemicals (state which ones)	None

Surface water compliance criteria: Hydromorphology

Consider if your activity:	Yes	No	Hydromorphology risk issue(s)	
			Tees transitional water body	Tees coastal water body
Could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status		✓	No, the water body is not at high status	No, the water body is not at high status
Could significantly impact the hydromorphology of any water body	✓ (Tees transitional water body only)		Capital dredging will deepen the approach channel and therefore there is a possibility of impacting on the hydromorphology of the WFD water body	Capital dredging will deepen the approach channel and therefore there is a possibility of impacting on the hydromorphology of the WFD water body. However, the area within this water body is very small (see Figure 1.1) and therefore significantly hydromorphological effects are not anticipated.
Is in a water body that is heavily modified for the same use as your activity	✓		Yes, the water body is modified for Navigation, Ports and Harbours.	Yes, the water body is modified for Navigation, Ports and Harbours.

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Surface water compliance criteria: Biology

Consider if the footprint of your activity is:	Yes	No	Biology habitats risk issue(s)	
			Tees transitional water body	Tees coastal water body
0.5km^2 or larger	✓ (Tees transitional water body only)		Yes. The area to be affected is greater than 0.5km^2 (1.772655km^2) and will affect at least 1% of the water body's area.	No, the area to be impacted (0.07946km x1.5 = is 0.119km^2)[2] less than 0.5km^2 and will not impact 1% of the water body's area.
1% or more of the water body's area	✓ (Tees transitional water body only)			
Within 500m of any higher sensitivity habitat	✓		Information provided on MAGIC indicates that the proposed dredging will occur within 500m of higher sensitivity habitats: mussels beds and saltmarsh	
1% or more of any lower sensitivity habitat	✓ (Tees transitional water body only)		The proposed activities could impact on 1% or more of any lower sensitivity habitat in the water body.	No, the proposed activities will not impact on more than 1% of a lower sensitivity habitat.

[2] *Environment Agency guidance suggests dredge area within the water body is multiplied by 1.5 to get an approximate area of impact*

Surface water compliance criteria: Fish

Consider if your activity:	Yes	No	Biology fish risk issue(s)	
			Tees transitional water body	Tees coastal water body
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary	✓		There is a possibility that the dredging would impact on fish migrating up the channel.	There is a possibility that dredging in the coastal water body could interrupt fish migration
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	✓			
Could cause entrainment or impingement of fish		✓	No	No

Surface water compliance criteria: Water Quality

Consider if your activity:	Yes	No	Water quality risk issue(s)	
			Tees transitional water body	Tees coastal water body
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)	✓		Yes, dredging will be required for longer than 14 days	
Is in a water body with a phytoplankton status of moderate, poor or bad		✓	No, status is good	No, status has not been assessed

Consider if your activity:	Yes	No	Water quality risk issue(s)	
			Tees transitional water body	Tees coastal water body
Is in a water body with a history of harmful algae		✓	Not monitored	

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water quality risk issue(s)	
			Tees transitional water body	Tees coastal water body
The chemicals are on the Environmental Quality Standards Directive (EQSD) list		✓	No chemicals will be released as part of the proposed works.	
It disturbs sediment with contaminants above Cefas Action Level 1		✓	Sediment sampling indicates that the sediments to be dredged do not contain levels of contamination significantly above Action Level 1 (with the exception of PAHs which have been historically elevated throughout the Tees and therefore the elevations were expected).	

Surface water compliance criteria: Protected Areas

Consider if your activity is:	Yes	No	Protected areas risk issue(s)	
			Tees transitional water body	Tees coastal water body
Within 2km of any WFD protected area	✓ (bathing waters only)		Yes. However, note that European designated sites have been considered within the EIA Report so are not considered further here. The capital dredging will occur within 2km of the following Protected Areas: • Seaton Carew North Gare designated bathing water • Seal Sands, Tees Estuary – sensitive area (nutrients) Urban Waste Water Treatment Directive. • There are also two nitrate sensitive areas within the Tees transitional water	

Consider if your activity is:	Yes	No	Protected areas risk issue(s)	
			Tees transitional water body	Tees coastal water body
			body: 244 and 245 However the proposed dredging will not give rise to changes in nutrient concentrations and therefore the only potential Protected Area considered to be at risk is the designated bathing water.	

