Tees Maintenance Dredging Baseline Document

PD Teesport

February 2008
Final Report
9S2047

A COMPANY OF

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HASKONING UK LTD.
ENVIRONMENT

Marlborough house
Marlborough Crescent
Newcastle upon Tyne, NE1 4EE
United Kingdom
+44 (0)191 2111300 Telephone
0191 211 1313 Fax
info@newcastle.royalhaskoning.com E-mail
www.royalhaskoning.com Internet

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CONTENTS

List of Abbreviations

BTO	The British Trust for Ornithology
CD	Chart Datum
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CCME	Canadian Council of Ministers of the Environment
dB	Decibels (noise measurement)
DBT	Dibutyl tin
DDT	Dichloro-Diphenyl-Trichloroethane
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DO	Dissolved Oxygen
EA	Environment Agency
EAF	East Atlantic Flyaway
EEC	European Economic Community
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standard
ES	Environmental Statement
FEPA	Food and Environment Protection Act
GB	Great Britain
HBCD	Hexabromocyclododecane
HCH	Hexachlorocyclohexane
ISQG	Interim Sediment Quality Guideline
L_{A90}	The A-weighted sound pressure level of nonspecific noise in decibels exceeded for 90% of the given time. [BS4142]
L_{Aeq}	Equivalent continuous A-weighted sound pressure level
MBT	Monobutyl Tin
NE	Natural England
NGCT	Northern Gateway Container Terminal
NMMP	National Marine Monitoring Programme
OD	Ordnance Datum
PAH	Polyaromatic Hydrocarbon
PBDE	Polybrominated diphenyl ethers
PCB	Polychlorinated biphenyl
PDT	PD Teesport
PEL	Probable Effect Level
RSTC	Regional Sewage Treatment Centre
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TBBPA	Tetrabromobisphenol A
TBT	Tributyl Tin
TEL	Threshold Effect Level
TSHD	Trailer Suction Hopper Dredger
UES	Uniform Emission Standard
WeBs	Wetland Bird Survey

1 INTRODUCTION

1.1 Background

The UK Government considers that where maintenance dredging has the potential to affect a *Natura 2000* site (such as a Special Protection Area (SPA) or Special Area of Conservation (SAC)), maintenance dredging should be considered as a 'plan or project' for the purposes of the Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora; the Habitats Directive. Based on this interpretation, maintenance dredging operations would need to be assessed in accordance with Article 6(3) of the Directive. Whilst not endorsing this interpretation, the ports industry has agreed to co-operate with the Government to seek to devise arrangements which allow the effects of maintenance dredging on *Natura 2000* sites to be reviewed in a way which does not impose a disproportionate burden on industry, Government, or its agencies.

In order to inform this process, a *Draft Conservation Assessment Protocol on Maintenance Dredging and the Habitats Regulations 1994* (hereafter referred to as the 'Draft Protocol') has been developed to assist port authorities in fulfilling their statutory obligations, through the co-operation of the following organisations:

- British Ports Association;
- British Marine Federation;
- Cabinet Office;
- Department for Environment, Food and Rural Affairs (DEFRA);
- Department for Transport (DfT);
- Natural England; and
- UK Major Ports Group.

The Draft Protocol was produced in December 2003. Since this date it has been trialled at a number of ports, but has not yet been adopted. The Draft Protocol recommends that a 'Baseline Document' is prepared. This document should draw on existing and readily available information to describe current and historic patterns of dredging in relation to the conservation objectives of adjacent European Marine Sites (EMS).

1.2 Objectives

A Baseline Document has already been produced for the Tees estuary (ABPmer, 2005). This report therefore represents an updated 'Baseline Document' for PD Teesport and contains information which is relevant to the integrity of the Teesmouth and Cleveland Coast SPA and Ramsar site.

The presumption in assessing any potential consequences of dredging activity is that maintenance dredging will continue in line with the established practice (described herein). The Baseline Document also presumes that existing practise is part of the functioning of the existing system. It should, however, be noted that there are proposals to construct a deep sea container terminal (referred hereafter as the Northern Gateway Container Terminal; NGCT) at Teesport. This will require capital dredging to deepen the existing approach channel and berths. However, the studies undertaken as part of the Environmental Impact Assessment (EIA) for NGCT predict that the existing maintenance dredging practices will not be significantly altered following the capital dredge (Royal

Haskoning, 2006). This Baseline Document will, therefore, be applicable following the construction of this scheme, should it receive consent.

The objectives of the Baseline Document are as follows:

- To collate relevant existing data regarding the environmental status of the study area and the potential extent of impacts resulting from previous capital and maintenance dredging undertaken by PD Teesport.
- To provide the necessary data to allow any maintenance dredging proposals for the study area to be assessed in accordance with Article 6(3) of the Habitats Directive and in line with the *Draft Conservation Assessment Protocol on Maintenance Dredging and the Habitats Regulations 1994*; and,
- To assist competent authorities in identifying 'likely significant effect' in respect of future maintenance dredging applications or proposals.

It should be noted that this document will require regular updating as further information becomes available and if circumstances change. A protocol is provided in Appendix 1 to enable this to be undertaken efficiently.

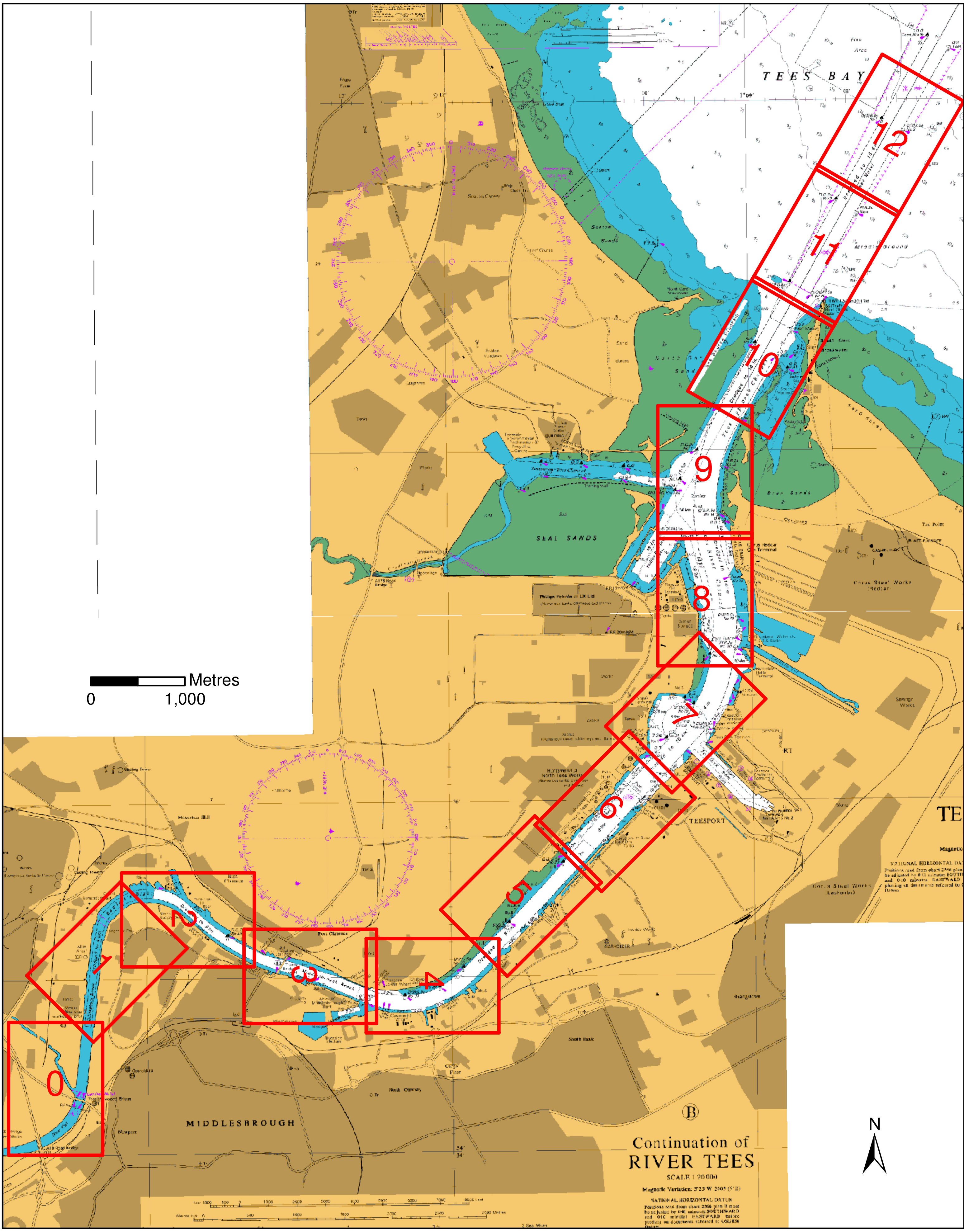
1.3 Study area

The study area is defined as the area in which maintenance dredging is undertaken by PD Teesport, that is, the area commencing 185m down estuary of the Tees Barrage at Blue House Point to the seaward limit of the Port Authority Area. This area effectively includes all river frontage and facilities within the estuary commencing near the Tees Barrage. Also included in this area are the port facilities within Hartlepool Bay. The study area is shown in Figure 1. This is subdivided into 13 sectors (0 – 12) and each is shown respectively in Figure 2a – 2m together with the respective volume of material dredged from 2001-2005.

1.4 Information requirements

The Draft Protocol states that baseline documents are to be developed using existing and readily available information. Where possible, they should identify:

- The existing need for maintenance dredging;
- Existing volumes, frequencies and duration of dredging operations (actual dredge returns rather than volumes applied for);
- The precise location of dredging and disposal;
- Methods of dredging, transport and disposal, including any restrictions imposed in licence conditions or by physical constraints (e.g. depth, tidal flow wave or weather conditions);
- Material type and chemical status;
- History of dredging and disposal at particular locations;
- Monitoring requirements previously imposed via licence conditions and any outcomes of such monitoring;
- Any beneficial use and sediment cell maintenance schemes or mitigation and compensation schemes; and,
- Any other relevant information from past studies and/or previous applications that are linked to maintenance dredging.



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The documents should also include any information supplied by Natural England and other organisations (DEFRA, the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) and the Environment Agency (EA)) on the conditions and characteristics of the *Natura 2000* site, in particular:

- The interest features of the site and the conservation objectives that could be affected by maintenance dredging; and,
- The extent to which the ecological requirements of the site have been achieved, maintained or restored.

1.5 Methodology

In preparing this Baseline Document, a data gathering exercise was carried out and the following data sources consulted:

- Previous Baseline Document prepared by ABPmer for PD Teesport (2005);
- Recently published literature (such as the Environmental Statement (ES) prepared for the NGCT, Royal Haskoning 2006); and,
- Data held by consultees such as Natural England and the Environment Agency (Regulation 33 advice and water quality data, for example).

The data gathering exercise has deliberately focused on those environmental parameters that potentially could be affected by maintenance dredging and are of relevance to the integrity of the SPA. These include the following:

- Coastal processes and morphology;
- Sediment quality;
- Water quality;
- Intertidal ecology;
- Ornithology; and,
- Noise (where this is limited to potential disturbance of feeding or roosting birds).

1.6 Report structure

Following this introductory section, Section 2 details the history of dredging within the study area.

An overview of the Teesmouth and Cleveland Coast SPA and Ramsar site is presented in Section 3. The baseline conditions of the estuary relevant to the integrity of the SPA and Ramsar are then considered in Section 4.

Section 5 concludes the report with comments regarding the potential for impact on the parameters identified and recommendations for taking the document forward.

2 EXISTING AND HISTORICAL DREDGING REGIME

2.1 PD Teesport's current maintenance dredging operations

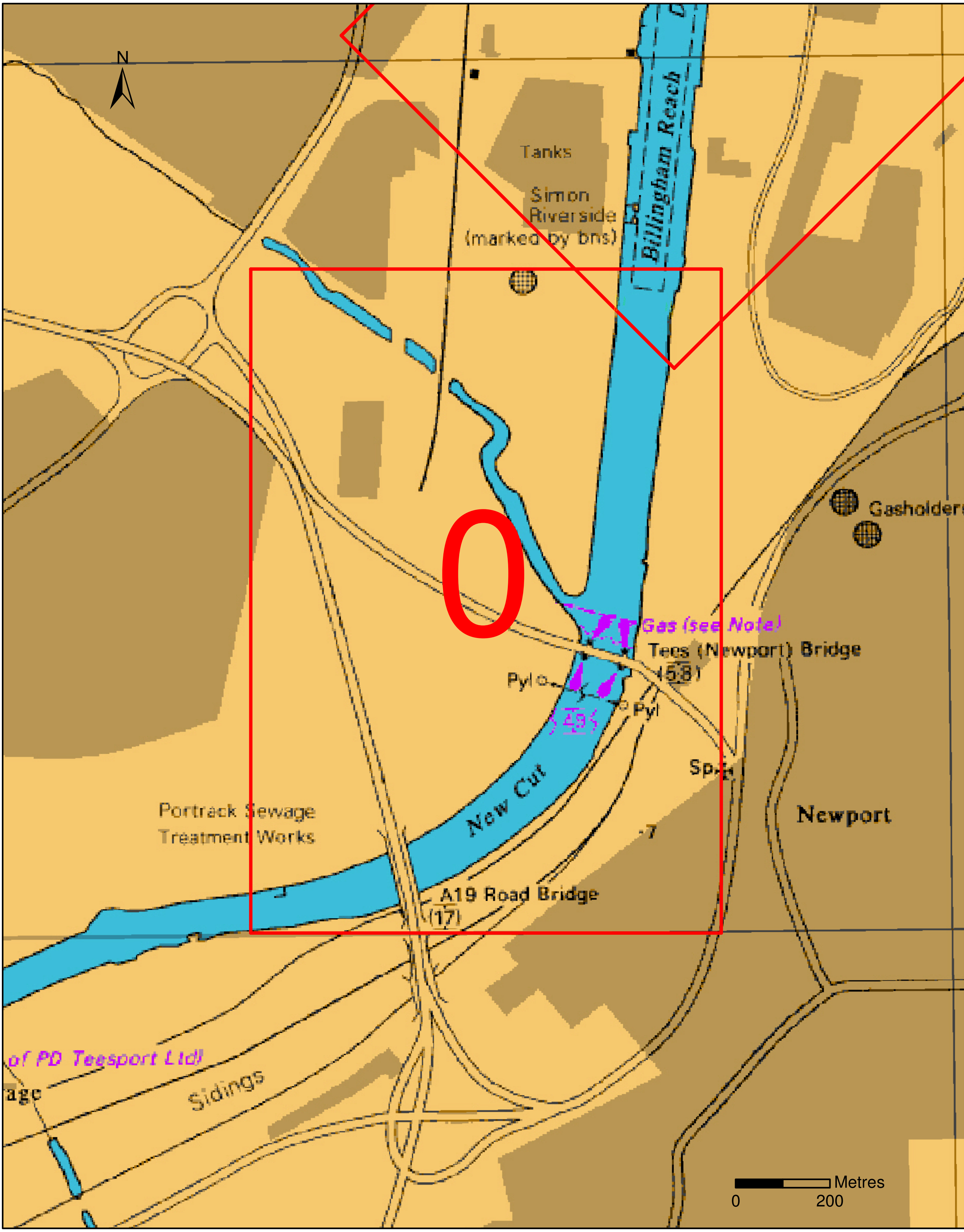
PD Teesport has a statutory duty to maintain navigation within the Tees estuary and into the Hartlepool docks. As part of this responsibility, PD Teesport must maintain the advertised dredge depths within designated areas (hereafter referred to as "the maintained areas"). In order to achieve this, PD Teesport carry out maintenance dredging. The areas that PD Teesport maintain are shown in Figure 2 (a - m). Most dredging occurs in the approach channel and low-middle estuary in order to maintain access to berth pockets and impounded docks. The only other maintenance dredging undertaken within the study area is that carried out by Hartlepool Marine. This amounts to 10,000m^3 per annum but is not undertaken regularly.

The present main channel has declared depths of 15.4m below Chart Datum (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. Berths and docks vary depending on the location and the vessels which require access. The approach channel to Hartlepool Docks is currently maintained to 5.7m below CD. Victoria dock is maintained to 6.8m below CD and the deep water berths within the docks are maintained to 9.5m below CD.

Up until the mid 1960s, most dredging was carried out by steam bucket dredgers. Trailer Suction Hopper Dredgers (TSHD) are currently used for the majority of the dredging and are supported by grab dredging and ploughing where required.

A summary of where dredging is generally undertaken and the reasons why dredging is required, is provided in Table 1 (summarised from information in ABPmer, 2005).

Data on dredging has also been obtained from PD Teesport and spans the period 2000 to 2005. This information is shown by reach in Figures 2 and 3. In 2005, a total of around 1 million m^3 of material was dredged. The areas that were dredged are mostly located in the Seaton Channel Turning Area and consisted predominantly of sand. The majority of the dredged material was deposited at Tees Bay A disposal ground (see Section 2.3 for a description of the disposal grounds).