Surface water compliance criteria: Invasive Species

Consider if your activity could:	Yes	No	INNS risk issue(s)	
			Tees transitional water body	Tees coastal water body
Introduce or spread INNS		✓	The activities have the potential to release invasive species if the materials and equipment used in the process have not been properly cleaned after use at a previous location that may have had invasive species present. Good practice measures will be employed to ensure all equipment is cleaned and checked before use. Given the very small number of invasive individuals encountered during the 2019 benthic survey, it is concluded that the species are not present at levels of concern within the Tees estuary.	

Surface water summary – Tees transitional water body

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Yes	The proposed changes to the channel could impact on hydromorphology
Biology: habitats	Yes	Both lower and higher sensitivity habitats are at risk
Biology: fish	Yes	The dredging could potentially impact on migratory fish due to the sediment plume being present for an extended period of time
Water quality	Yes	There is a potential risk to physic-chemical WFD compliance parameters since the proposed dredging and associated plume will be longer than 14 days.

Protected areas	Yes	Protected areas are at risk
Invasive non-native species	No	Control measures undertaken as part of the project preparation will remove this risk

Surface water summary – Tees coastal water body

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	No	The proposed changes to the channel could impact on hydromorphology
Biology: habitats	No	Both lower and higher sensitivity habitats are at risk
Biology: fish	Yes	The dredging could potentially impact on migratory fish due to the sediment plume being present for an extended period of time
Water quality	Yes	There is a potential risk to physic-chemical WFD compliance parameters since the proposed dredging and associated plume will be longer than 14 days.
Protected areas	Yes	Protected areas are at risk
Invasive non-native species	No	Control measures undertaken as part of the project preparation will remove this risk

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Completed scoping tables for activity: Construction and presence of new container terminal

The following tables summarise the information relevant to the consideration of the requirements of the Water Framework Directive for the installation and presence of the new container terminal (tables taken from Clearing the Waters for All; Environment Agency, 2016 and modified to assess the potential effects for the groundwater body).

Activity Information

Your activity	Description, notes or more information
Applicant name	PD Teesport
Application reference number (where applicable)	TBC
Name of activity	Construction and presence of the new terminal
Brief description of activity	Construction of a 1035m quay face with a proposed quay deck level of 9.0m above CD (+6.15m OD). It is proposed for the purposes of the EIA that the terminal construction would be undertaken in two phases (700m followed by 300m). The phasing will however be dependent on a number of factors and is therefore subject to change. The actual structural form of the main quay wall has not yet been determined, as different options will be explored to provide a value engineered and efficient structure. It is likely that this decision will be made as the design of the scheme progresses, using construction expertise from the Maritime Civil Engineering industry. There are options for both an open and closed structure; that is a deck on piles open to the river below, or a closed structure where a retaining wall is introduced along the quay alignment and fill placed behind. From experience it is understood that the structural form which presents the greatest environmental impact is the closed solution. On this basis, the assessment evaluates the closed solution, noting that an open solution would have a lesser impact and, therefore, the closed solution represents an upper bounding case for the purposes of the EIA. For the purpose of the assessment it is assumed that the quay wall will be constructed as an anchored combi-piled retaining wall (i.e. a closed solution). Construction of the quay is anticipated to be undertaken using either a jack-up rig or a floating barge.

Your activity	Description, notes or more information
	The anchored retaining combi-wall comprises large diameter tubular steel piles (approximately 2m diameter), spaced at approximately 3.5m to 4.0m centres. These are proposed to be connected by steel sheet piles to form a continuous, vertical faced, retaining wall. The tubular piles will be pitched and driven into the river bed. However, it is likely that the presence of hard layers of rock (e.g. mudstone) will prevent the piles being driven to the required depth. It is, therefore, envisaged that an auger will be used to drill down inside each pile. This will allow a concrete socket to be formed that will extend the pile to the required depth. The steel sheet piles will then be driven between the tubular piles to toe into the river bed. The tubular piles will be anchored to resist horizontal loads acting on the back of the retaining wall when reclamation fill is placed behind it. As a result of the various different operations required to install the combi-piled wall and the potential variability in ground conditions, the impact driving of both tubular and sheet piles will be intermittent. A reinforced concrete "relieving" slab will be supported on piles vibrated through the reclamation fill and driven to found in the underlying ground. Above the relieving slab, further reclamation will be placed up to the underside of the pavement surfacing. Regardless of the chosen option the level of the proposed quay will be set at +6.15m Ordnance Datum (OD). The main terminal area will generally have a downward slope of gradient 1 in 100 from the rear of the terminal towards the quay face, with intermediate valleys formed at 120m centres within traffic aisles. The terminal will be level parallel to the quay face. It is proposed that the terminal would be paved with Concrete Block Paving (CBP) surfacing on a Cement Bound Material (CBM) base. The proposed terminal area will be approximately 55ha. This area can be subdivided into existing land (approximately 46.5ha) and the area which is currently seaward of mean high water (approximately 8.5ha).
Location of activity	See **Figure 1.1**
Footprint of activity	Approximately 8ha
Timings of activity (including start and finish dates)	PDT's intention is to construct the proposed scheme prior to the expiry date of the HRO (which as noted in Section 1 is 7th May 2028). Indicative durations for the various scheme elements are detailed below. Overall, the construction period for the full development is expected to be 120 weeks in total, with this