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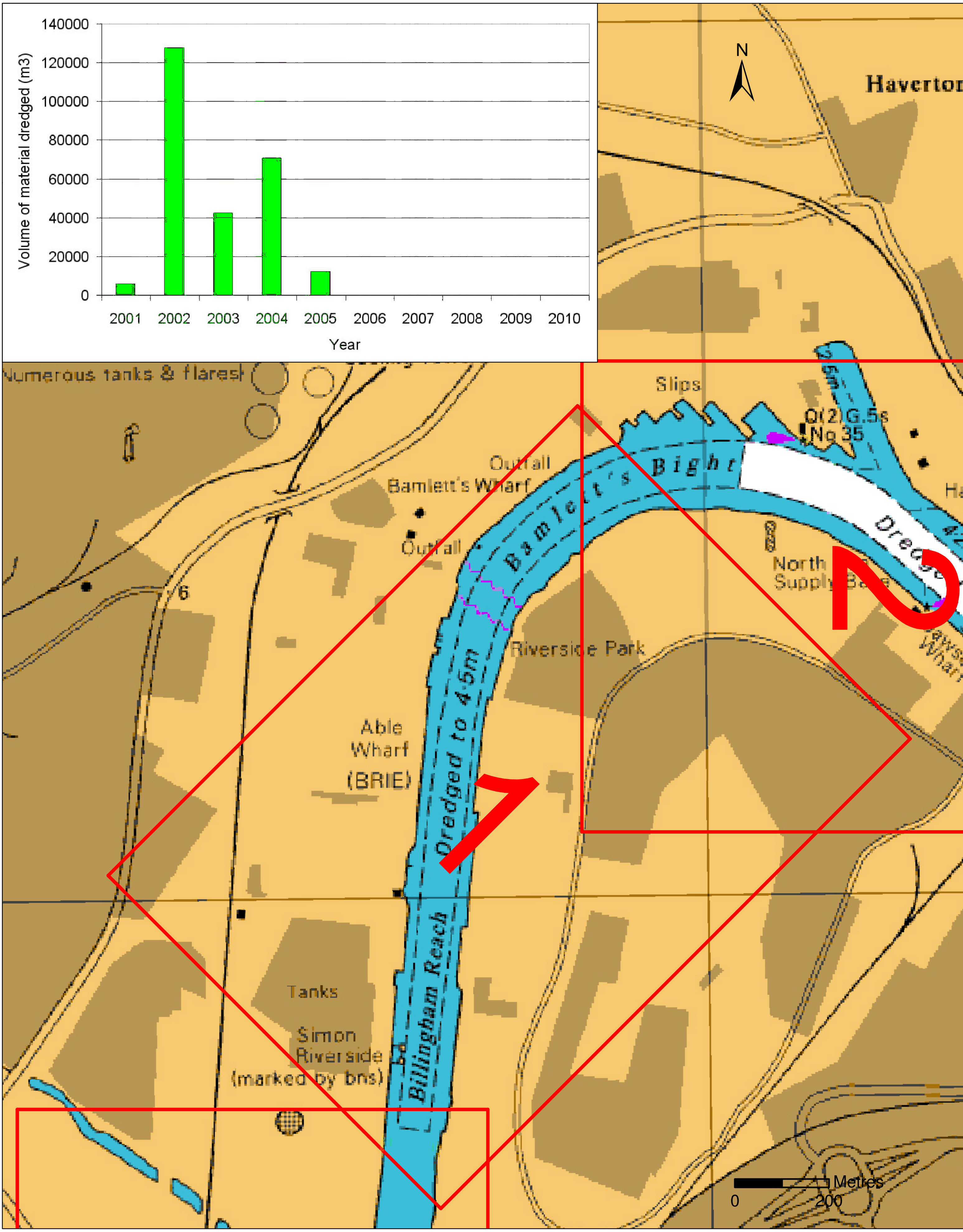

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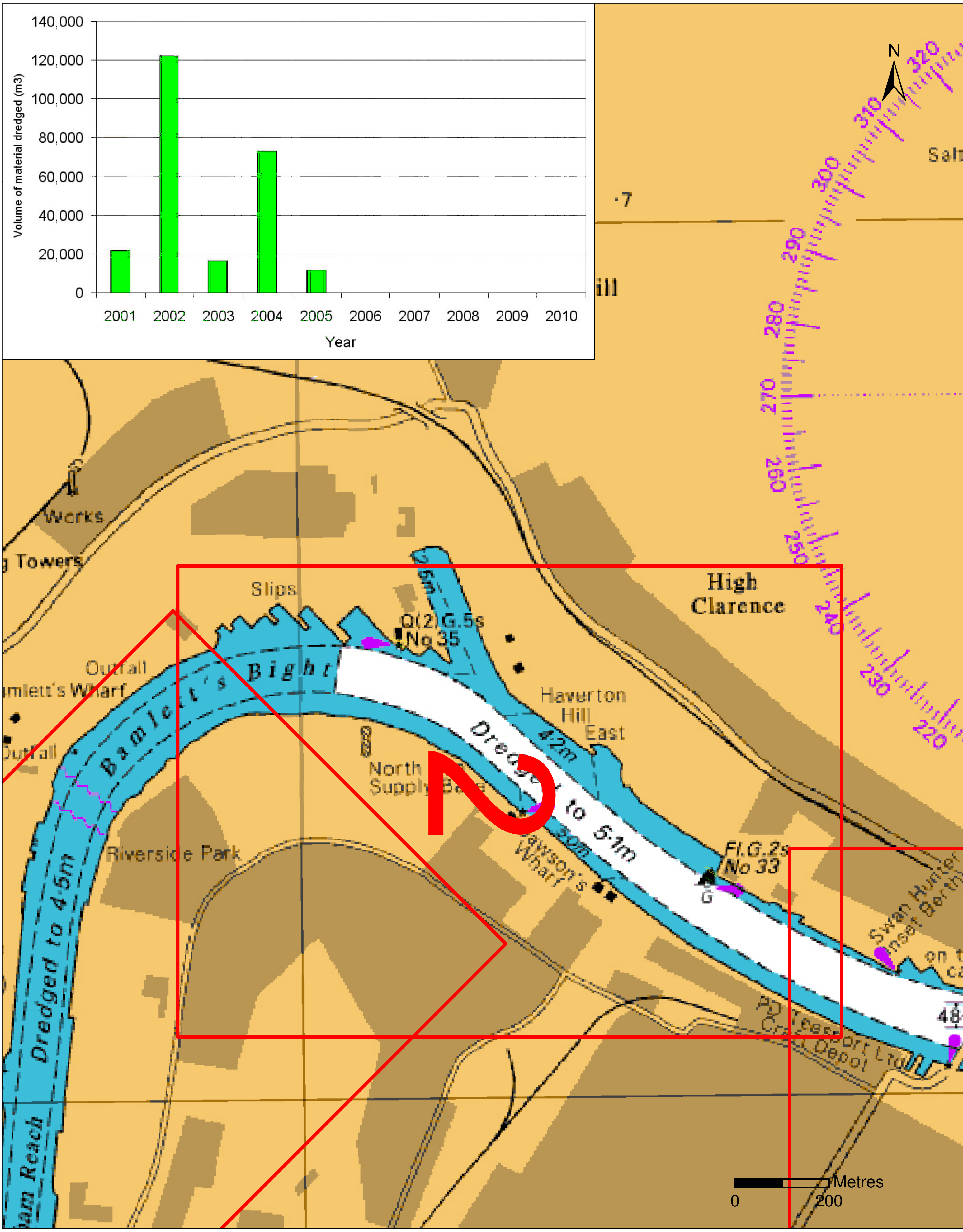

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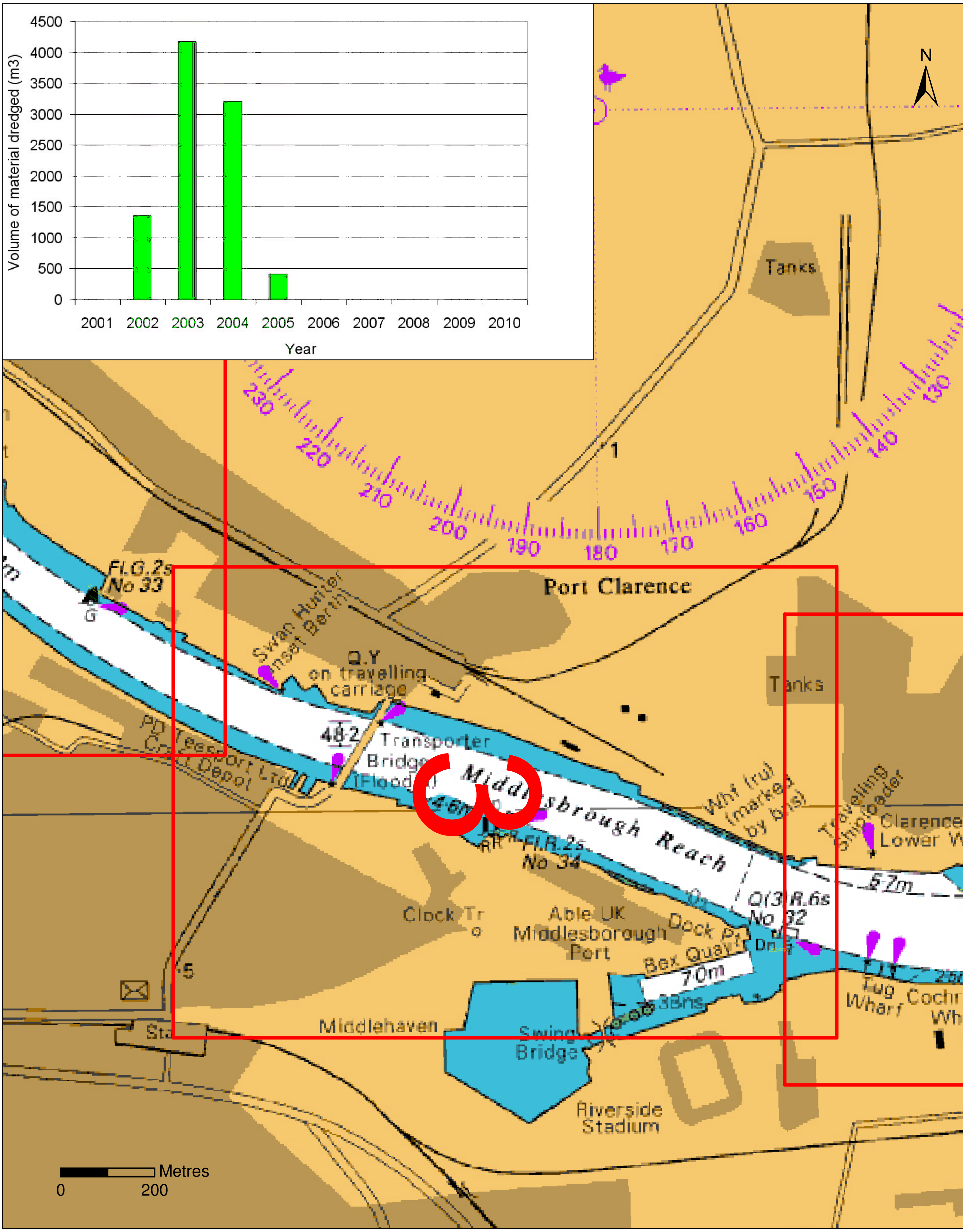

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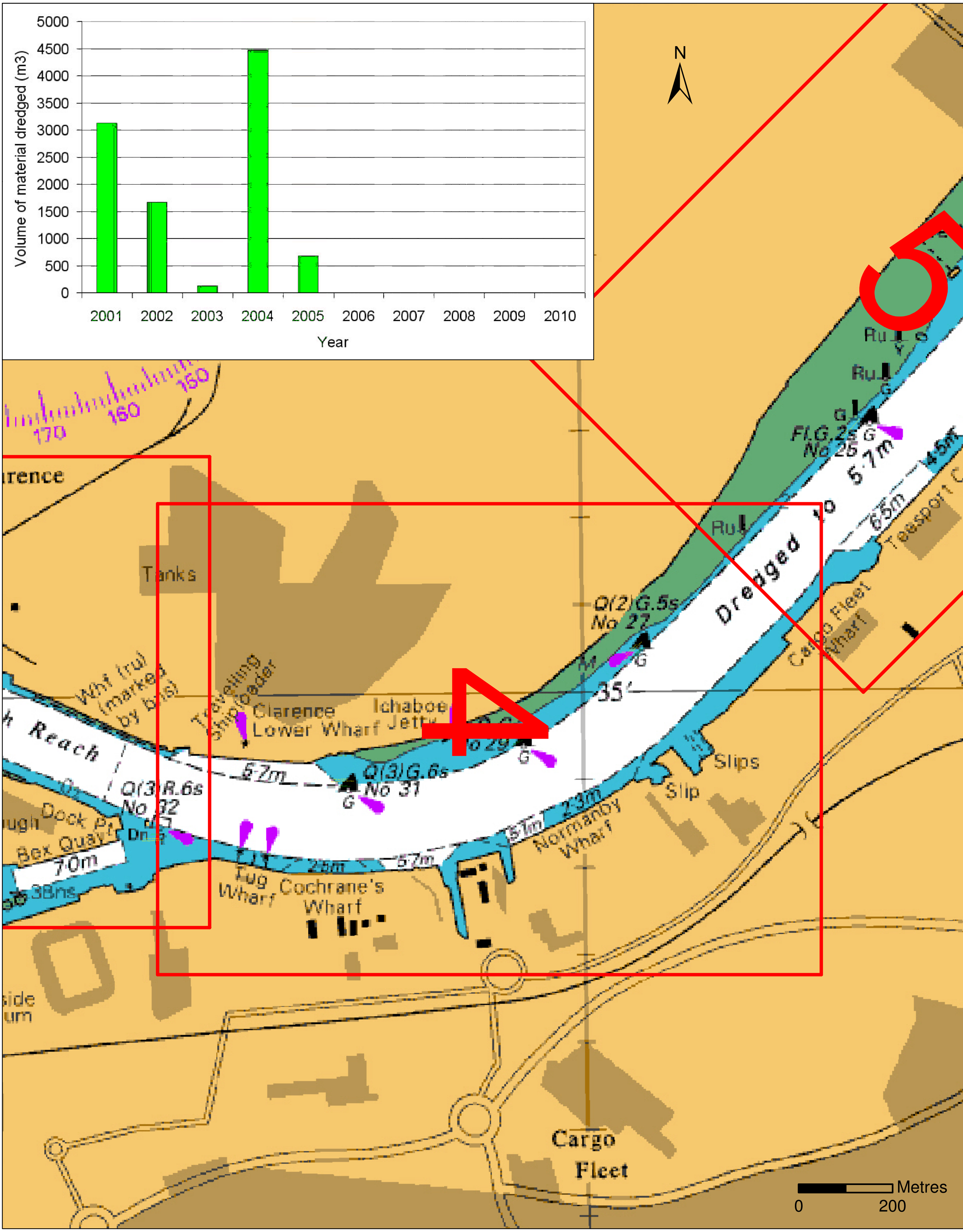

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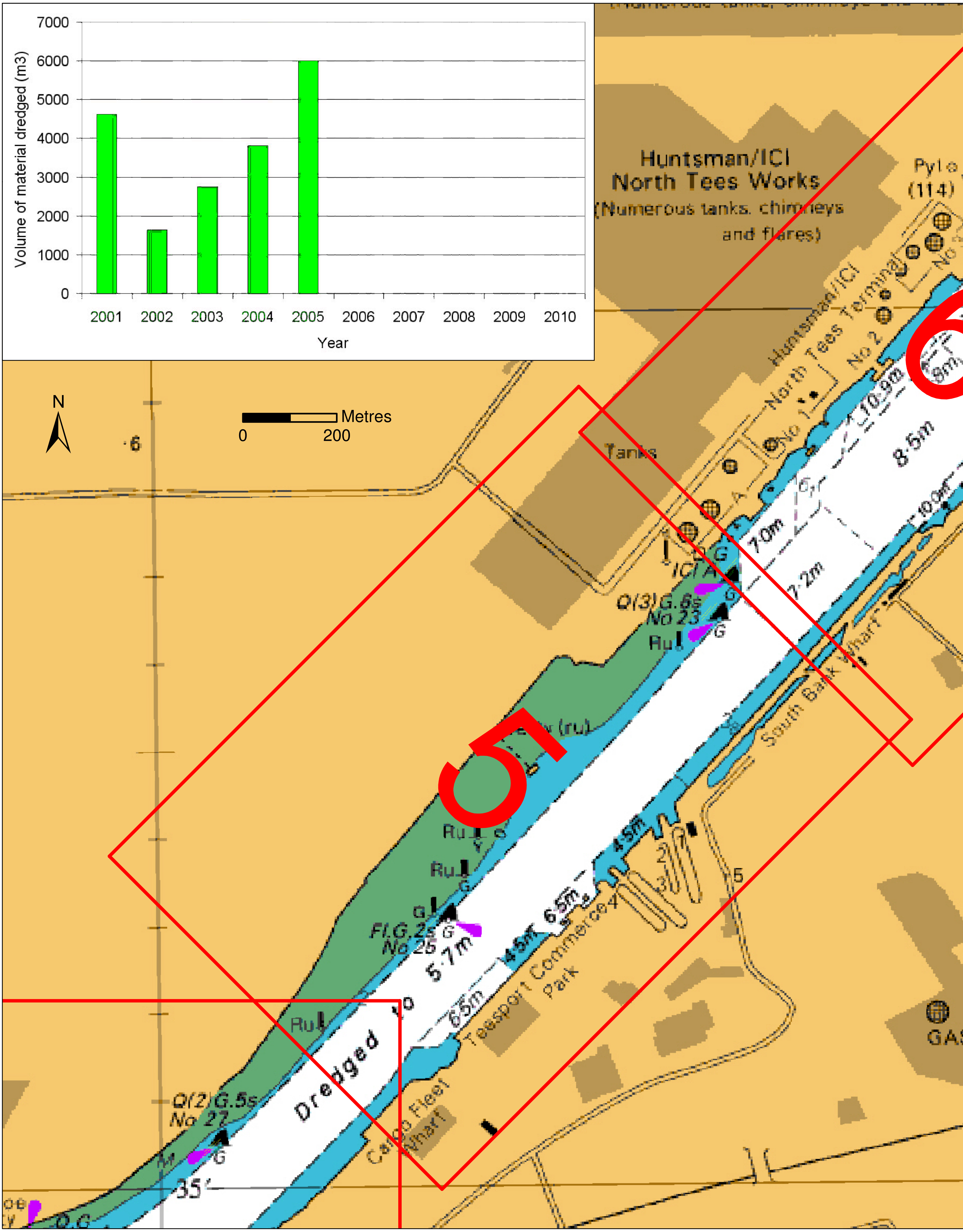

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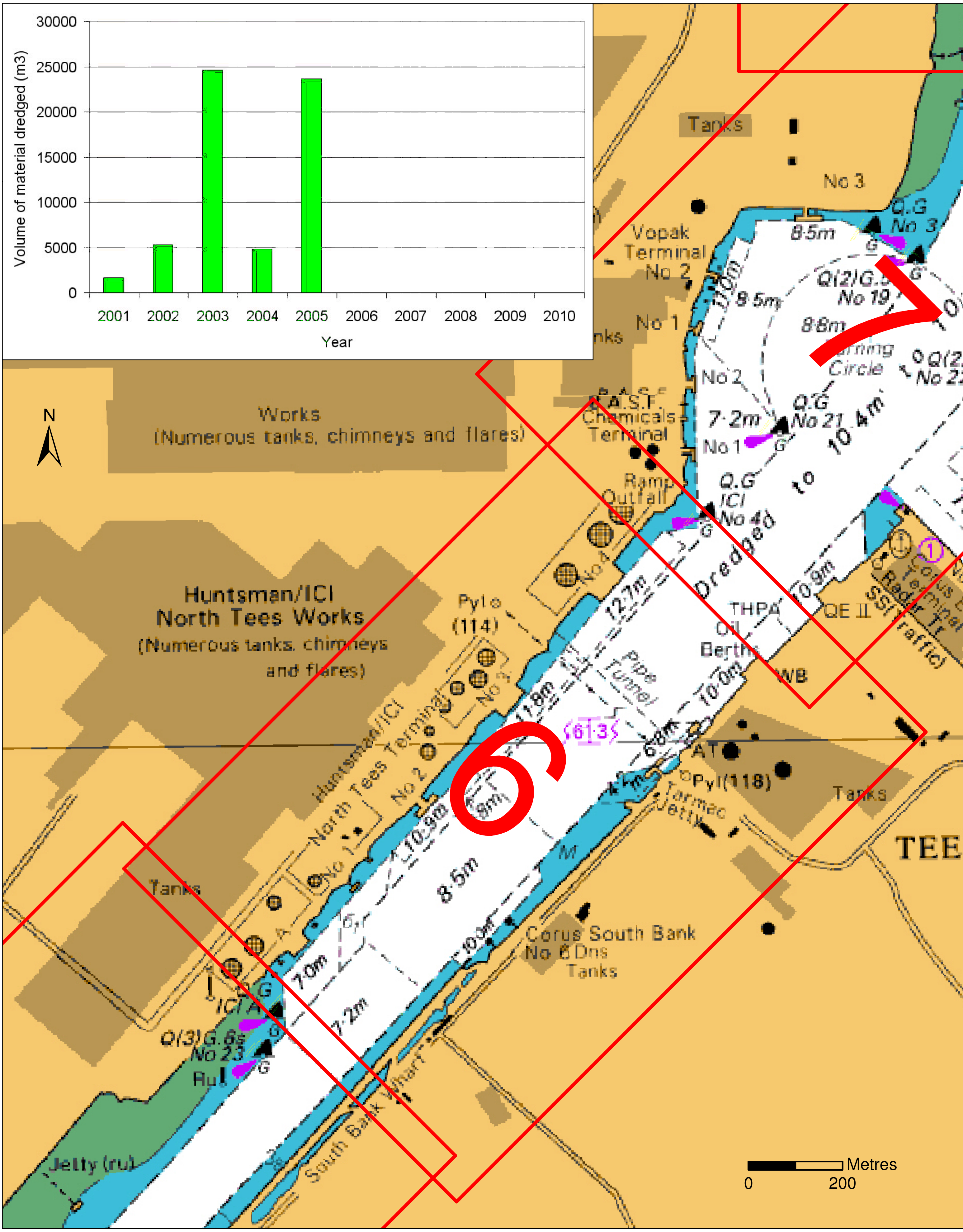

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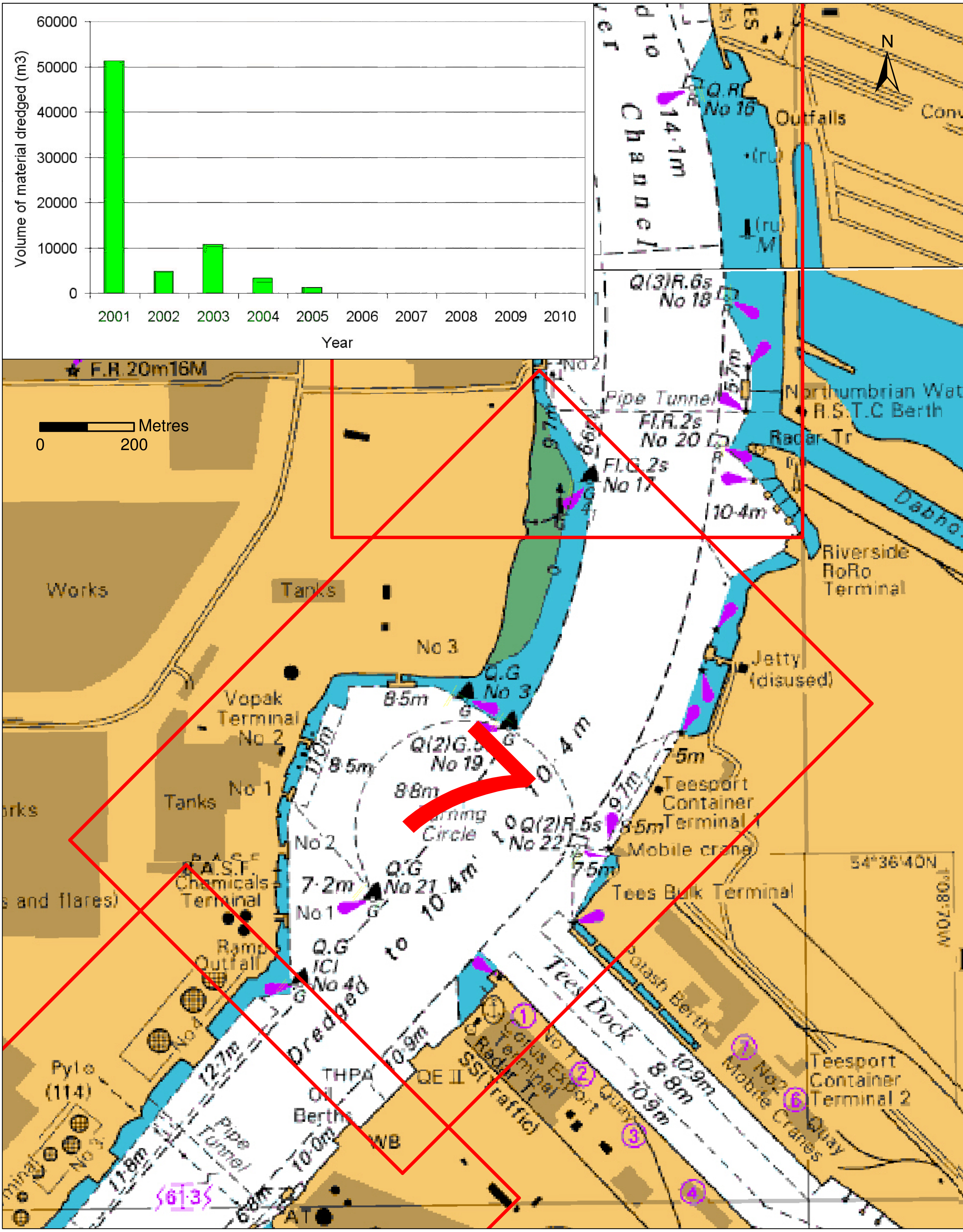

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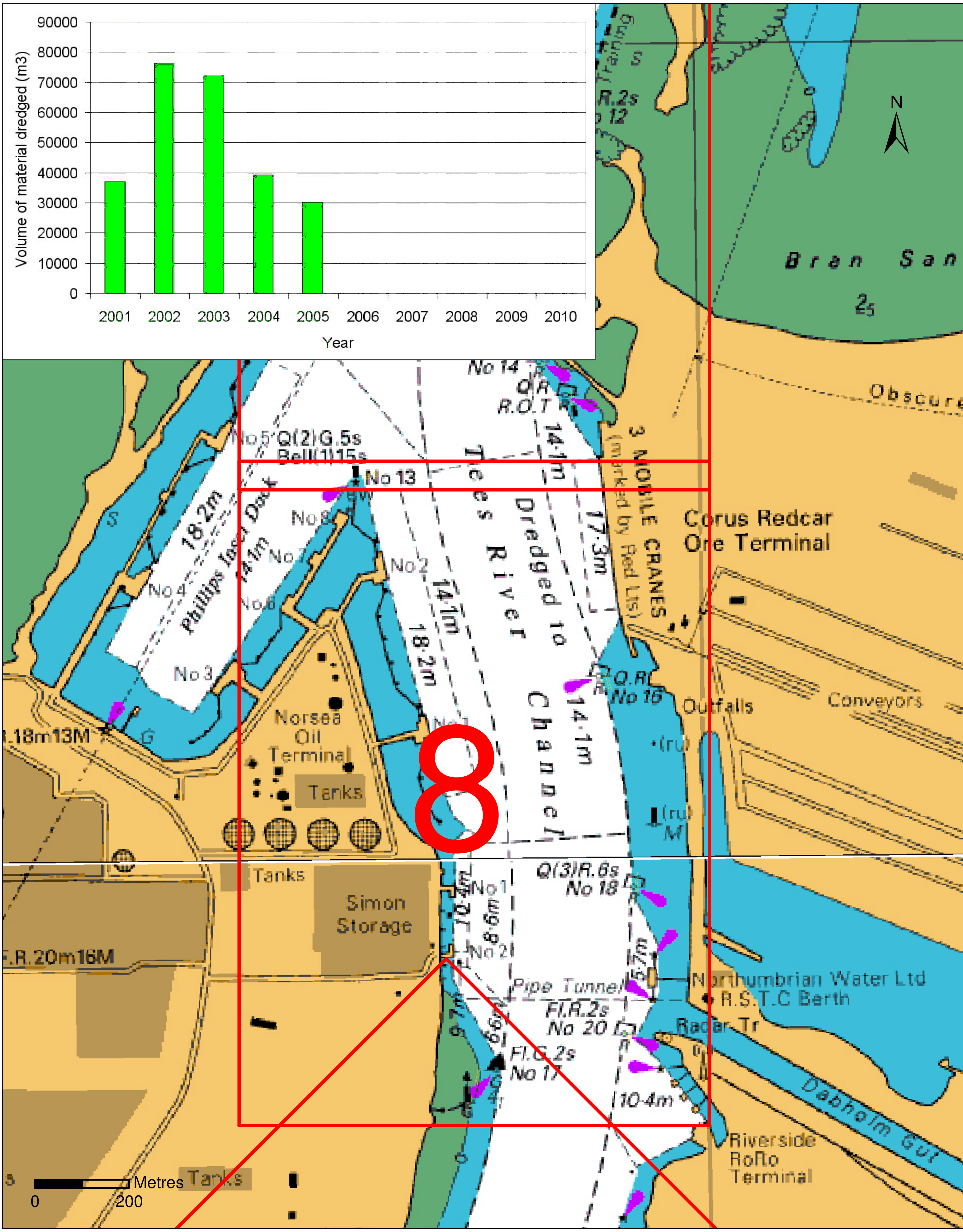

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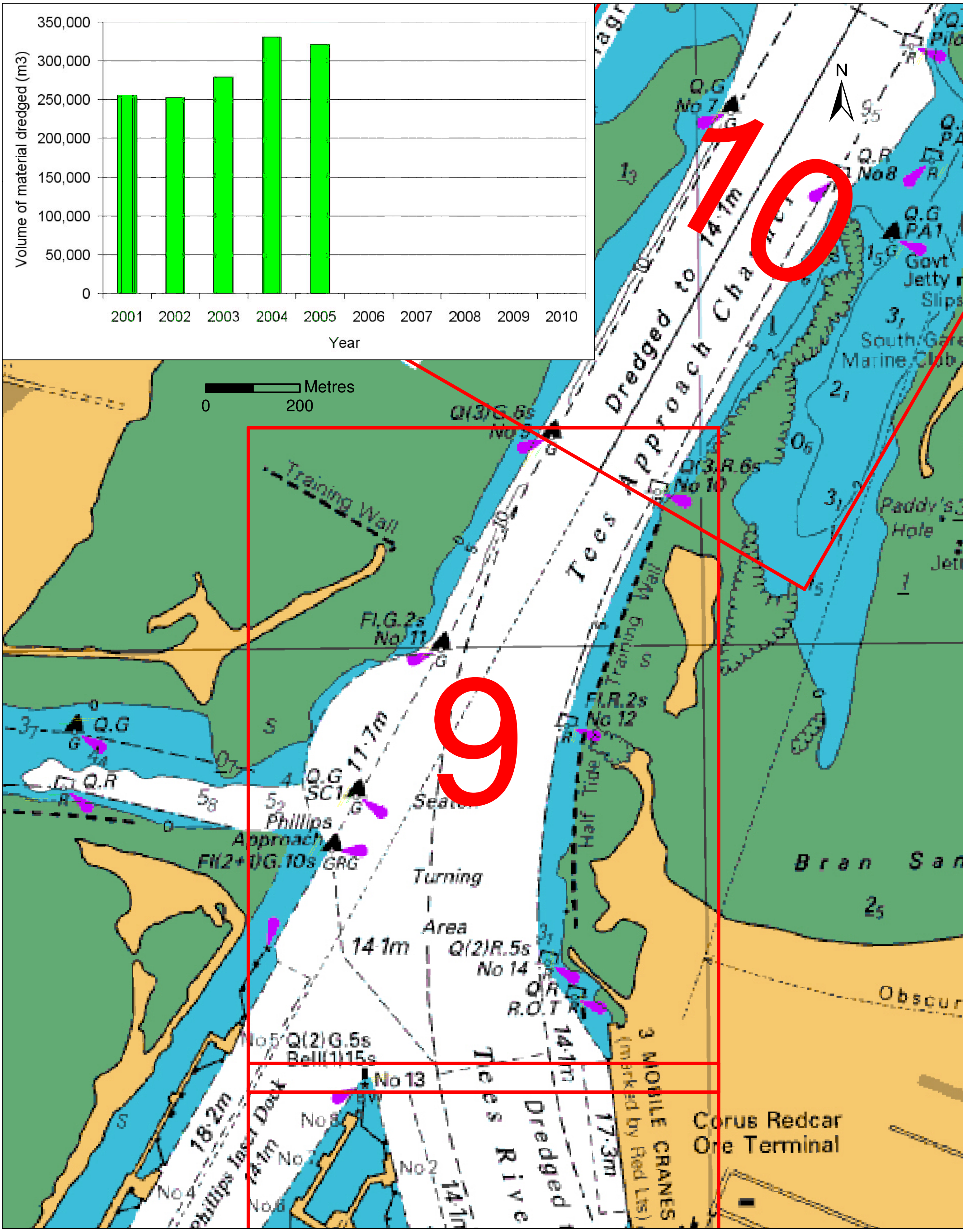

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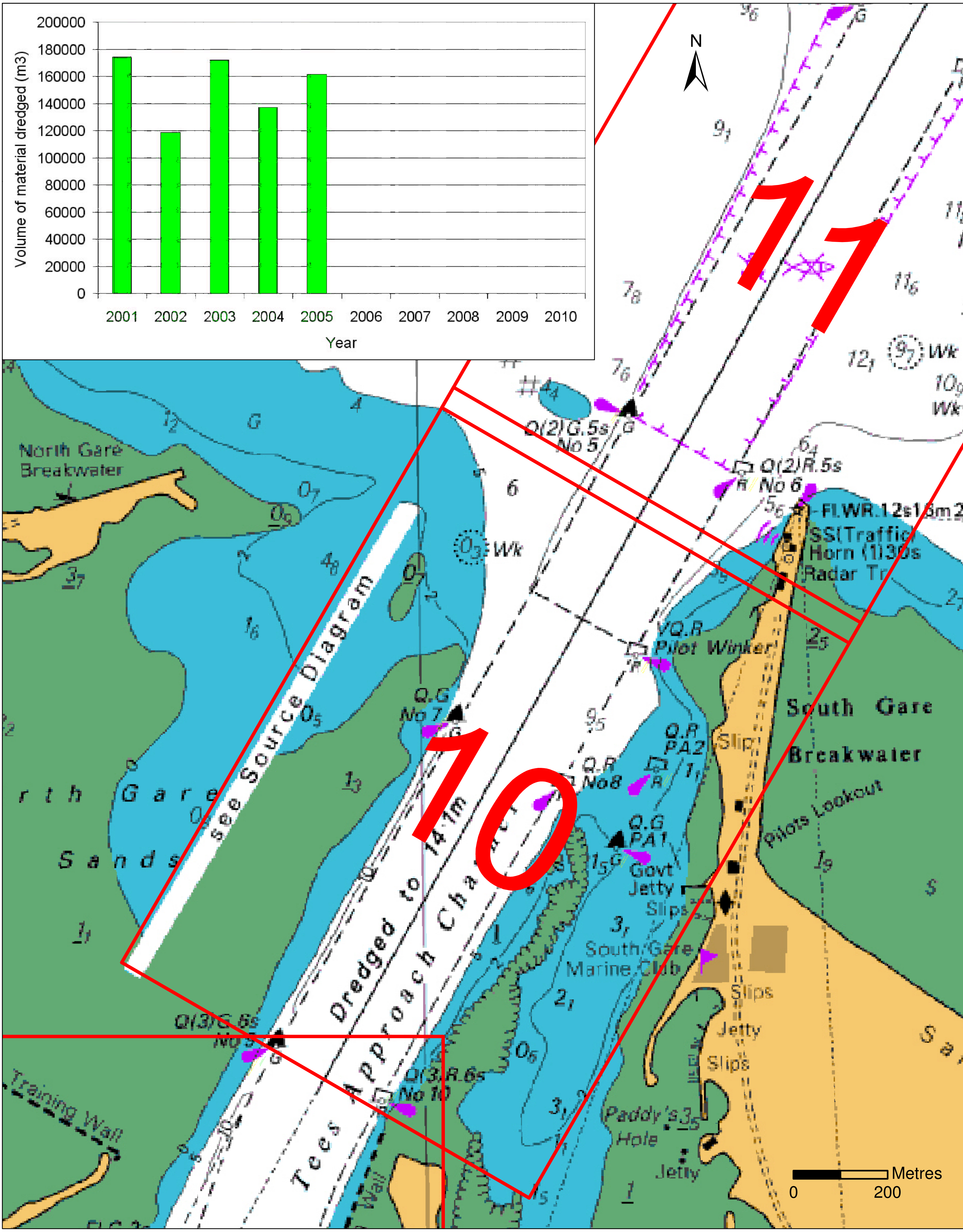

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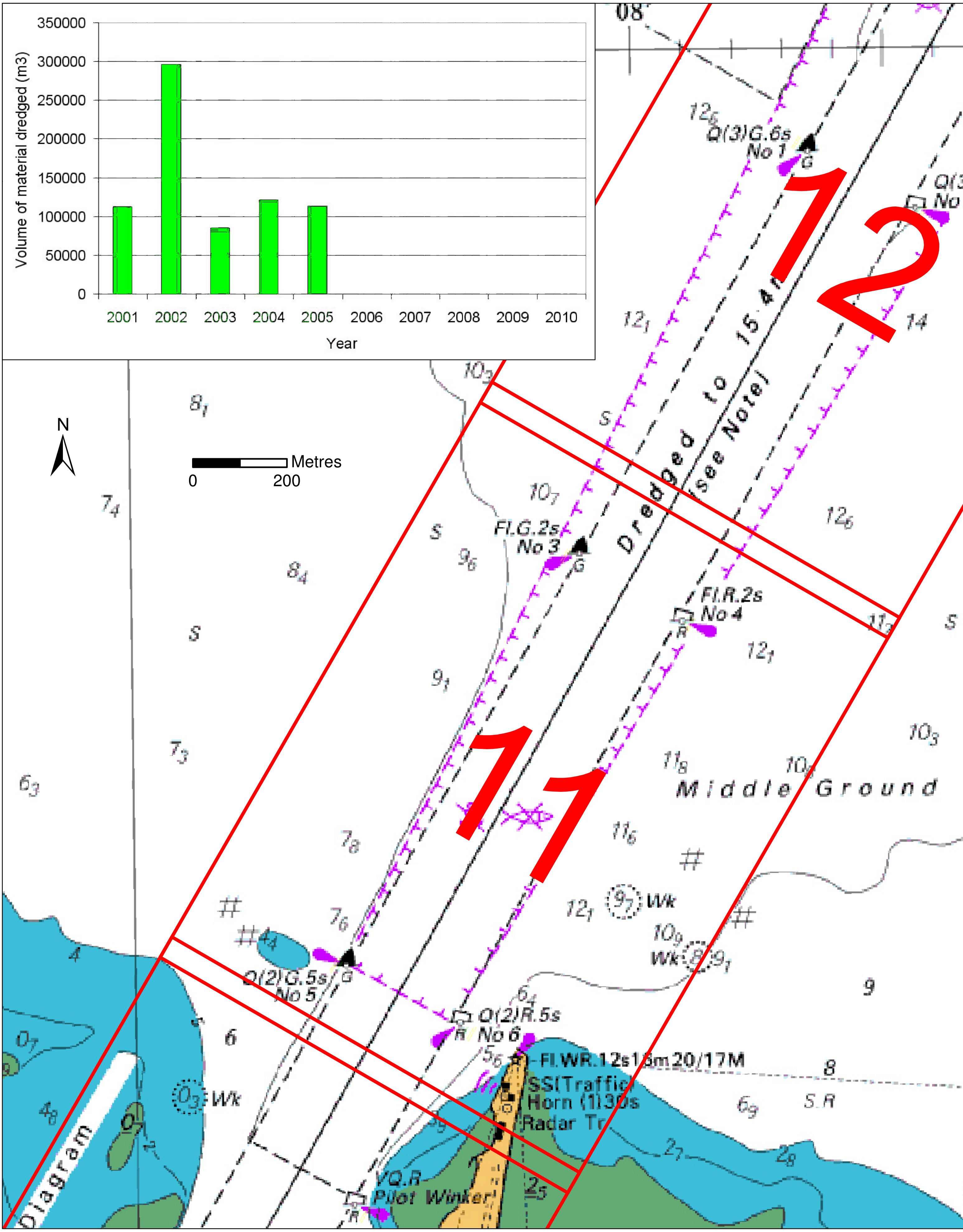