Your activity	Description, notes or more information
	total period being split into two phases of 80 and 40 weeks.
Extent of activity (for example size, scale frequency, expected volumes of output or discharge)	As above
Use or release of chemicals (state which ones)	None

Surface water compliance criteria: Hydromorphology

Consider if your activity:	Yes	No	Hydromorphology risk issue(s)	
			Tees transitional water body	Tees Coastal water body
Could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status		✓	No, the water body in which the activities will occur is not at high status	These activities will not occur in this water body
Could significantly impact the hydromorphology of any water body	✓(transitional water body only)		Yes, the presence of the new quay wall could impact on hydrormorphology of the WFD water body	These activities will not occur in this water body
Is in a water body that is heavily modified for the same use as your activity		✓	The new quay wall will replace the existence of an existing hard structure therefore will not further alter the WFD water body.	These activities will not occur in this water body

Surface water compliance criteria: Biology

Consider if the footprint of your activity is:	Yes	No	Biology habitats risk issue(s)	
			Tees transitional water body	Tees coastal water body
0.5km^2 or larger 1% or more of the		✓	The reclamation is larger than 0.5km^2 (but smaller than 1% of the WFD water body). Surveys undertaken to inform the 2006 ES established that this activity would not results in the	These activities will not occur in this water body

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Consider if the footprint of your activity is:	Yes	No	Biology habitats risk issue(s)	
			Tees transitional water body	Tees coastal water body
water body's area			removal of a particular species group from the lower estuary as similar groups exist outside of the footprint. Additionally, the sediments exhibit elevated levels of contamination.	
Within 500m of any higher sensitivity habitat			There are no higher sensitivity habitats within 500m of the disposal area	These activities will not occur in this water body
1% or more of any lower sensitivity habitat			See above	These activities will not occur in this water body

Surface water compliance criteria: Fish

Consider if your activity:	Yes	No	Biology fish risk issue(s)	
			Tees transitional water body	Tees coastal water body
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary	✓		Yes – the quay wall will require piling. This could form a barrier for migrating fish. Piling could also affect fish behaviour. See potential impacts on water quality.	These activities will not occur in this water body
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)	✓			
Could cause entrainment or impingement of fish		✓	No	These activities will not occur in this water body

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Surface water compliance criteria: Water Quality

Consider if your activity:	Yes	No	Water quality risk issue(s)	
			Tees transitional water body	Tees coastal water body
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)		✓	Reclamation will take place within a confined area, formed by construction of the new quay wall, to minimise the chance of any detrimental effect to water quality in the river. During the reclamation process, settling basins will allow suspended sediment to settle out from the mudstone reclamation slurry. Overflow water from the reclamation will then pass through silt traps to limit the amount of suspended sediment discharged to the river. As a result, significant effects on water quality are not anticipated. The proposed construction could give rise to temporary disturbance of the seabed. However this is likely to be minimal and unlikely to impact on WFD compliance parameters.	These activities will not occur in this water body
Is in a water body with a phytoplankton status of moderate, poor or bad		✓	Status is good.	These activities will not occur in this water body
Is in a water body with a history of harmful algae		✓	Not monitored	These activities will not occur in this water body

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water quality risk issue(s)	
			Tees transitional water body	**Tees coastal water body**
The chemicals are on the Environmental Quality Standards Directive (EQSD) list		✓	No chemicals will be released as part of the proposed works.	These activities will not occur in this water body
It disturbs sediment with contaminants above Cefas Action Level 1		✓	Reclamation will be undertaken using dredged material predominantly made up of granular material or mudstone. Due to the nature of the material to be placed, the risk of further contamination is very low. There is an additional advantage in that the reclamation will effectively cap the contaminated sediment material located within the reclamation area. The proposed construction could give rise to temporary disturbance of the seabed. However this is likely to be minimal and short term in nature.	These activities will not occur in this water body