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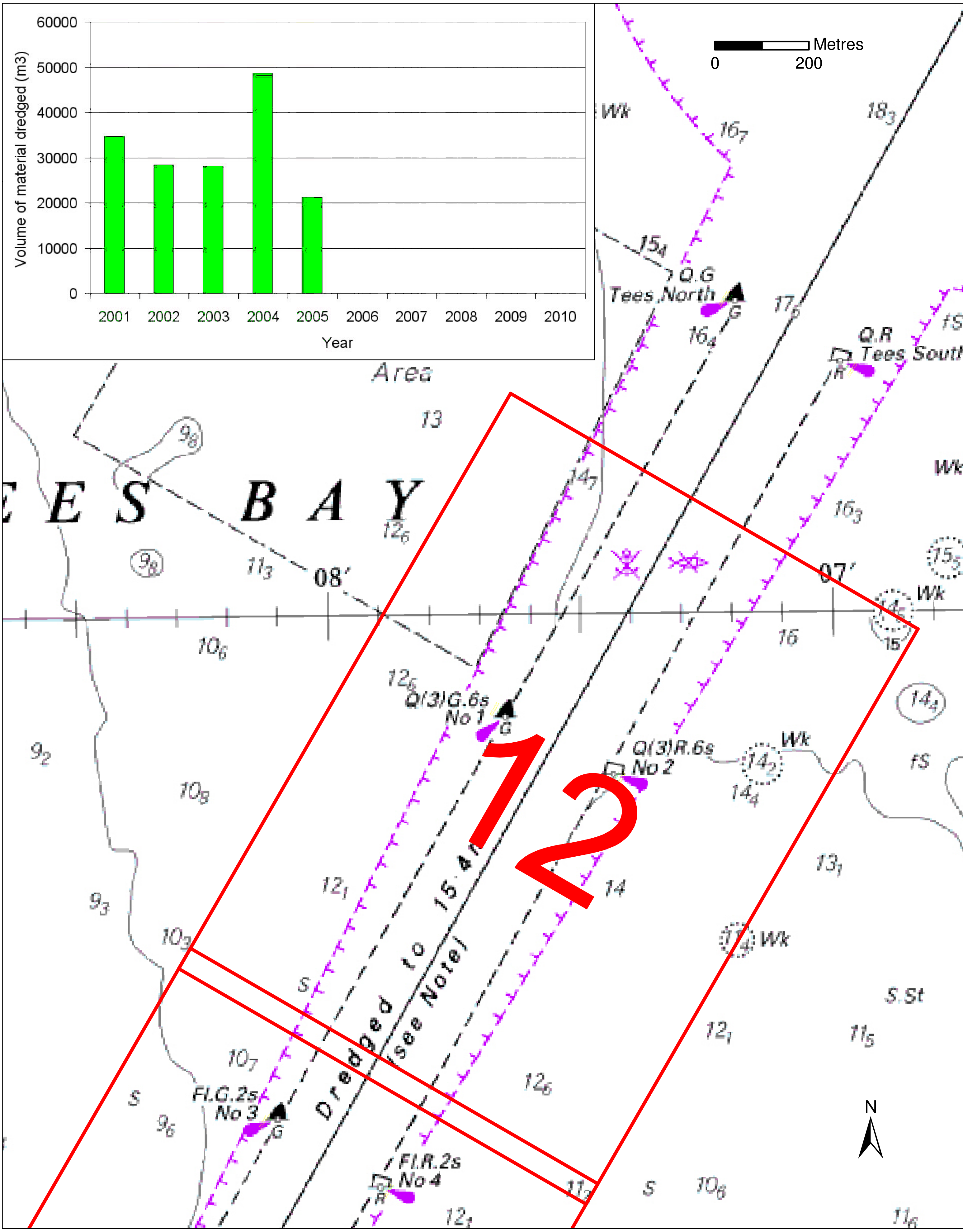

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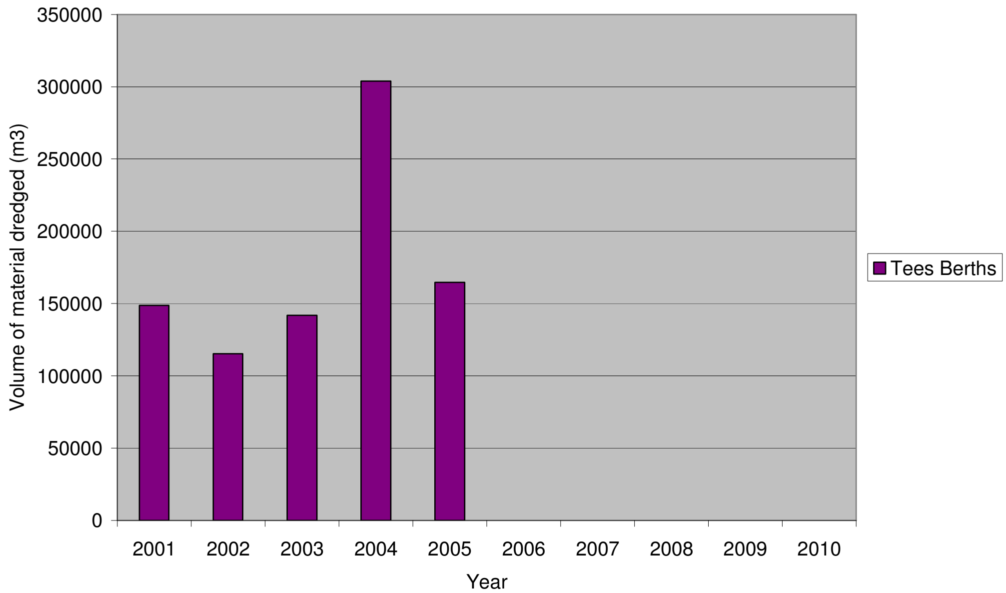


Figure 3a **Volume of material dredged (m^3) from the Tees Berths sector for the period 2001 – 2010**

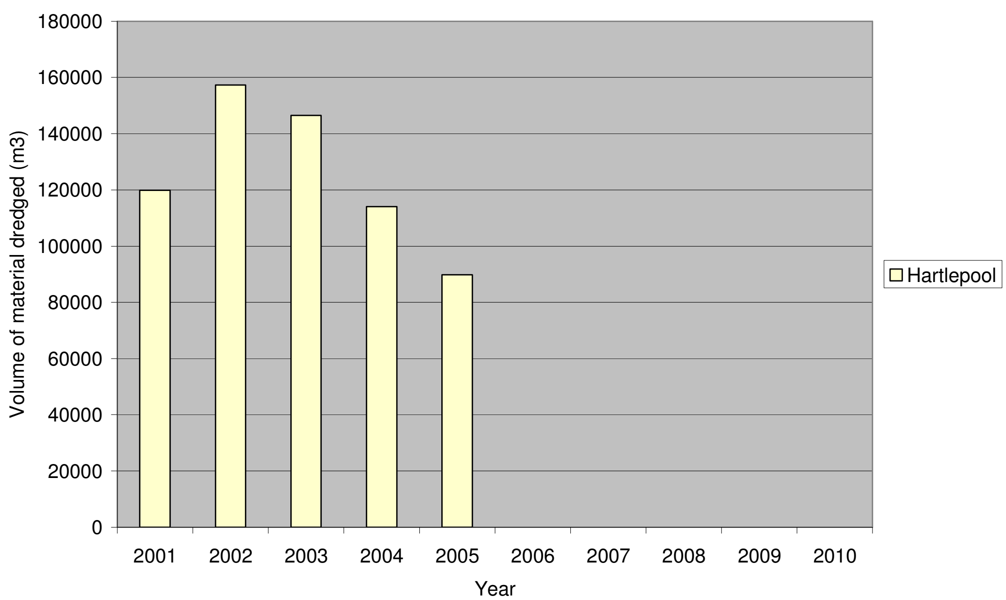


Figure 3b **Volume of material dredged (m^3) from the Hartlepool sector for the period 2001 - 2010**

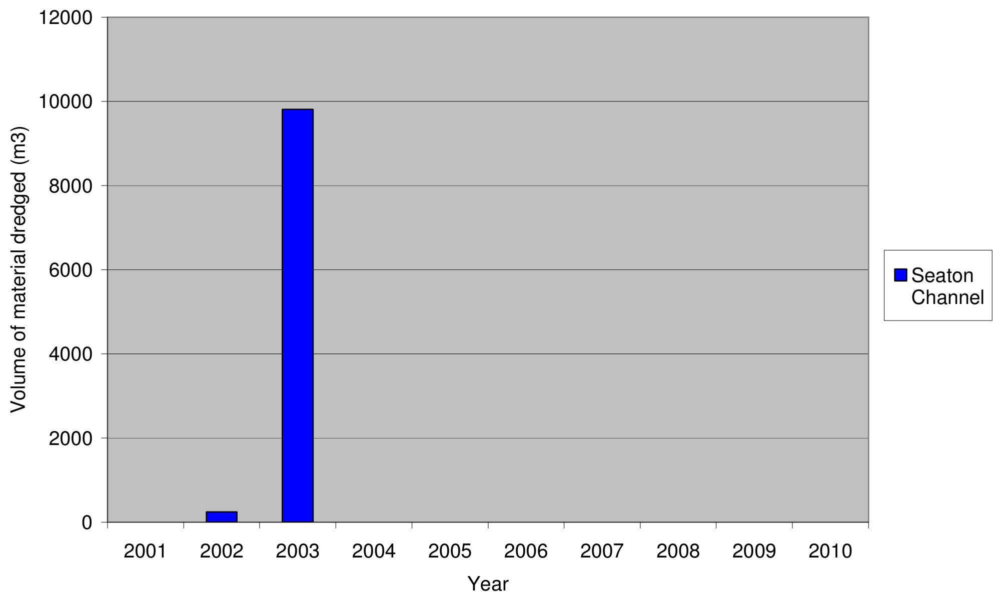


Figure 3c **Volume of material dredged (m^3) from Seaton Channel for the period 2001 – 2010**

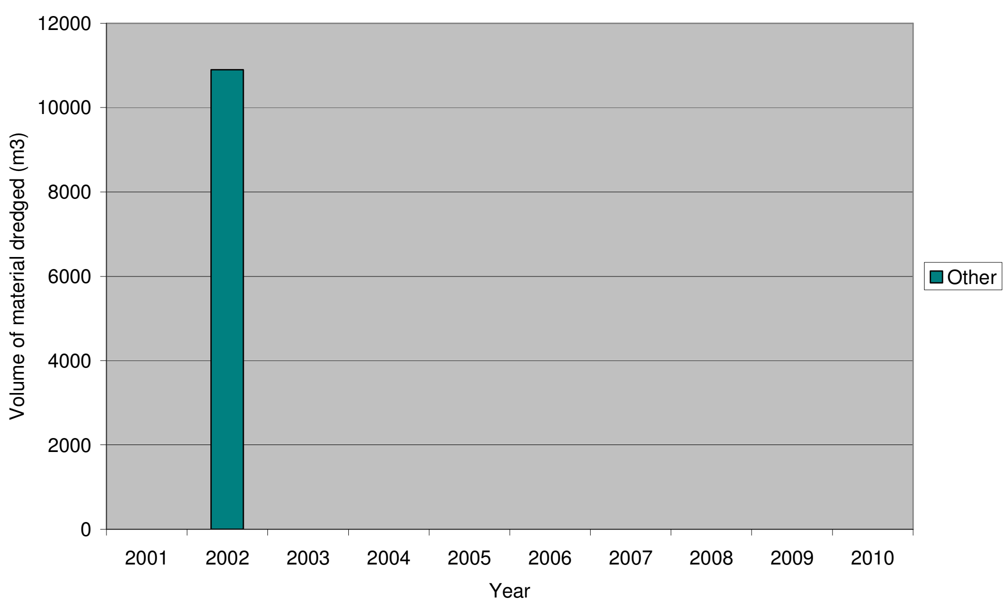


Figure 3d **Volume of material dredged (m^3) from 'Other' areas for the period 2001 – 2010**

Table 1 Summary of areas which require maintenance dredging

Location	Siltation issues	Current dredging operations	Dredged depths
Blue House Point to Mid-Billingham Reach	Main siltation occurs along straight section of south bank of the channel, between Simon Riverside to start of Bamlett's Bight. No dredging occurs between Blue house point and landward end of the Billingham Reach	TSHD	Billingham Reach is dredged to 4.5 below CD and extends adjacent to Simon Riverside to the outfall landward side of Bamlett's Wharf.
Mid-Billingham Reach to Transporter Bridge	Siltation occurs along both north and south banks of the channel around section Haverton Bend (seaward end of Bamlett's Bight). Siltation also occurs around buoy 33 on north side of the channel.	TSHD, occasional use of grab dredger to maintain Bamlett's Bight	Dredged to 4.5 below CD (Billingham Reach and Bamlett's Bight). At North Sea Supply Base, river dredged to 5.1m below CD. Depth maintained to transporter bridge
Transporter Bridge to Tees Dock	South bank of channel at Normanby Wharf is subject to increased rates of siltation. North Bank of channel at North Tees mudflat accretes. Limited siltiation occurs at the change of depth point in main navigation channel.	TSHD. Grab dredger maintains berth pockets.	Channel is dredged to 5.1 below CD in Middlesbrough Reach from Transporter Bridge to landward side of the Huntsman ICI North Tees Terminal. Main channel, Tilcon Wharf and approaches to Middlesbrough dock are dredged to 5.7m below CD. Berthing pocket is maintained at 7.2m below CD. The berthing pockets at Tees Offshore Base are dredged to 6.3 and 6.5m below CD. Huntsman/ICI North tees terminal has 4 berths all dredged from between 7m below CD to 12.7m below CD (1 has been decommissioned). The main channel is dredged to 10.4m below CD. This depth continues as the main navigation channel to a point adjacent to Tees Dock.
Tees Dock to No. 13 Beacon (Phillips)	Limited accretion occurs in the northerly part of the turning circle. More significant siltation occurs along the northern bank of the navigation channel adjacent to the Vopak terminal. Also occurs on south bank further down estuary opposite Simons Storage	TSHD. Grab dredged in confined berth pockets. General reduction in dredging after barrage (40-60%). Seaton turning circle has increased (nearly doubled).	Significantly variable depending on location. It should be noted that Dabholm gut is not maintained.

No. 13 Beacon to Outer North and South Fairways Buoys	Area of most significant sedimentation. Rates have increased at south end corner of North Gare – get slippages from North Gare Sands. Outside breakwaters, dredging same as that in 1980s, early 90s. Suggestion that majority of sedimentation occurs in the winter period.	TSHD frequently required due to slippage. Trends show an increase in dredging required.	Norsea Oil terminal berths 3,6,8 are dredged to same depth as main channel (ie 14.1m below CD). 4 and 5 are dredged to 18.2m below CD. Tees Approach Channel is maintained at 14.1m below CD until it reaches buoy No. 6. From 6 dredged to 15.4m below CD until reaches water deeper at channel buoys 1 and 2.
Seaton Channel	Suggested accretion occurs at 0.4m/year (90,000m^3 per annum). Most occurs on Eastern side near channel entrance. Accumulation of this area over the year has caused a deviation of the channel to the West.	Dredging infrequent. Last campaign in 1989 (removed 600,000m^3 material).	Channel is dredged to 4.6m LAT. Greatham Creek is not maintained.
Hartlepool Dock and entrance channel	Approach channel accretes along southerly edge. Occasionally northerly sections of the channel reduce in depth. Within docks, Victoria Dock accretes generally evenly.	TSHD and grab dredger	Constant dredge commitment ranging from 160,000 to 116,000 m^3 over 5 yearly periods. Total dredge is 10-12% of overall programme. Approach channel is maintained to 5.7m below CD. Victoria Dock is maintained to 6.8m below CD. Deep water berths are dredged to 9.5m below CD.

2.2 PD Teesport's historical dredging operations

Figure 4 summarises the history of dredging in the study area and includes both the capital and maintenance dredging undertaken between 1810 and 2003. Details are given where information exists in terms of volumes and areas impacted.

	1800		
		1810	First record of dredging
Dredging employed to increase water area of M'boro Dock from 3.6ha to 10.3ha	1842		
		1853	Steam driven bucket dredger purchased. Used to help training walls maintain 4.3m channel between M'boro docks and the sea.
	1897		
	1900		
Various capital schemes carried out: - Tees Approach channel. Two other capital schemes created a 183m wide navigational channel from the end of the South Gare breakwater to Philips (now ICI) refinery jetties to a depth of 10.4m below MLWS. 244m base width and turning circles were incorporated. Extended navigational channel up to Cargo Fleet - min depth 7.6m below MLWS and widening to 244m base width.	1950		Consistent maintenance dredging carried out to maintain access to M'boro dock. Material pumped to intertidal areas on or around Seal Sands for reclamation.
			Tees Dock developed.
	1960		
		1963	Tees Dock deepened - required 2 million m3 material to be removed.
		1967	Deepening of main channel and vessel turning circles at entrance to Tees Dock and Seaton Channel. Removed 10 million m3 of sands, silt and marl used for reclamation.
To improve overall access to the estuary, approach channel depth increased to 15.4 below LAT. 7.6 million m3 removed and used for reclamation on Seal Sands.	1970		Seaton Channel deepened to provide access to new dock.
		1973	Philips dock dredged (now Norsea Oil Terminal)
Average maintenance dredge commitment 1.5-1.6 million m3 in situ. Late 1980s, changing siltation patterns were highlighted. Also noted in some areas, over deepening associated with dredging in some areas.	1980		
	1990		
		1995	**1995 - barrage construction**
In 1990 1.4 million m3 dredged which slowly reduces to 0.7 million m3 dredged in 2000.	2000		**1998** 500,000m3 removed for Riverside Ro-Ro project. 1996-2003: Dredging requirement varies between 1.0 to 1.35 million m3.

Figure 4 Timeline showing (capital and maintenance) dredging history (summarised from ABPmer, 2005)

Figure 4 shows that maintenance dredging has been undertaken since the early 1800's. Detailed information in relation to volumes dredged is not, however, easily available. A number of capital dredging schemes have significantly changed the study area over the years and, as the channel has progressively deepened, the requirement for maintenance dredging has increased. Locations that require maintenance dredging have moved further towards the mouth of the estuary and sediments have become finer, particularly in the upper reaches of the estuary towards the barrage. Training walls and low tide walls have also been constructed and have changed the way in which the areas accrete. Construction of the barrage has also had a significant influence on the distribution of downstream sedimentation.

Figure 5 provides further information on the amount of material dredged in the period 1995-2000.

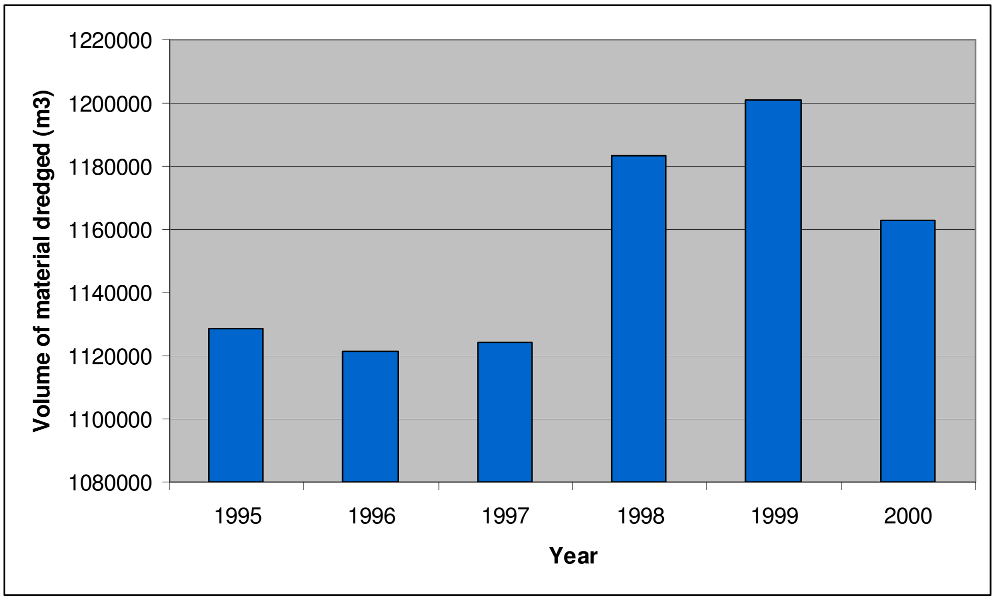


Figure 5 **Amount of material dredged for maintenance purposes during the period 1995-2000**

2.3 Disposal

Historically, dredged material was disposed of in reclamation areas around the estuary. Since 1970, however, material has been deposited at the Tees Bay disposal sites (see Figure 6) due to the increase in finer arisings not suitable for reclamation purposes. Additionally, areas to reclaim within the estuary are limited. The disposal sites present in Tees Bay are summarised in Table 2.

Table 2 Disposal sites and descriptions of material and activities undertaken at each site

Disposal site	Status	Description	
Tees Bay A (TY160)	Active	Inner site for soft non-cohesive maintenance material.	DEFRA records show volume fluctuating from 0.3 million to 2.4 million wet tonnes over a 15 year period. Volumes drop off post 1996. Largest volume since 1996 was 1.8 million wet tonnes deposited.
Tees Bay B (TY110)	Closed	-	-
Tees Bay C (TY150)	Active	Predominantly used for capital dredged material. Some maintenance dredging has been disposed of here.	DEFRA records show period small scale usage. Peak volume deposited in 1999 of 1.9 million wet tonnes associated with the construction of the downstream Ro-Ro berths. Usual yearly volume is 0.1 million wet tonnes. Some years show no usage at all.
Tees Bay Foreshore (TY170)	Closed	-	-

2.4 Beneficial use

Although the majority of the material is deposited at the disposal sites offshore, a number of schemes have been developed which will use some of the material within the estuarine system.

The first is a proposal to use material for the creation of bird islands within Bran Sands. Additionally, a scheme which involves the placement of material at the North Tees mudflats is also under consideration. The aim of this scheme is to improve the quality of the surface sediment in this intertidal area.

2.5 Monitoring requirements

There are currently no monitoring requirements attached to licences issued to undertake maintenance dredging in the study area. However, all sections of the main navigational channel undergo bathymetric survey on a monthly basis. Additionally, the disposal sites are monitored qualitatively by CEFAS. The bioassay of sediment samples has been proposed as part of a future extension of CEFAS monitoring of sediments. The Environment Agency undertakes a programme of water quality monitoring and Northumbrian Water monitors levels of nutrients in waters discharged from its treatment works at Bran Sands. This is particularly relevant to the monitoring of algal growth at Seal Sands for which PD Teesport provides support through boat time and crew. As part of the environmental monitoring required as part of the Northern Gateway container terminal application, PD Teesport has recently purchased probes to monitor turbidity and dissolved oxygen in the water column.

3 TEES AND CLEVELAND COAST SPA AND RAMSAR SITE

3.1 Overview

The Teesmouth and Cleveland Coast SPA includes both marine areas and land which is not subject to tidal influence. The marine component qualifies as a European Marine Site. The seaward boundary of the EMS is concurrent with the SPA and the landward boundary is the same as the upper boundary of the SPA or, where that extends above land that is covered continuously or intermittently by tidal waters, it is at the limit of the marine habitats. Figure 7 illustrates the boundaries of the site.

3.1.1 Interest features

The following details are taken from the citation for the SPA as provided by Natural England. The Teesmouth and Cleveland Coast SPA is of European importance because it is used regularly by at least 1% of the Great Britain population of the following species listed on Annex 1 of the Birds Directive (79/409/EC).

Annex 1 species	5 year peak mean	% of GB population
Little tern *Sterna albifrons*	40 pairs (1995-1998)	1.7
Sandwich tern *Sterna sandvicensis*	1900 birds (1988-1992)	4.0

In addition, the SPA is used regularly by 1% or more of the biogeographical population of the following migratory species (other than those listed in Annex 1) in any season.

Non-Annex 1 migratory species	5 year peak mean	% East Atlantic Flyway
Knot *Calidris canutus*	5509 (1991/92-1995/96	1.6
Redshank *Tringa totanus*	1648 (1987-1991)	1.1

The SPA further qualifies as it is used regularly by over 20,000 waterbirds or 20,000 seabirds in any season; the SPA supported a peak mean of 21,312 individuals over the period 1991/92 to 1995/96.

In addition to the above, the SPA also supports nationally important populations of cormorant *Phalacrocorax carbo*, shelduck *Tadorna tadorna*, teal *Anas crecca*, shoveler *Anas clypeata*, ringed plover *Charadrius hiaticula* and sanderling *Calidris alba*.

3.1.2 Conservation objectives

Under Regulation 33(2)(a) of the Conservation (Natural Habitats &c.) Regulations 1994, Natural England has a duty to advise relevant authorities as to the conservation objectives for a EMS. Natural England's advice for the Teesmouth and Cleveland Coast EMS, details the sites conservation objectives and provides information on how to recognise 'favourable condition' (as defined through the conservation objectives). It was published in November 2000 (English Nature, 2000).

Based on this advice, the conservation objective for the internationally important populations of the regularly occurring Annex I bird species is as follows:

- Subject to natural change, maintain in favourable condition the habitats for the internationally important populations of the regularly occurring Annex 1 bird species, under the Birds Directive, in particular:

- Sand and shingle;
- Intertidal sandflat and mudflat; and
- Shallow coastal waters.

Similarly, the conservation objective for the internationally important populations of the regularly occurring migratory bird species and for the internationally important assemblage of waterfowl is:

- Subject to natural change, maintain in favourable condition the habitats for the internationally important populations of the regularly occurring migratory bird species, under the Birds Directive, in particular:

- Rocky shores;
- Intertidal sandflat and mudflat;
- Saltmarsh.

The relevant favourable condition targets for the SPA are presented in Table 3.

3.2 Teesmouth and Cleveland Coast Ramsar site

The Teesmouth and Cleveland Coast Ramsar site is of international importance because:

a) The site is used regularly by 1% or more of the individuals in a population of waterbirds (Ramsar site selection criterion 3c) as follows -

Species	**5 year peak mean**	**Population**
Knot *Calidris canutus*	5509 (1991/92 – 1995/96)	1.6% EAF*
Redshank *Tringa totanus*	1648 (1987 – 1991)	1.1% EAF*
Little tern *Sterna albifrons*	40 pairs (1995 – 1998)	1.7% GB
Sandwich tern *Sterna sandvicensis*	1900 (1988 – 1992)	4.0% GB

*EAF East Atlantic Flyaway

The site is used regularly by over 20,000 waterfowl (Ramsar site selection criteria 3b) (21,312 individuals over the period 1991/92 – 1995/96).

Table 3 Favourable condition table for Teesmouth and Cleveland Coast SPA

Feature	Sub-feature	Attribute	Measure	Target	Comments
Internationally important populations of regularly occurring Annex 1 bird species (little tern, Sandwich tern)		Disturbance	Reduction of displacement of birds	No significant reduction in numbers or displacement of wintering birds attributable to disturbance from an established baseline, subject to natural change	Significant disturbance to human activities can result in increased energy expenditure (flight and/or reduced food intake, displacement to areas of poorer feeding conditions)
		Extent and distribution of habitat	Area (ha) measured during reporting cycle	No decrease in extent from an established baseline, subject to natural change	These habitats provide both breeding and roosting sites for terns.
	Sand and Shingle	Vegetation characteristics	Predominantly open ground with sparse/short vegetation and bare surfaces (colonial nesting).	Vegetation height and density at nesting sites should not deviate significantly from an established baseline, subject to natural change.	Vegetation cover of <10% required throughput the areas used for nesting by little tern
	Intertidal sand and mudflats	Absence of obstructions to bird sight lines	Openness of terrain unrestricted by obstructions	No increase in obstructions to sight lines, subject to natural change	Sandwich tern require views >200m to allow early detection of predators at roost sites
	Shallow coastal waters	Food availability	Presence and abundance of marine fish, crustaceans, worms and molluscs. Measured periodically (frequency to be determined).	Presence and abundance of prey species should not deviate significantly from an established baseline, subject to natural change	Crustacea, annelids. Sandeel and sprats are important for little tern and Sandwich terns

Internationally important populations of regularly occurring migratory species (knot (winter), redshank (autumn) and of the internationally important assemblage of waterbirds		Disturbance	Reduction or displacement of birds.	No significant reduction in numbers or displacement of wintering birds attributable to disturbance from an established baseline, subject to natural change	Significant disturbance attributable to human activities can result in reduced food intake and/or increased energy expenditure
		Extent and distribution of habitat	Area (ha) measured during reporting cycle	No decrease in extent from an established baseline, subject to natural change	Rocky shores have particular significance for feeding knot at Teesmouth. Existing saltmarsh habitats are mere remnants of those of the original Tees estuary
	Rocky Shores	Absence of obstructions to bird sight lines	Openness of terrain unrestricted by obstructions	No increase in obstructions to sight lines, subject to natural change	Waders require views over >200m to allow early detection of predators when feeding and roosting during the non-breeding season (at Teesmouth this is July-March inclusive)
		Food availability	Presence and abundance of surface and sub-surface invertebrates. Measured periodically (frequency to be determined)	Presence and abundance of prey species should not deviate significantly from an established baseline, subject to natural change	*Mytilus* spat are important prey for knot
	Intertidal sand and mudflats	Absence of obstructions to bird sight lines	Openness of terrain unrestricted by obstructions	No increase in obstructions to sight lines, subject to natural change	Waders require views over >200m to allow early detection of predators when feeding or roosting
		Food availability	Presence and abundance of surface and sub-surface invertebrates	Presence and abundance of prey species should not deviate significantly from an established baseline, subject to natural change	Prey items include *Hydrobia*, *Macoma*, *Corophium*, *Nereis* (redshank and shelduck), *Macoma*, *Mytilus/Cerastoderma* spat, *Hydrobia* (knot), *Bathyporeia, Nerine, Mytilus*, wrack flies, sandhoppers (sanderling)

			Measured periodically (frequency to be determined)		
Internationally important populations of regularly occurring migratory species (knot (winter), redshank (autumn) and of the internationally important assemblage of waterbirds	Saltmarsh	Absence of obstructions to bird sight lines	Openness of terrain unrestricted by obstructions	No increase in obstructions to sight lines, subject to natural change	Waders require views over >200m to allow early detection of predators when feeding or roosting
		Vegetation characteristics	Open, short vegetation or bare ground predominating (feeding and roosting)	Vegetation height throughout areas should not deviate significantly from an established baseline, subject to natural change	Vegetation of <10cm is required throughput areas used for roosting
		Food availability	Presence and abundance of aquatic invertebrates, measured periodically (frequency to be determined)	Presence and abundance of prey species should not deviate significantly from an established baseline, subject to natural change	*Hydrobia, Corophium* are important for redshank, shelduck and teal. These habitats provide supplementary feeding opportunities especially at high water
			Presence and abundance of seed-bearing plants. Measure periodically (frequency to be determined)	Presence and abundance of food species should not deviate significantly from an established baseline, subject to natural change	*Salicornia* and *Atriplex* are important for teal during the non-breeding season (November – March) while *Salicornia* seeds may be taken by shelduck

3.3 Current conservation status

The UK government has a duty to report to the European Union at six yearly intervals on the condition of SPAs in the UK. Currently, a condition assessment for the Teesmouth and Cleveland Coast SPA is not available. However, condition assessments for the Sites of Special Scientific Interest (SSSI) on the Tees estuary and surrounding areas are available. These were undertaken in 2001/2002 and have since been updated in February 2007.

Although the conditions assessments are for the SSSIs rather than the SPA, the SSSI boundaries are concurrent with the SPA boundaries and many of the features are similar. For example, a number of the SSSIs are notified in relation to waterbird interest. Relevant SSSIs in this context are listed below:

- Tees and Hartlepool Foreshore and Wetlands SSSI;
- Seaton Dunes and Common SSSI;
- Seal Sands SSSI;
- South Gare and Coatham Sands SSSI; and,
- Cowpen Marsh SSSI.

Within each of the SSSIs, the area is split into a number of management units. For example, the Tees and Hartlepool Foreshore and Wetlands SSSI is split into seven management units. Comments are then made against each management unit and the unit is assessed on the basis of the definitions described in Table 4.

Table 4 Definitions used to describe individual SSSI management units

Status assessment	Definition
Favourable	SSSI is being adequately conserved and is meeting its ‘conservation objectives’, however there is scope for enhancement of these sites.
Unfavourable recovering	SSSI units are not yet fully conserved but al the necessary management measures are in place. Provided that the recovery work is sustained, the SSSI will reach favourable condition in time.
Unfavourable no change	SSSI unit is not being conserved and will not each favourable condition unless there are changes to the site management or external pressures.
Unfavourable declining	SSSI unit is not being conserved and will not reach favourable condition unless there are changes to the site management or external pressures. The site conditions is becoming progressively worse.
Part Destroyed	Part destroyed means that lasting damage has occurred to part of the special conservation interest of a SSSI unit such that it has been irretrievably lost and will never recover.
Destroyed	Lasting damage has occurred to all the special conservation interest of the SSSI unit such that is has been irretrievably lost. This land will never recover.

Table 5 briefly describes the interest features for each of the relevant SSSIs and summarises the conclusions of their condition assessments obtained from Natural England in February 2007. Figures 8 and 9 present the boundaries of the SSSI sites and the condition of each of the management units.

The main issues thought to be impacting the sites where the condition assessment concluded unfavourable status are related to land management. A particular issue of relevance to this study is the presence of *Enteromorpha* mats on Seal Sands and its subsequent condition assessment as unfavourable; no change. This is reported to be due to water pollution issues associated with agricultural pollution. An area of the Seal Sands SSSI is also assessed as destroyed. This is recorded to be due to the removal of the tidal influence in the late 1970s.

On this basis, it is likely that similar assessment results would be derived for the SPA, at least for the features which are common to both sets of designations. The majority of the SPA would therefore be deemed to be in favourable condition, with the exception of Seal Sands.

Table 5 Summary of condition assessment of SSSIs

SSSI	Short description of interest features	Condition assessment (2007)	Comment regarding why unfavourable
Tees and Hartlepool Foreshore and Wetlands	Several coastal areas forming part of the complex of wetlands, estuarine and maritime sites that support the internationally important population of waterbirds.	Favourable	-
Seaton Dunes and Common	Considerable importance for flora, invertebrate fauna and birdlife. Range of habitats include sandy, muddy and rock foreshores, dunes, dune slacks and dune grassland, as well as relict saltmarsh, grazed freshwater marsh with dykes, pools and seawalls	All units assessed as either favourable or unfavourable but recovering (latter due to specific one off events). Only one management unit was assessed as unfavourable declining.	Unfavourable declining status is allocated to management unit 2. It is thought to be due to inappropriate scrub control.
Seal Sands	Intertidal mudflats with tidal channels/ Mudflats of great ornithological importance attracting large numbers of migratory waterbirds, especially during the winter months	Destroyed (southern area) or unfavourable (majority of Seal Sands); no change and favourable (Greatham Creek area)	The unit described as unfavourable is reported to be due to coverage of *Enteromorpha* mats. The reason for the mats is reported to be due to water pollution and agricultural run off. The area that is considered to be destroyed is associated with the removal of the tidal influence in the mid 1970s.
South Gare and Coatham Sands	Considerable importance for flora, invertebrate fauna and birdlife. Range of habitats includes extensive tracts of intertidal mud and sand, sand dunes, saltmarsh and freshwater marsh. Developed since construction of South Gare breakwater. Exposed at low tide are areas of rocky foreshore along the breakwater.	Favourable	-
Cowpen Marsh	Saltmarsh with adjacent coastal grazing and marshes. Important wintering site for migratory waterbirds	Littoral sediment favourable. Lowland neutral grass unfavourable.	The unit described to be unfavourable is reported to be due to inappropriate water level management. Grazing levels other mineral and waste issues are also reported as being issues.

Figure 8 **Map showing SSSI designated sites and condition assessment (not to scale) for the Tees estuary (maps taken from Nature on the Map http://www.natureonthemap.co.uk/map.aspx?m=sssi)**

Figure 9 **Map showing SSSI designated sites and condition assessment (not to scale) for Hartlepool Bay (maps taken from Nature on the Map http://www.natureonthemap.co.uk/map.aspx?m=sssi)**

4 DESCRIPTION OF BASELINE CONDITIONS

4.1 Coastal and estuarine processes and morphology

A number of recent studies are available in relation to the coastal and estuarine processes and morphology of both the Tees estuary and Tees Bay. Of particular relevance is the Baseline Document produced by ABPmer (2005) and the Technical Document produced by HR Wallingford in relation to the NGCT development (Accompanying Document 1 to the ES, Royal Haskoning 2006). As part of the EIA, HR Wallingford undertook a review of available historic information and established 3D models of the tidal flows and mud transport for the area downstream of the barrage to Tees Bay. Models of wave propagation into the estuary mouth from offshore were also developed.

This section of the report, therefore, summaries the baseline morphological conditions; coastal evolution and historical change; sediment information and likely future change based on these reports. The baseline conditions considered are taken as the state of the estuary since the construction of the Tees barrage.

4.2 Baseline information

4.2.1 Morphology of the study area

A description of the morphology of the study area is provided in HR Wallingford Technical Document 1 (Accompanying Document 1 to ES, Royal Haskoning 2006). The main points are summarised here.

The morphology of the coast in the vicinity of the Tees estuary is constrained by the Permian Magnesium Limestone outcrop at the Heugh breakwater 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.

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 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).

Historical charts suggest that the natural channel level at the mouth of the Tees estuary is around -10m OD (Newlyn) (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.

Anthropogenic activities over the last 150 years have therefore 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. The level and form of much of the intertidal area is controlled by the presence of these training works. Within this area a remnant of the originally large Seal Sands is divided from the other intertidal areas by Seaton Channel.

4.2.2 Hydrodynamics

Tides and water level

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). There is significant variation between the astronomical maximum and minimum and the highest and lowest levels (ABPmer, 2002). This indicates that the level can be strongly influenced by meteorological effects, such as winds, surge and waves (HR Wallingford in Royal Haskoning, 2006).

Fluvial flow

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 and flows vary from around 9m^3/d (mean daily flow) in the summer and up to 36m^3/d in the winter months (HR Wallingford in Royal Haskoning, 2006).

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. As a result of the partial mixing of freshwater with saline waters, density driven circulation occurs.

Further detailed information for each reach is provided in the ABPmer (2005) Baseline Document. This is summarised in Table 6.