Surface water compliance criteria: Protected Areas

Consider if your activity is:	Yes	No	Protected areas risk issue(s)	
			Tees transitional water body	Tees coastal water body
Within 2km of any WFD protected area		✓	Yes. However, note that European designated sites have been considered within the EIA Report so are not considered further here. The disposal will occur within 2km of the following Protected Areas: • Seal Sands, Tees Estuary – sensitive area (nutrients) Urban Waste Water Treatment Directive. • There are also two nitrate sensitive areas within the Tees transitional water body: 244 and 245 However, reclamation and quay construction is not anticipated to release significant levels of nutrients. Therefore further consideration of potential effects on these protected areas is not considered necessary.	No –activities will not occur within this water body

Surface water compliance criteria: Invasive Species

Consider if your activity could:	Yes	No	INNS risk issue(s)	
			Tees transitional water body	Tees coastal water body
Introduce or spread INNS		✓	The activities have the potential to release invasive species if the materials and equipment used in the process have not been properly cleaned after use at a previous location that may have had invasive species present. Good practice measures will be employed to ensure all equipment is cleaned and checked before use.	No –these activities will not occur within this water body

Surface Water Summary – Tees transitional water body

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Yes	Yes – the presence of the new quay wall could alter hydromorphology of the WFD water body
Biology: habitats	No	N/A
Biology: fish	No	
Water quality	No	
Protected areas	No	
Invasive non-native species	No	

Surface water summary – Tees coastal water body

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	No	Since no receptors were identified to be at risk during scoping, the impact assessment stage is not required.
Biology: habitats	No	
Biology: fish	No	
Water quality	No	
Protected areas	No	
Invasive non-native species	No	

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Groundwater Quantitative Status

Consider if your activity could:	Yes	No	Risk issue(s)
Quantitative Dependent Surface Water Body Status		✓	The presence of the container terminal may alter the infiltration of rainwater to ground very locally, however the nature of the natural strata and overlying made ground are such that the current rate of recharge within the footprint of the development is likely to be very small. Therefore quantitative impacts are anticipated to be undiscernible.
Quantitative GWDTEs test		✓	
Quantitative Saline Intrusion		✓	
Quantitative Water Balance		✓	

Groundwater Chemical Status

Consider if your activity could:	Yes	No	Risk issue(s)
Chemical Dependent Surface Water Body Status	✓		Ground investigations have indicated the presence of historic contamination which may have an impact the quality of groundwater and result in impacts on water quality in the estuary. If not addressed during the development, the construction phase of the container terminal which includes piling, has the potential to increase the release and migration of contaminants.
Chemical Groundwater dependent terrestrial ecosystem (GWDTEs) test		✓	
Chemical Saline Intrusion		✓	

General Chemical Test		✓	

Groundwater Supporting elements

Consider if your activity could:	Yes	No	Risk issue(s)
Prevent and Limit Objective		✓	No pathway for effect
Trend Assessment		✓	

Groundwater WFD Summary

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Quantitative	No	
Chemical	Yes	Piling could create a pathway for chemical contamination of the ground water
Supporting elements	No	

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Completed scoping tables for activity: Installation of landside elements

The following tables summarise the information relevant to the consideration of the requirements of the Water Framework Directive for the installation of landside elements (tables taken from Clearing the Waters for All; Environment Agency, 2016) and modified to assess the potential effects for the groundwater body.

Activity Information

Your activity	Description, notes or more information
Applicant name	PD Teesport
Application reference number (where applicable)	TBC
Name of activity	Installation of landside elements
Brief description of activity	The following landside works are required: • Paving the terminal area; • Provision of an area outside of the terminal fence for emergency parking of heavy goods vehicles (HGVs) • Construction of a new intermodal rail terminal; • Installation of cargo handling equipment; • Modifications to the existing roads within the Teesport Estate to provide vehicular access to the new terminal; • Entrance and exiting gateways to the terminal; • Buildings and workshops within the proposed terminal area; and • Installation of a surface water drainage system, a pumped foul drainage system, a power supply system (including floodlighting) and installation of a water supply system (including firefighting supply). Of the above activities, the installation of the surface water drainage could impact on the transitional WFD water body as it will potentially discharge into it. In addition, there is potential for disturbance to fish withi the transitional water body as a result of lighting disturbance. All other water will be collected and transferred to the new foul water system. It is envisaged that the drainage system would comprise channel drains with heavy duty gratings running parallel to the quay with outfall carrier pipes running