Table 6 Summarised information regarding hydrodynamics (taken from ABPmer (2005))

Area	Description
Blue House Point (Tidal Barrage) to Mid-Billingham Beck (start of main maintained navigation channel)	Includes confluence of Billingham Beck. Surface flows significantly affected by riverine input which is controlled by the barrage. If barrage open, flows can increase to 1.5m/s.
Mid-Billingham Reach to Transported Bridge	Includes Bamlett Bight and Billingham Reach. This section shows the most significant change in flow with distance along estuary.
Transporter Bridge to Tees Dock	Contains an intertidal area known as North Tees mudflats. The impounded dock at Middlehaven is also included. Flow rates at Transporter are close to the lowest in the estuary, particularly on the flood.
Tees Dock to no. 13 Beacon (Phillips)	Includes turning circle. Wave penetration is limited as waves from a northerly direction are the only direction able to penetrate the mouth of the estuary. Flow speeds reduce as progression is made up the estuary. At Tees Dock, flow speeds have reduced to 0.10m/s.
No 13 Beacon Outer North and South Fairways Buoys	Incorporates the Tees approach channel from the outer fairways buoys to the Philips Oil Terminal. Subjected to adverse coastal processes and environmental conditions – wind wave induced. >70% of all winds blow from inland. Prevailing wind is SW.
Tees Bay area of above stretch	Full exposed to high wave energy which is dominated by storm events in the North Sea. Peak water flow is max 1.0 m/s on springs and 0.5 m/d on neaps. At entrance to estuary, reduced to 0.3m/s. Between the breakwaters and the Philips Oil refinery, a barrel shaped vertical current profile on the flood and a triangular shaped profile on the ebb. On the flood, mid water depths are stronger by 0.1m/s than the top or bottom flows. On ebb, flow speeds increase from the bed to the surface.
Seaton Channel	Peak flows occur around 1.5 hours after low water and again within the first hour after high water. On springs peak flows throughout depth can reach 0.4-0.5 m/s but only 0.15 to 0.3 m/s on neaps (data from HR Wallingford, 1992). Flows are controlled by the half tide training wall at the edge of Seal Sands so from low water to half mid tide, flow is confined to the channel – this causes peak flood flows. As training walls are topped, flows reduce significantly – flows are diverted over Seal Sands. At high water, flow in channel ebbs along alignment. During first half of ebb, flow off Seal Sands creates peak ebb flows which slow once the water level falls beneath height of training wall. During lower half of tide, Seal Sands continues to drain though breaches in the training wall. There is also the possibility that initially the flow is direction westwards into Greatham Creek which then joins main eastward flow in the channel. During later phase, there is a tendency for the surface flows to swing to a northwesterly direction. Information from Carins and Partners (1988) in ABPmer (2005).
Hartlepool Docks and Entrance Channel	Hartlepool is located within Tees Bay in a distinct area termed Hartlepool Bay. Approach channel extends fro 740m into the bay. Subject to adverse wind and wave action from an arc commencing in a north-easterly direction round to south-easterly. The Heugh breakwater provides an amount of protection to the approach channel.

4.2.3 Sedimentary processes

In general, suspended sediment concentrations are low within the estuary and within Tees 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 (HR Wallingford in Royal Haskoning, 2006). Table 7 summarises the suspended solid conditions in the various reaches detailed above (summarised from information provided in ABPmer, 2005 and HR Wallingford in Royal Haskoning, 2006).

Table 7 Suspended solid concentrations in each reach of the study area (summarised from ABPmer, 2005 and HR Wallingford in Royal Haskoning, 2006)

Area	Description
Blue House Point to Mid-Billingham Beck	Average concentrations show a slight tendency to increase but remain low (around 30mg/l). Highest levels are in the lower layers. In Billingham Reach, there is a tendency for higher levels to occur around low water.
Transporter Bridge to Tees Dock	EA data compares turbidity at the Transport Bridge to freshwater flows and tidal range. Good correlation of higher turbidity events with the freshwater discharge. No significant correlation seen with tidal range. Indicates upper reaches suspended solids concentrations are dominated by freshwater discharge. Could be sediment from upstream of barrage and or increased erosion of upstream estuary bed during periods of high fluvial flow.
Tees Dock to no. 13 Beacon (Phillips)	Suspended solids concentrations are typically less than 20mg/l up to Tees Dock. Short term peaks are noted from 40-80mg/l. Highest concentrations occur close to high water. Following storm wave action in Tees Bay, higher concentrations are typically noted around Shell Jetty but this does not penetrate further up estuary.
No 13 Beacon Outer North and South Fairways Buoys	Some evidence suggests storm wave action (strong northerly winds) leads to elevated near bed concentrations in Tees Bay and within the downstream parts of the estuary when a near bed residual flow is also present.
Seaton Channel	Since the mid 1990s, EA data indicates that typical (near surface) suspended solids concentrations have decreased in this area to a range of 10-20mg/l. Greatham Creek is thought to be a major source of material.
Hartlepool Docks and Entrance Channel	Siltation within Hartlepool Docks is derived from suspended sediments entering from Tees Bay via the dock entrance.

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 re-eroded from the estuary bed by currents, shipping and dredging activity. Within the system, the driving forces for sediment transport are tidal flows, density driven currents, wave induced currents, vessel induced forces and re-suspension by dredging operations (HR Wallingford in Royal Haskoning, 2006). Inputs to the system can be summarised as follows (from HR Wallingford in Royal Haskoning, 2006):

- **Fluvial input**: pre-barrage conditions for fluvial input ranged from 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.

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:** 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. This is the remaining major industrial source of material to the Tees estuary.

- **Marine Input:** Comparison of the above figures with the present knowledge of the dredging requirements in the area (presently approximately 1.35 million m^3/year) 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 re-suspension of material from the sea bed during storm events. The coarser material, mostly fine sand, is then able to settle out in the lower estuary, whereas the finer cohesive material is drawn further up the estuary by the gravitational circulation.

The most recent evidence for types of maintenance dredging material from PD Teesport 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) from the lower reaches of the estuary. Assuming the silty sands have a 15-35% fines content, the total fine material input is in the region of 280,000 – 330,000 m^3 per year.

4.3 Sediment quality

4.3.1 Methodology

Sediment quality is of direct relevance to intertidal and subtidal flora and fauna health and, hence, to food sources and habitats for SPA species. This section describes the chemical characteristics of sediments within the Tees estuary.

Data on sediment quality within the area are described below and have been updated where new information exists. This is predominantly information available from CEFAS in relation to Food and Environment Protection Act (FEPA) licence applications (sediment quality information in terms of both physical and chemical qualities is required as part of the application process), information from the Environment Agency gathered as part of the National Marine Monitoring Programme (NMMP) and information collated as part of the studies undertaken to inform the EIA undertaken for the NGCT Development.

Unlike water quality, there are no quantified UK Environmental Quality Standards (EQS) for *in-situ* sediment quality. The only guidance for sediment quality is defined as "standstill (no deterioration)" and is required for most of the EC Dangerous Substances List 1 parameters. In the absence of any UK standards, the sediments for the Tees estuary have been compared against two sets of guidelines to provide a basic assessment regarding the degree of contamination within the sediments of the estuary. These are:

- Canadian Sediment Quality Guidelines for the Protection of Aquatic life; and,
- CEFAS guideline Action Levels for the disposal of dredged material.

Canadian Sediment Quality guidelines

These guidelines were developed by the Canadian Council of Ministers of the Environment (CCME) as broadly protective tools to support the functioning of healthy aquatic ecosystems (CCME, 2001). They are based on field research programmes that have demonstrated associations between chemical and biological effects by establishing cause and effect relationships in particular organisms. Comparison of measured concentrations of various contaminants within the sediments with these guideline values will, therefore, provide a basic indication on the degree of contamination.

The guidelines consist of threshold effect levels (TELs) and probable effect levels (PELs). The TELs and PELs are used to identify the following three ranges of chemical concentrations with regard to biological effects. It is likely that the TELs will be adopted as the Interim Sediment Quality Guidelines (ISQG) (CCME, 2001). The levels are summarised as follows:

- Below the TEL - the minimal effect range within which adverse effects rarely occur.
- Between the TEL and PEL - the possible effect range within which adverse effects occasionally occur.
- Above the PEL - the probable effect range within which adverse effects frequently occur.

Table 8 lists the existing sediment quality guidelines for some of the parameters monitored during the various surveys where they exist.

There are no ISQGs for the following determinands:

- Metals (Aluminium, Boron, Iron, Manganese, Nickel, Selenium, Silver, Vanadium);
- Tributyl Tin;
- Dibutyl Tin;
- Total Petroleum Hydrocarbons (C6-C30) (TPH);
- Aldrin;
- Endosulfan;
- Benzo (k) fluoranthene;
- Indeno (1-2-3-cd) anthracene;
- Benzo (ghi) perylene; and,
- Brominated Flame Retardants.

The Canadian ISQGs should however, be used with caution and the findings treated as indicative. This is because they are designed specifically for the country in which they were developed.

Table 8 Selected interim marine sediment quality guidelines (ISQGs)/threshold effect levels (TELs) and probable effect levels (PELs) (dry weights)

Substance	Units	ISQG/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
Lead	mg/kg	30.2	112
Mercury	mg/kg	0.13	0.7
Zinc	mg/kg	124	271
DDD*	µg/kg	1.22	7.81
DDE*	µg/kg	2.07	374
DDT*	µg/kg	1.19	4.77
Dieldrin	µg/kg	0.71	4.3
Endrin	µg/kg	2.67	62.4
Heptachlor epoxide	µg/kg	0.6	2.74
Lindane (HCH)	µg/kg	0.32	0.99
Nonylphenol	µg/kg	1.0	-
PCBs: total PCBs	µg/kg	21.5	189
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	1494
Fluorene	µg/kg	21.2	144
2-Methylnaphthalene	µg/kg	20.2	201
Naphthalene	µg/kg	34.6	391
Phenanthrene	µg/kg	86.7	544
Pyrene	µg/kg	153	1398

CEFAS Action Levels

CEFAS guideline Action Levels for the disposal of dredged material are not statutory contaminant concentrations for dredged material, but are used as part of a weight of evidence approach to decision-making on the disposal of dredged material to sea. The Action Levels are presented in Table 9. Action Levels are not pass/fail criteria, but triggers for further assessment. Accordingly, if concentrations are below Action Level 1, the refusal of disposal at sea on the grounds of contamination is unlikely. If concentrations fall between Levels 1 and 2, then further assessment is likely to be required. If concentrations exceed Level 2, then the dredged material may not be acceptable for disposal at sea. All data is considered on a case by case basis.

Table 9 CEFAS guideline Action Levels for dredged material (CEFAS, 2006)

Contaminant / Compound	Action Level 1 mg/kg Dry Weight (ppm)	Action Level 2 mg/kg Dry Weight (ppm)
Arsenic	20	100
Mercury	0.3	3
Cadmium	0.4	5
Chromium	40	400
Copper	40	400
Nickel	20	200
Lead	50	500
Zinc	130	800
Organotins; TBT DBT MBT	0.1	1
Polychlorinated Biphenyls (PCB), sum of ICES 7	0.01	none
PCB's, sum of 25 congeners	0.02	0.2
DDT	*0.001	none
Dieldrin	*0.005	none

4.3.2 Overview of sediment quality in relation to sediment quality guidelines

Sediment quality data for a number of locations within the study are presented in Tables A to F of Appendix 2. Results are highlighted in the tables using a colour coding system. Orange indicates concentrations that exceed CEFAS Action Level 1 and red indicates where results exceed CEFAS Action Level 2. Where CEFAS Action Levels are not available and ISQG exist, cells are highlighted yellow where results exceed the TEL/ISQG. A summary of sediment quality, where data is available, is provided below.

Metals

Metals are of concern because of their toxicity, persistence and tendency to bioaccumulate in living organisms. The most recent data (i.e. that collected in 2006), indicates a number of instances where Action Level 1 and TEL for metals are exceeded. No instances of levels being exceeded at Action Level 2 however, are recorded.

Historical data, i.e. that collected in 2003 and 2004 for FEPA licence purposes by CEFAS however, indicates further examples where Action Level 1 had been exceeded with some results exceeding Action Level 2. Particularly noticeable are those recorded for lead. Data provided by the Environment Agency again highlights a number of contaminants which exceed Action Level 1. Only a small number of samples exceed Action Level 2 and these predominantly relate to lead and mercury.

Polyaromatic Hydrocarbons (PAH)
PAHs are of particular concern due to their persistence in the environment. Samples collected for the FEPA licence and the EIA for the NGCT reflect some variation in concentrations. NGCT data indicates a number of PAH levels above the TEL. This is not however, reflected in the samples collected by CEFAS in 2003 and 2004.

The Environment Agency data again indicates elevated levels of PAHs.

Polychlorinated Biphenyls (PCB)
Due to their hydrophobic nature, PCBs tend to be adsorbed quickly by organic matter. Again concern arises from their persistence and potential to bioaccumulate within the food chain. Levels of PCBs are generally low within the estuary. It is difficult to make an assessment as to whether these parameters have exceeded the sediment guidelines (both CEFAS Action Levels and ISQGs) as totals are not provided. Additionally, a number of less than values are recorded.

Organotins
Tributyl Tin (TBT) is of concern due to its sub-lethal effects at very low concentrations. Levels of organotins in the sediments are generally low and many results record 'not detected'. Samples collected by CEFAS do, however, indicate elevated levels of TBT which exceed Action Level 1 in several locations. Data collected by the Environment Agency is relatively limited and therefore it is difficult to comment regarding spatial distribution.

Other contaminants
Other contaminants monitored, such as nonylphenols and brominated flame retardants for the NGCT EIA studies provide a snap shot of the levels of these contaminants. Nonalyphenols are used in industry as surfactants and have been reported to act as endocrine disrupting chemicals. Concentrations varied quite significantly across the study area considered for the NGCT development and ranged from 13µg/kg to 3160µg/kg. There is a standard of 1.0mg/kg listed in the Canadian Sediment Quality Guidelines; however a PEL is not defined. It can therefore be concluded that the concentration of nonalyphenol at some sites exceed the ISQG/TEL.

Brominated flame retardants are a diverse group of chemicals used to retard the combustibility of commercial goods. As a consequence, these compounds can be found in a large range of everyday products. The most widely used materials fall into three groups;

- Tetrabromobisphenol A (TBBPA) and its derivatives;
- Polybrominated diphenyl ethers (PBDE); and
- Hexabromocyclododecane (HBCD)

Information on the potential of brominated flame retardants to enter the environment and consequently to cause pollution is limited. Additionally, there are no guidelines to ascertain at what level these substances become harmful. Information gathered from a literature search for PDBEs undertaken for the NGCT project states that measured levels are considered to be low if they are less than 100µg/kg of dry sediments. Samples for PBDEs taken from the Tees estuary are therefore predominantly low and are in the range <0.1µg/kg and 9µg/kg of sediment for each congener. There were however several sites which recorded values of 150µg/kg and 340µg/kg of Decabromo DPE respectively.

4.3.3 Overview of sediment quality in relation to ecotoxicology studies

The data collated reveals a number of areas where available sediment quality guidelines are exceeded. This does not immediately imply an impact; as limitations exist regarding the suitability of these standards in different environments. For example, the Tees estuary is heavily industrialised and has been for many years. There is therefore the possibility that the marine ecology has acclimatised, to some extent, to these levels of contamination. Additionally, CEFAS have also stated that sediment quality in the estuary has significantly improved over the years. This is supported by Tansley (2003). In order to provide further information in relation to the potential for impact associated with sediment contamination, available sediment ecotoxicolgy information is described below.

The first survey was undertaken in 2004 by the EA as part of the NMMP. These laboratory surveys were based on 10-day bioassays measuring *Corophium volutator* and *Arenicola marina* mortality and feeding inhibition rates. Results are then compared to reference sediment. The findings of the survey are presented in Figures 10a - 10c.

The results show that mortality rates are generally low in the estuary for both species. However, there is one result showing increased mortality rates for *C.volutator*, located between the Tees Dock turning circle and Dabhom Gut. A reduction in feeding activity is also recorded in both of these locations for *A.marina* and in the upper areas of the estuary, close to the barrage.

The second survey was undertaken by CEFAS in 2005. Again, these surveys were undertaken in the laboratory and were based on 10-day bioassays measuring *C.volutator* and *A.marina* mortality. Casting of *A.marina* was also assessed. The findings of the survey are presented in Tables 10 and 11 below.

Figure 10a. **NMMP Biological Effects in Sediments provided by the Environment Agency. *Arenicola marina* mortality.**

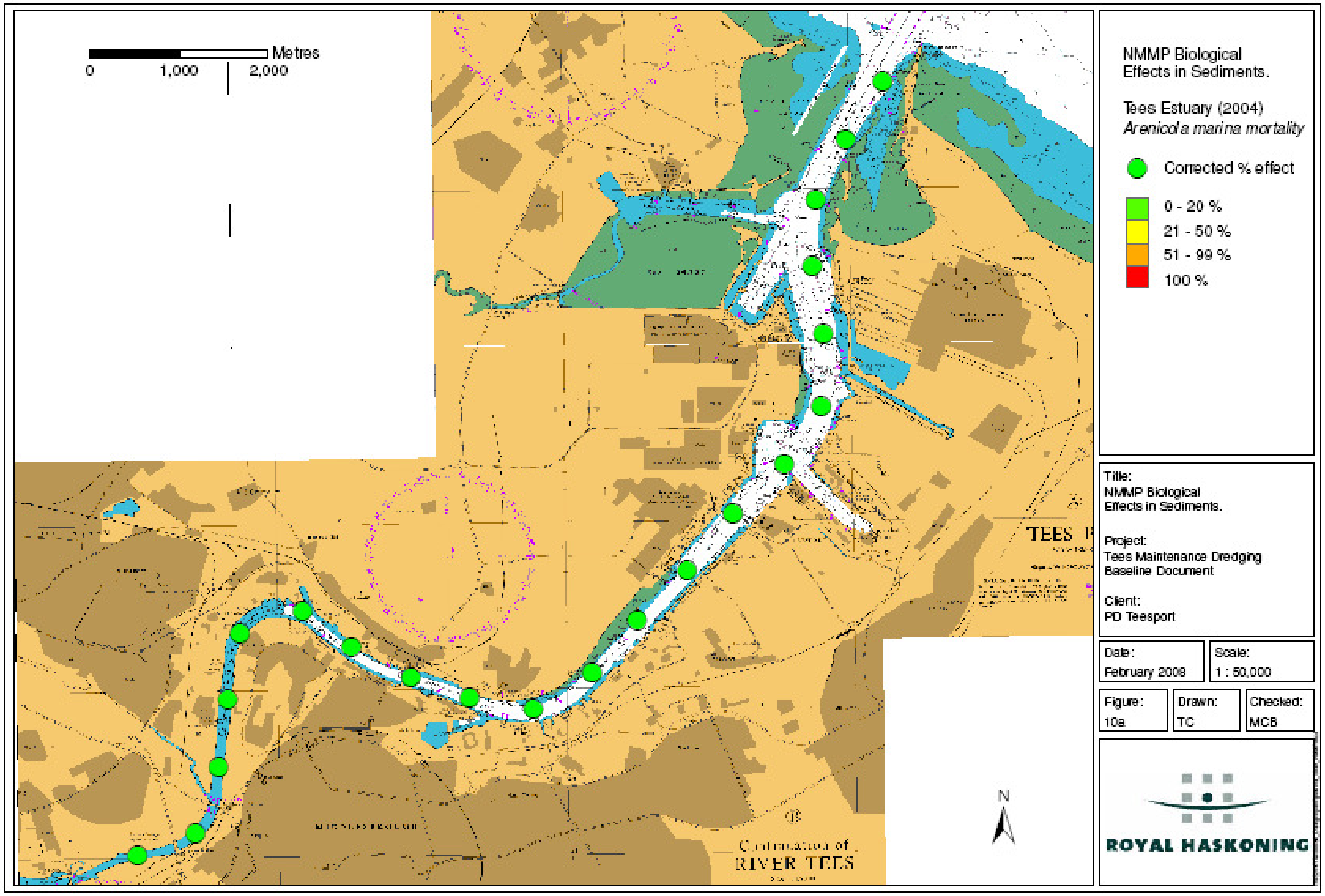


Figure 10b. **NMMP Biological Effects in Sediments provided by the Environment Agency. *Arenicola marina* inhibition of feeding.**

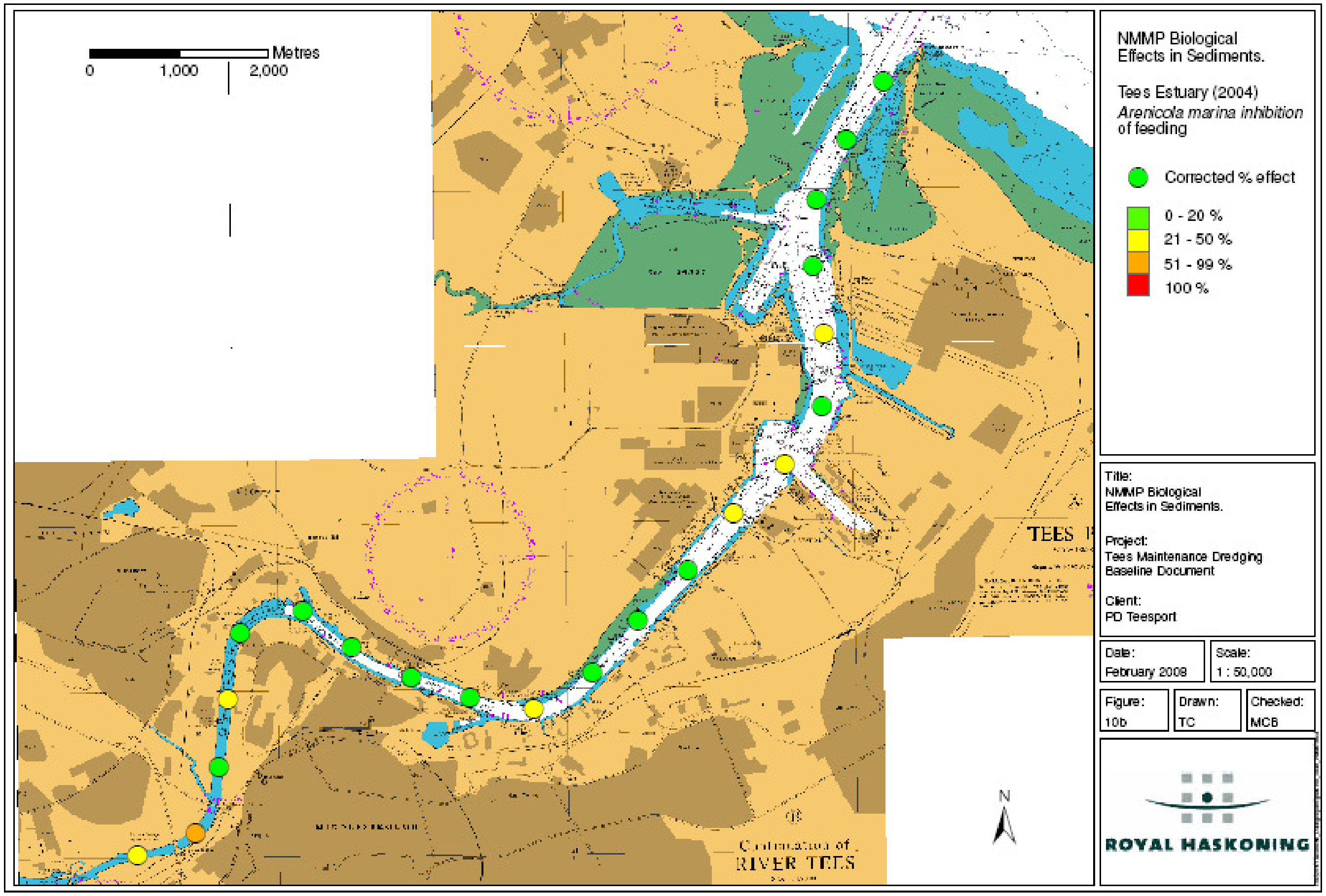


Figure 10c. **NMMP Biological Effects in Sediments provided by the Environment Agency. *Corophium volutator* mortality.**

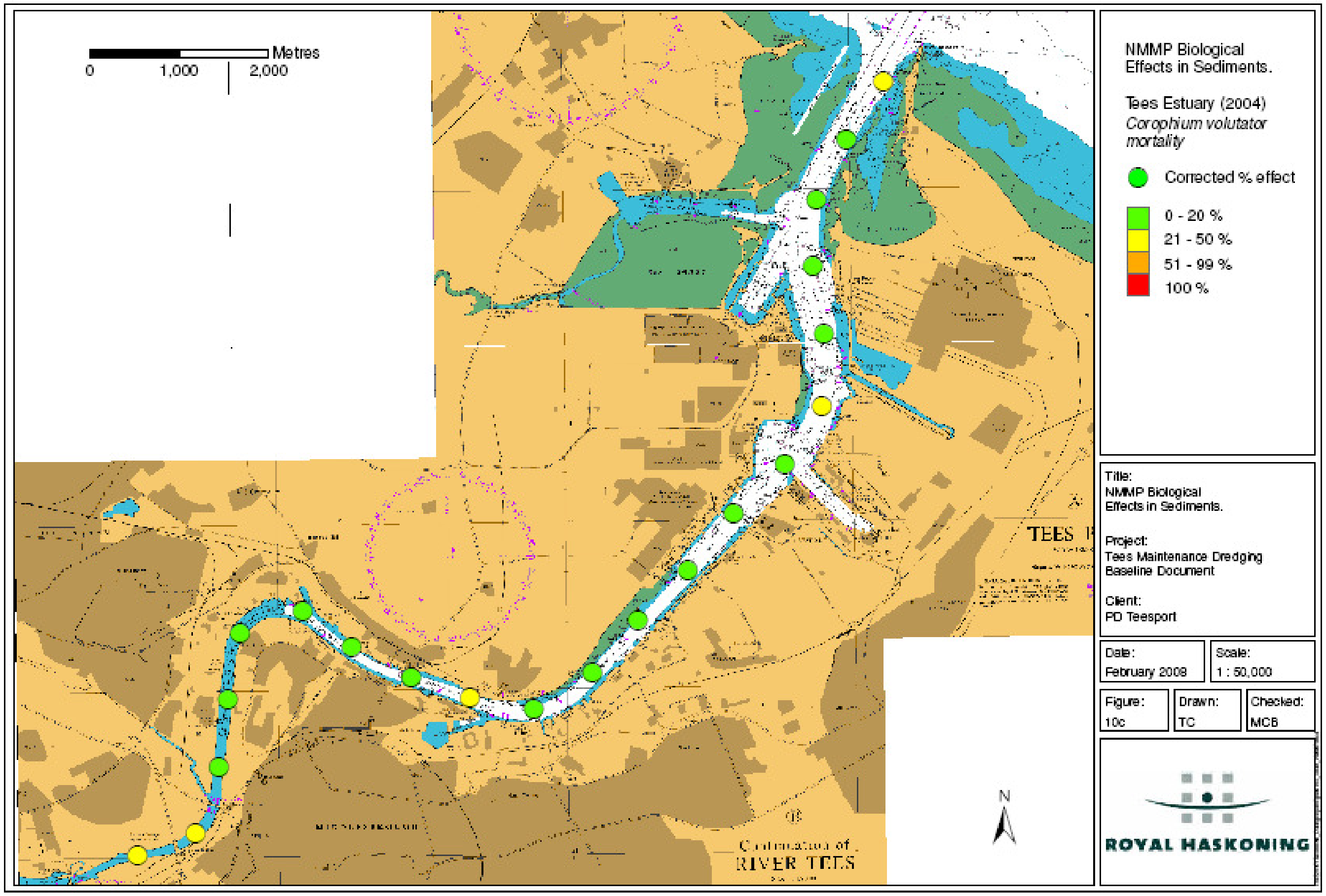


Table 10 Survival of *C. volutator* exposed to sediment for 10 days

Site	Location	Mean % survival
Control	Shoebury sands, Essex	90
1	Terrc. Base	100
2	Seaton Channel	83
3	Adj. RSTC* berth	73
4	Ro-Ro Terminal (In Tees Dock)	87
5	Shell Jetty	97
6	Offshore Base (Opposite to North Tees mudflats)	87

* Regional Sewage Treatment Centre

Table 11 Casting of *A. marina* exposed to sediment for 10 days

Site	Location	Mean % survival	% casts of control
Control	Shoebury sands, Essex	1.03	
1	Terrc. Base	1.23	119
2	Seaton Channel	1.63	158
3	Adj. RSTC* berth	0.00	0
4	Ro-Ro Terminal (In Tees Dock)	0.33	32
5	Shell Jetty	1.5	146
6	Offshore Base (Opposite to North Tees mudflats)	1.35	131

* Regional Sewage Treatment Centre

Data collected for *A.marina* mortality is not considered to be valid due to the control mean survival being below the validity criteria.

Analysis was then undertaken using one-way anova for survival and multifactor anova for casting. This enables a comparison to be made between the Tees estuary and the control sample. The only sites to show a significant difference in casting were those sites located adjacent to the Regional Sewage Treatment Centre (RSTC) berth and by the Ro-Ro terminal (In Tees Dock). For the survival data, no significant difference in survival was recorded in any of the site samples when compared to the control.

4.4 Water quality

4.4.1 Methodology

Water quality is relevant to the general health of the environment, as well as the habitats and food sources upon which the SPA species rely. Additionally, other uses (such as bathing water designations) rely on good water quality. As such, the information here is collated from the results of monitoring to ensure compliance with designation requirements and specific water quality directives.

Of particular relevance is the water quality monitoring undertaken to ensure compliance with the Dangerous Substances Directive by the Environment Agency. Additionally, the Environment Agency undertakes monitoring for estuary classification purposes. Information in relation to general water quality of the estuary is available, however, water quality information for Tees Bay and Hartlepool Bay is limited. This is because monitoring is only undertaken for the purposes of monitoring discharges. This information is not considered appropriate to determine the general background water quality of the Bays and is not, therefore, considered further in this document.

4.4.2 Tees estuary

Up until 2005, estuaries in England and Wales were classified every five years as good, fair, poor or bad based on their:

- Biological quality - presence of certain species of fish;
- Aesthetic quality - evidence of aesthetic pollution, for example sewage-derived litter;
- Water quality - in terms of levels of dissolved oxygen.

In 2005, the stretches within the study area were all classified as fair.

Classification schemes are now being developed for the Water Framework Directive (WFD) which will replace this scheme and assess a much wider range of pressures impacting on the marine environment. The schemes will classify the status of transitional and coastal waters using information on the ecological, chemical and hydromorphological quality of a body of water. Monitoring for the WFD and the subsequent classification of data started in 2006. General monitoring undertaken in the Tees estuary and data collated for the past five years is provided in Table 12. Note that this data is derived from surface water samples.

Table 12 Summarised water quality data (Environment Agency 2000-2005)

Determinand	The Gares	Redcar Jetty	Smiths Dock	Transporter Bridge	Tees Barrage	Greatham Creek	Princess Diana Bridge
Temperature (^oC)	11.9	12.1	11.9	11.7	11.3	11.7	13.7
Salinity (g/kg)	32.3	26.9	25.7	22.2	17.3	31.5	7.4
pH	7.9	7.9	7.8	7.7	7.8	7.9	7.8
Susp. solids (mg/l)	13.2	8.8	8.2	-	-	21.5	10.8
Turbidity (FTUs)	19.6	24.4	22.2	21.7	17.6	7.9	15.3
Chlorophyll a (µg/l)	4.7	11.1	4.3	-	-	-	7.3
Dissolved Oxygen (% saturation)	93.9	84.5	85.4	81.4	84.3	92.3	93.1
Nitrate (mg/l)	0.59	1.6	1.3	1.98	1.59	-	2.95
Nitrite (mg/l)	0.02	0.09	0.05	0.07	0.03	-	0.04
Ammonia (mg/l)	0.49	1.52	0.98	1.4	0.29	-	0.13
Orthophosphate (mg/l)	0.079	0.31	0.16	0.24	0.14	-	0.19

4.4.3 Dangerous Substances

The EC Dangerous Substances Directive was adopted in 1976 to control pollution caused by certain dangerous substances on the aquatic environment. The Directive established List I substances, which are regarded as particularly dangerous because of their toxicity, persistence and bioaccumulation. Pollution by these substances must be eliminated. List II substances are regarded as less dangerous but have a deleterious effect on the aquatic environment; input of these substances must be reduced.

The Dangerous Substances Directive stipulates uniform emission standards (UESs, also known as limit values) and EQSs as approaches for the control of List I substances. For List II substances, all member states are required to establish EQSs on a national level. EQSs for List II substances have been implemented in the UK by the Surface Waters (Dangerous Substances) (Classification) Regulations 1997 and 1998. The EQSs for List I and List II substances form the assessment criteria for water quality concerning dangerous substances.

The EQSs for selected List I substances are shown in Table 13.

Table 13 Selected List I dangerous substances*

Substance**	EQS Type	Estuarine EQS*** (annual average, µg/l)
Mercury (dissolved)	Annual average	0.5
Cadmium (dissolved)	Annual average	5
HCH (Lindane) ******	Annual average	0.02
Total DDT	Annual average	0.025
ppDDT	Annual average	0.01
Pentachorophenol	Annual average	2
Aldrin	Annual average	0.01
Dieldrin	Annual average	0.01
Endrin	Annual average	0.005
Isodrin	Annual average	0.005
Total 'Drins'	Annual average	0.03
Hexachlorobenzene	Annual average	0.03
Hexachlorobutadiene	Annual average	0.1
Carbon tetrachloride	Annual average	12
Chloroform	Annual average	12
1,2-dichloroethane	Annual average	10
Trichloroethyleme	Annual average	10
Perchloroethylene	Annual average	10
Trichlorobenzene	Annual average	0.4

* EQS List I taken from www.environment-agency.gov.uk
**total concentration (i.e. without filtration) unless specified
*** all HCH isomers, including Lindane

EQSs for List II substances have been implemented in the UK by the Surface Waters (Dangerous Substances) (Classification) Regulations 1997 and 1998. The EQSs for selected List II substances are shown in Table 14.

Table 14 Selected List II dangerous substances*

Substance	EQS Type	Estuarine EQS (annual average, µg/l)
Arsenic (dissolved)	Annual average	25
Chromium (dissolved)	Annual average	15
Copper (dissolved)	Annual average	5
Lead (dissolved)	Annual average	25
Nickel (dissolved)	Annual average	30
Tributyl tin (TBT)	Maximum concentration	0.002
Zinc (total)	Annual average	40

*The full EQS List II is available on www.environment-agency.gov.uk

Water quality monitoring data for the years 2000 to 2005 was provided by the Environment Agency and is summarised in Tables 15 to 18 for each of the sites monitored within the study area.

It should be noted that much of the data from the monitoring is for the purposes of compliance monitoring only. Detection limits are, therefore, set with that purpose in mind. For assessment purposes, in instances where the recorded value was below the limit of detection, the limit of detection value was halved in order to provide an input value to the summary statistics. This is in line with the approach adopted by the Environment Agency.

Where the majority of samples have recorded below the limit of detection, for a particular parameter, minimum and maximum values only are listed and means are not calculated.

Table 15 Summarised dangerous substances data for the Gares sampling site (2000-2005)

Determinand	Minimum (µg/l)	Maximum (µg/l)	Mean (µg/l)	EQS (µg/l)	No. of Data	No of < than data	No. of Data Exceeding EQS
Cadmium	0.04	0.37	0.06	5	46	25	0
Mercury	0.01	0.03	-	0.5	54	48	0
Arsenic	1.0	2.07	1.09	25	51	13	0
Chromium	0.35	98.0	3.14	15	54	21	2
Copper	0.55	2.97	1.24	5	52	0	0
Lead	0.14	2.44	0.61	25	55	1	0
Nickel	0.43	3.97	1.6	30	51	1	0
Zinc	2.72	39.9	13.5	40	51	0	0
HCH (Lindane – 3 isomers)	0.003	0.018	-	0.02	54	44	0
ppDDT	Not detected			0.01	55	55	0
Pentachlorophenol	Not detected			2	52	52	0
Chloroform	0.1	0.5	0.13	12	54	33	0
Carbon tetrachloride	Not detected			12	55	55	0
Tributyl tin	0.004	0.02	0.005	0.002	55	27	*
Total 'Drins'	0.007	0.016	-	0.03	55	44	0
Hexachlorobenzene	-	0.004	-	0.03	55	54	0
Hexachlorobutadiene	Not detected			0.1	54	54	0

*The detection limit for TBT for each of the sites is higher than the EQS.

The Gares

The information provided by the Environment Agency indicates generally low levels of the various substances. For pesticides and herbicides (HCH, ppDDT, Drins etc) the majority of values are below detection limits. For metals, only two examples where EQS was exceeded were highlighted. These were both for chromium in July 2001 and then again in February 2002. There have been no recorded events where levels of these parameters have been exceeded since. Although the limit of detection is higher than the EQS, examination of the raw data highlights that concentrations of TBT regularly exceed the EQS.

Table 16 Summarised dangerous substances data for the Redcar Jetty sampling site (2000-2005)

Determinand	Minimum (µg/l)	Maximum (µg/l)	Mean µg/l)	EQS (µg/l)	No. of Data	No of < than data	No. of Data Exceeding EQS
Cadmium	0.04	4.09	0.13	5	53	27	0
Mercury	0.01	0.04	-	0.5	55	44	0
Arsenic	1.0	2.1	1.12	25	53	13	0
Chromium	0.35	11.3	1.26	15	54	12	0
Copper	0.4	6.9	1.72	5	54	1	1
Lead	0.08	2.94	0.84	25	55	0	0
Nickel	0.98	8.01	2.44	30	51	0	0
Zinc	4.88	655.0	27.7	40	54	0	2
HCH (Lindane – 3 isomers)	0.003	0.015	-	0.02	54	38	0
ppDDT	Not detected			0.01	54	54	0
Pentachlorophenol	Not detected			2	53	53	0
Chloroform	0.1	4.0	0.75	12	49	10	0
Carbon tetrachloride	Not detected			12	55	55	0
Tributyl tin	0.004	0.028	0.006	0.002	51	26	*
Total 'Drins'	0.007	0.016	-	0.03	54	38	0
Hexachlorobenzene	-	0.001	-	0.03	54	53	0
Hexachlorobutadiene	Not detected			0.1	53	53	0

*The detection limit for TBT for each of the sites is higher than the EQS.

Redcar Jetty

The information provided by the Environment Agency again indicates generally low levels of dangerous substances. There have however, been several instances where levels have exceeded threshold levels for metals. Concentrations of copper exceeded in June 2000 and concentrations of zinc exceeded on the same day in June and again, in July 2000. There have been no recorded events where levels for these parameters have exceeded the action thresholds since 2000. All data for pesticides and herbicides (HCH, ppDDT, Drins etc) are below detection limits. Although the limit of detection is higher than the EQS, examination of the raw data highlights that concentrations of TBT regularly exceed the EQS.