Your activity	Description, notes or more information
	perpendicular to the quay discharging generally through vented oil separators under/through the quay. With respect to the groundwater, the activities considered relevant are installation of any new buildings and the new intermodal rail terminal
Location of activity	See **Figure 1.1**
Footprint of activity	Covers approximately 63 ha
Timings of activity (including start and finish dates)	Throughout operational period of the new container terminal.
Extent of activity (for example size, scale frequency, expected volumes of output or discharge)	Surface water drainage therefore relates to amount of rainfall experienced.
Use or release of chemicals (state which ones)	None – water will be discharged via oil separators which will remove hydrocarbons

Surface water compliance criteria: Hydromorphology

Consider if your activity:	Yes	No	Hydromorphology risk issue(s)
Could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status		✓	No, the water body in which the disposal will occur is not at high status
Could significantly impact the hydromorphology of any water body		✓	No – no additional structures required within the WFD water body
Is in a water body that is heavily modified for the same use as your activity		✓	N/A – these are landside activities

Surface water compliance criteria: Biology

Consider if the footprint of your activity is:	Yes	No	Biology habitats risk issue(s)
0.5km^2 or larger		✓	These are proposed landside works so will not have direct effects on biological habitats. The potential for indirect effects is considered under water quality below.
1% or more of the water body's area			
Within 500m of any higher sensitivity habitat			
1% or more of any lower sensitivity habitat			

Surface water compliance criteria: Fish

Consider if your activity:	Yes	No	Biology fish risk issue(s)
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary		✓	Since the drainage system would comprise channel drains with heavy duty gratings running parallel to the quay with outfall carrier pipes running perpendicular to the quay discharging generally through vented oil separators under/through the quay, impacts on water quality are not anticipated therefore effects on fish can be scoped out.
Could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)		✓	
Could cause entrainment or impingement of fish		✓	No

Surface water compliance criteria: Water Quality

Consider if your activity:	Yes	No	Water quality risk issue(s)
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)		✓	Since the drainage system would comprise channel drains with heavy duty gratings running parallel to the quay with outfall carrier pipes running perpendicular to the quay discharging generally through vented oil separators under/through the quay, impacts on water quality are not anticipated therefore effects on water quality can be scoped out.
Is in a water body with a phytoplankton status of moderate, poor or bad		✓	Status is good.
Is in a water body with a history of harmful algae		✓	Not monitored

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water quality risk issue(s)
The chemicals are on the Environmental Quality Standards Directive (EQSD) list		✓	No chemicals will be released.
It disturbs sediment with contaminants above Cefas Action Level 1		✓	N/A

Surface water compliance criteria: Protected Areas

Consider if your activity is:	Yes	No	Protected areas risk issue(s)
Within 2km of any WFD protected area		✓	Yes. However, impacts on European Designated Sites are considered in the EIA Report. The proposed activities are unlikely to impact on nutrient concentrations in the water body so Protected Areas related to designations associated with eutrophication will not be impacted.

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Surface water compliance criteria: Invasive Species

Consider if your activity could:	Yes	No	INNS risk issue(s)
Introduce or spread INNS		✓	There is no potential to release invasive species into the WFD water body

Surface Water Summary

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	No	No receptors were identified as being at risk
Biology: habitats	No	
Biology: fish	No	
Water quality	No	
Protected areas	No	
Invasive non-native species	No	

Groundwater Quantitative Status

Consider if your activity could:	Yes	No	Risk issue(s)
Quantitative Dependent Surface Water Body Status		✓	The presence of the container terminal may alter the infiltration of rainwater to ground very locally, however the nature of the natural strata and overlying made ground are such that the current rate of recharge within the footprint of the development is likely to be very small. Therefore quantitative impacts are anticipated to be undiscernible.
Quantitative GWDTEs test		✓	
Quantitative Saline Intrusion		✓	
Quantitative Water Balance		✓	

Groundwater WFD Chemical Status

Consider if your activity could:	Yes	No	Risk issue(s)
Chemical Dependent Surface Water Body Status	✓		Ground investigations have indicated the presence of historic contamination which may have an impact the quality of groundwater and result in impacts on water quality in the estuary. If not addressed during the development, the construction phase of the container terminal which includes piling, has the potential to increase the release and migration of contaminants.
Chemical Drinking Water Protected Area		✓	
Chemical Groundwater dependent terrestrial ecosystem (GWDTEs) test		✓	

Chemical Saline Intrusion		✓	
General Chemical Test		✓	

Groundwater Supporting elements

Consider if your activity could:	Yes	No	Risk issue(s)
Prevent and Limit Objective		✓	
Trend Assessment		✓	

Groundwater Summary

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Quantitative	No	
Chemical	Yes	There is the potential for any piling or excavation undertaken to create a temporary pathway for ground contaminants to enter the groundwater body
Supporting elements	No	