Table 17 Summarised dangerous substances data for the Smith's Dock sampling site (2000-2005)

Determinand	Minimum (µg/l)	Maximum (µg/l)	Mean (µg/l)	EQS* (µg/l)	No. of Data	No of < than data	No. of Data Exceeding EQS
Cadmium	0.04	1.06	0.083	5	47	23	0
Mercury	0.01	0.033	-	0.5	54	48	0
Arsenic	1.0	2.38	1.039	25	54	21	0
Chromium	0.35	7.95	1.09	15	55	14	0
Copper	0.521	2.94	1.65	5	54	0	0
Lead	0.136	4.38	1.02	25	55	0	0
Nickel	0.78	4.95	2.15	30	50	0	0
Zinc	6.0	186.0	17.33	40	52	0	1
HCH (Lindane – 3 isomers)	0.003	0.024	-	0.02	55	42	0
ppDDT	Not detected			0.01	55	55	0
Pentachlorophenol	Not detected			2	52	52	0
Chloroform	0.1	2.0	0.16	12	49	26	0
Carbon tetrachloride	Not detected			12	53	53	0
Tributyl tin	0.004	0.087	0.008	0.002	50	27	*
Total 'Drins'	0.007	0.016	-	0.03	55	42	0
Hexachlorobenzene	Not detected			0.03	55	55	0
Hexachlorobutadiene	Not detected			0.1	54	54	0

*The detection limit for TBT for each of the sites is higher than the EQS.

Smith's Dock

As for Redcar Jetty and The Gares, the information provided by the Environment Agency indicates generally low levels of dangerous substances at this location. There has, however, been one instance where zinc was found to be above the threshold level in July 2000. There have been no further examples where these parameters have exceeded action levels since 2000. All data for pesticides and herbicides (HCH, ppDDT, Drins etc) are below detection limits. Although the limit of detection is higher than the EQS, examination of the raw data highlights that concentrations of TBT regularly exceed the EQS.

Table 18 Summarised dangerous substances data for the Haverton Hill sampling site (2000-2005)

Determinand	Minimum (µg/l)	Maximum (µg/l)	Mean (µg/l)	EQS (µg/l)	No. of Data	No of < than data	No. of Data Exceeding EQS
Cadmium	0.04	0.28	0.07	5	43	33	0
Mercury	0.01	0.026	0.006	0.5	48	44	0
Arsenic	1.0	3.0	1.3	25	48	14	0
Chromium	0.35	4.82	1.4	15	51	9	0
Copper	0.67	1.03	**	5	46	3	0
Lead	0.107	3.810	1.122	25	52	2	0
Nickel	1.19	15.6	3.6	30	46	0	0
Zinc	3.61	70.5	18.5	40	46	0	1
HCH (Lindane – 3 isomers)	0.003	0.015		0.02	48	36	0
ppDDT	Not detected			0.01	50	50	0
Pentachlorophenol	Not detected			2	50	50	0
Chloroform	0.1	5.7		12	48	11	0
Carbon tetrachloride				12	51	51	0
Tributyl tin	0.004	0.03		0.002	47	32	*
Total 'Drins'	Not detected			0.03	50	50	0
Hexachlorobenzene	Not detected			0.03	50	50	0
Hexachlorobutadiene	Not detected			0.1	49	49	0

*The detection limit for TBT for each of the sites is higher than the EQS.

** Couldn't be calculated due to apparent error in EA spreadsheet

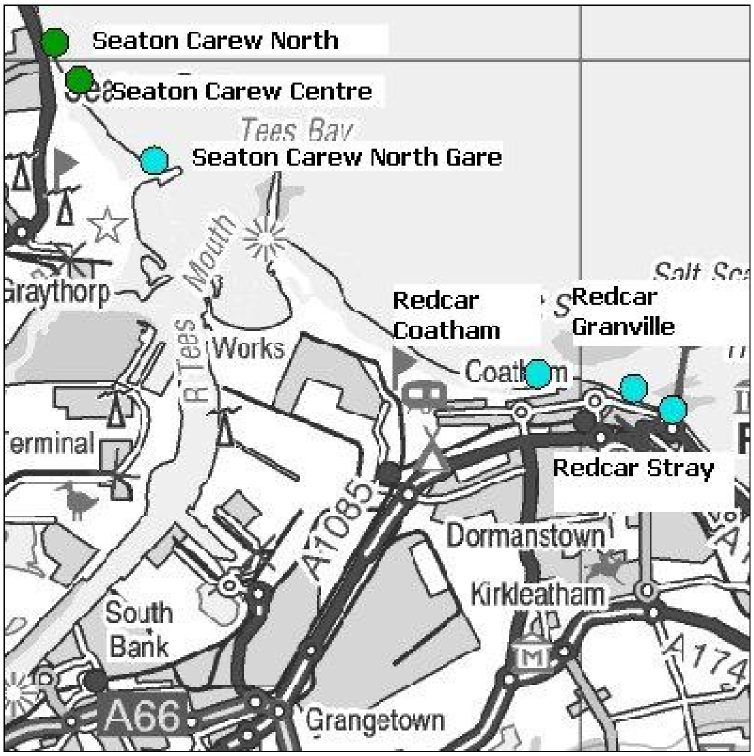
Haverton Hill Shipyard

The only example where the water quality standards were exceeded was for zinc which was recorded on the 12th August 2003. There have been no further examples where action levels have been exceeded since then for this parameter. All other parameters show relatively low levels of contamination.

4.4.4 Bathing water quality

There are six bathing waters within the study area and all are located on the open coast outside of the estuary. The locations of these bathing waters are shown in Figure 10. The bathing waters are shown as individual points on the map and reflect the Environment Agency's monitoring point for each designated bathing water. Bathing water quality is assessed by standards listed in the EC Bathing Waters Directive. The Directive was adopted by the Council of the European Communities in 1975 and transposed into law for England and Wales in August 1991 to form the Bathing Waters

(Classification) Regulations 1991. The Directive is concerned with the quality of bathing waters for the purpose of protecting public health and requires monitoring of microbiological parameters and a small number of physical parameters (visible oil etc).



Key

Good

Excellent

Figure 11 Locations of bathing waters within the study area and compliance in 2005

There are two types of microbiological standards; mandatory standards and the more stringent guideline standards.

The mandatory standards are:

- 10,000 total coliforms per 100ml of water; and,
- 2,000 faecal coliforms per 100ml of water.

For a bathing water to comply with the Directive, 95% of samples collected within a bathing season (15th May to 30th September) must meet these and the other physical criteria.

The guideline standards should be achieved where possible and are:

- 500 total coliforms per 100ml of water (in 80% samples);
- 100 faecal coliforms per 100ml of water (in 80% samples); and,
- 100 faecal streptococci per 100ml of water (in 90% samples).

Bathing water quality at the six designated beaches is illustrated in Table 19. Water quality is classified as ‘excellent’, ‘good’ or ‘poor’. ‘Excellent’ relates to the achievement of the more stringent guideline standards and ‘good’ relates to the achievement of the mandatory standards. Bathing waters classified as ‘poor’ fail to meet the Directive’s minimum mandatory standard.

All bathing waters have exhibited either ‘good’ or ‘excellent’ quality for at least the last five years. Historically there have been failures of the mandatory standards; however significant improvements in the levels of sewage treatment over the past 10 years probably accounts for this.

Table 19 Bathing water quality at bathing waters in Tees Bay

Bathing Water	2000	2001	2002	2003	2004	2005
Seaton Carew Centre	E	E	G	G	E	G
Seaton Carew North	G	E	E	G	G	G
Seaton Carew North Gare	E	E	E	E	E	E
Redcar Coatham	G	E	E	E	G	E
Redcar Glanville	G	G	G	G	G	E
Redcar Lifeboat Station	G	E	G	G	G	E

In December 2000, the European Commission put forward a proposal to revise the EC Bathing Waters Directive. Following several years of discussions and revisions, the Directive was enacted in March 2006. The UK therefore has two years in which to transpose the legislation into UK law from this date. The main differences to the current Directive include:

- A change in the standards and parameters to be applied;
- A new bathing water classification system;
- Proactive beach management;
- A significant increase in the information available to the public;
- The classification of the bathing water based on three seasons of data rather than the current one season; and,

- The opportunity for member states to make changes to the list of designated bathing waters, the length of the bathing season and the location of the monitoring point.

This information will, therefore, need to be updated once data is available for classification.

4.5 Marine ecology

4.5.1 Methodology

Easily accessible information in relation to marine ecology of the intertidal areas is relatively limited. A comprehensive review, however, is provided in Tansley, 2003. This information is summarised in the ES produced for the NGCT development (Royal Haskoning, 2006). A further summary of this information is included here for ease of reference.

4.5.2 Overview of the intertidal ecology of the Tees estuary

The most diverse intertidal habitats are the seawall, boulders and cobbles of the South Gare breakwater due to its proximity to the open coast. The boulders and cobbles are characterised by a fucoid/barnacle mosaic. Red algae are present at lower levels on the shore. The richness of this habitat is increased by the under boulder communities. Other hard substrata comprise the silted cobbles of the training wall on Seal Sands and cobbles in Greatham Creek which are colonised by bladderwrack *Fucus vesiculosus* and green algae *Enteromorpha* spp. with a particularly low species richness. On the training wall mussels *Mytilus edulis* and abundant periwinkles *Littorina littorea* are also recorded.

Bran Sands and Seal Sands are characterised by polychaetes including *Spio martinensis, Capitella capitata,* oligochaetes *Tubificoides pseudogaster* and bivalves *Cerastoderma edule* and *Fabulina fibula*. The muddier areas of Bran Sands and Seal Sands are characterised by species that are tolerant of fine sediment and variable salinity and are indicators of a nutrient rich environment, such as *Hediste diversicolor, Spio martinensis* and oligochaetes.

Very sheltered sites at Greatham Creek and adjacent to Newport Bridge comprise fluid anoxic mud typical of mid and upper estuaries which have a low species diversity dominated by *Streblospio shrubsolii, H. diversicolor* and the oligochaete *T. pseudogaster.*

As an overall general comment, an analysis of macrobenthic data from the Tees estuary suggests that since 1979 there has been a general trend of increasing macrofaunal diversity and abundance. The number of taxa (>1mm) inhabiting the estuary rose from 33 taxa in 1979 to 106 taxa in 1998. In terms of providing a feeding resource for waterfowl, only a few large invertebrate species occur at densities high enough to provide profitable food for waterbirds. For example, on Seal Sands and Bran Sands the three key species of waterbird prey are the ragworm *H.diversicolor*, the laver spire shell *H. ulvae* and the amphipod crustacean *Corophium volutator* (Evans *et al.,* 2001 in Tansley, 2003).

In spite of the overall general improvement in macrofaunal diversity and abundance however, some important prey species for waterbirds have declined at intertidal monitoring sites in the lower estuary. In particular, there has been an obvious decline in ragworm *H. diversicolor* on Seal Sands and this is perceived to be linked to the invasion of *Enteromorpha* mats in this area; ultimately this may impact on some species of feeding waterbirds.

In terms of epifauna, some data is available in relation to the surveys undertaken to inform the NGCT EIA studies. Perhaps more important in terms of determining the potential for impact on the designated features, is the reported feeding of terns on sandeels and small fish just outside the mouth of the estuary. Information regarding the abundance of these particular food species is, however, not readily available.

4.6 Ornithology

4.6.1 Methodology

The main data source with respect to ornithology is the bird count information for the Tees estuary from the British Trust for Ornithology (BTO). This information is collected as part of the Wetlands Bird Survey (WeBs). Core count data is available for the whole of the Tees estuary and the Hartlepool Bay area which is divided into a number of sectors (see Figure 12).

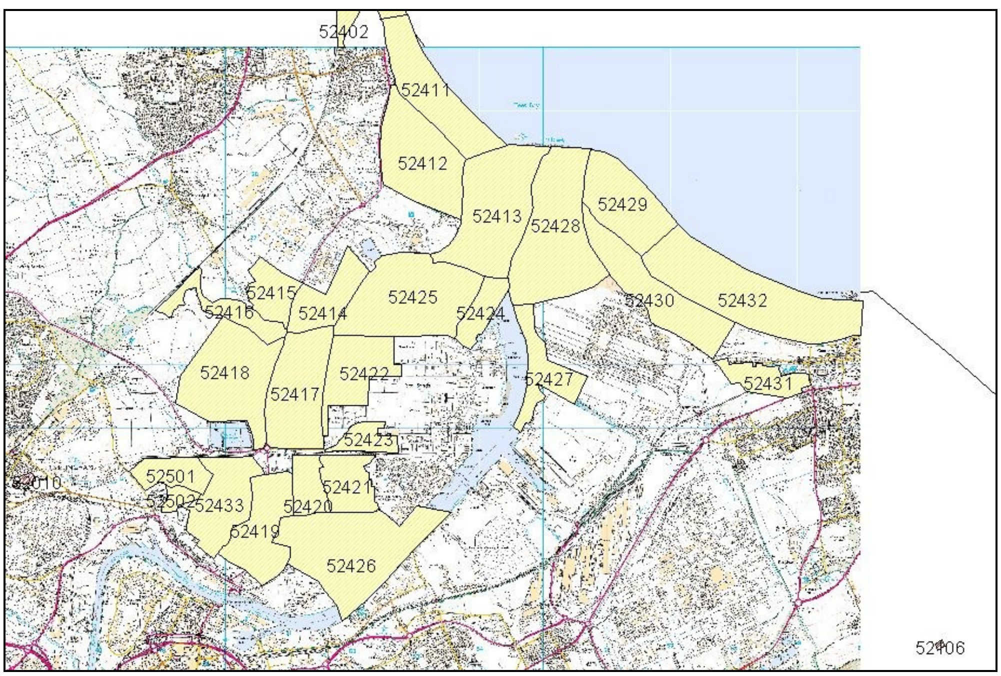


Figure 12 WeBs count sectors for the Tees estuary (source BTO)

4.6.2 Overview of ornithological interest of the study area

The importance of the area of waterbird species is reflected in the designated status of much of the intertidal area of the estuary and the area north of Hartlepool Bay (see Section 3).

Table 20 summarises the overall waterbird assemblage of the study area over 1999 to 2004. The data are presented on a sector by sector basis. Each sector therefore provides information on the maximum usage of different areas. The peak monthly total presented is the maximum number of the sum of the counts of all species within each month.

Table 20 Summary of overall waterbird assemblage of count sectors in the Tees estuary and Hartlepool Bay (1999/00 to 2003/04)

Year	Bran Sands South	Bran Sands North	Seal Sands (Peninsular East)	Seal Sands (Peninsular West)	North Gare Sands	Tees Estuary as a whole	Hartlepool Bay
99/00	1300 (Jan)	2372 (Jan)	391 (Sept)	2861 (Sept)	1135 (Sept)	17543 (Jan)	2268 (Feb)
00/01	1085 (Jul)	1373 (Feb)	423 (Sept)	4781 (Feb)	1994 (Dec)	19989 (Oct)	1421 (Jan)
01/02	1106 (Jan)	1088 (Dec)	398 (Oct)	3739 (Jan)	8454 (Feb)	21753 (Feb)	1648 (Jan)
02/03	795 (Feb)	3404 (Feb)	398 (Sept)	4401 (Jan)	1073 (Aug)	21894 (Nov)	1459 (Nov)
03/04	2577 (Aug)	3236 (Jan)	665 (July)	2814 (Sept)	3106 (Aug)	25790 (Dec)	1344 (Jan)

A detailed description of the various sectors in relation to the Tees estuary as a whole is provided in Royal Haskoning, 2006. For ease of reference, the main points are summarised below.

Table 20 demonstrates the importance of the Bran Sands and Seal Sands sectors in terms of supporting waterbird species. The Peninsular West area of Seal Sands is particularly important during the winter period. Raw data for the Bran Sands area demonstrates the importance of this sector for the common tern. The area is also used by Sandwich tern and redshank; both species are listed in the SPA citation.

Little tern now breeds to the north of the mouth of the estuary at Castle Eden Dene. A small number also breed at North Gare but these individuals are subject to relatively high level of disturbance from the public. These species also feed around the mouth of the estuary on small fish and sandeels. Sandwich terns have not bred in the Tees estuary since the 1930s but they are present on passage. This species favours the Seaton Snook area on the northern side of the Seaton Channel. Individuals do however, feed and loaf elsewhere in the lower estuary. Other waterbird species such as lapwing, goldeneye, teal and shelduck are also present in notable numbers, particularly during the winter period.

4.7 Noise

4.7.1 Methodology

Noise above the general background baseline may cause disturbance to SPA species. The baseline against which to compare maintenance dredging operations must therefore be established. Information exists in relation to the current noise levels that are experienced by waterbird populations of the SPA as a result of the studies undertaken to inform the EIA for the NGCT (Royal Haskoning, 2006). The assessment presented below has been based on this information, but is limited to the areas that potentially could be impacted as a result of maintenance dredging.

4.7.2 Baseline conditions

Noise measurements at North Gare Sands

The ambient noise climate at this location is subject to a significant amount of noise from the surrounding industrial and commercial operations on the banks of the Tees estuary. Depending on wind direction and strength, the noise climate is dominated either by wind and wave noise or industrial noise. 5-minute measurements of the background noise were made when conditions were cold and calm with a very light (<2m/s) westerly breeze. The industrial noise was noted to be dominant.

Noise measurements at Bran Sands

The ambient noise here is generally dominated by Corus steelworks and the Redcar Ore terminal. In particular, strong tonal noise from the cooling towers on the north side of the Corus steelworks, in the 630Hz to 1000Hz range and at 1600Hz, was audible. 5-minute background noise measurements were again considered appropriate. Night-time noise levels here and at North Gare Sands do not differ significantly from those during the day-time. This is thought to be due to dominance of the 24-hour port and industrial operations.

Table 21 below presents a summary of the average ambient noise levels at North Gare Sands and Bran Sands, measured in 2006 as the dB L_{Aeq}, the dB L_{A10} and the dB L_{A90} noise levels. An explanation of the various noise indices is given in the List of Abbreviations.

Table 21 Measured existing ambient noise levels (from Royal Haskoning, 2006)

	Existing day-time noise levels (dB)		
Location	L_{A10}	L_{Aeq}	L_{A90}
Bran Sands	54	52	51
N. Gare Sands	56	55	53

Table 22 summarises the background noise levels at ecological receivers within Teesmouth in 2006 derived from the nearest background measurement position, namely northern end of Bran Sands or northern end of North Gare Sands.

Table 22 Ambient noise levels at ecological receivers within Teesmouth (from Royal Haskoning, 2006)

Location	Background noise
Vopak foreshore	57*
Bran Sands lagoon	57*
Bran Sands A	54*
Bran Sands B	51*
Bran Sands C	51
Seal Sands A	56*
Seal Sands B	53
North Gare Sands A	56*
North Gare Sands B	53

*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.

4.7.3 Noise from vessels during maintenance dredging

Data for noise levels associated with dredging activities is derived in a number of ES produced for proposals which require dredging. Both the EIA for the NGCT and the EIA for the Bathside Bay Container Port development (Royal Haskoning, 2003; noise section produced by Bureau Veritas) use a predicted source noise level of 109dBL_w. In the absence of any specific site information, this value has been used in this assessment. The volume of sound generated and transmitted into the air or water depends however on the size, design and location of the engine and the crafts size and construction. The ES for NGCT did not consider disturbance due to dredging on ecological sensitive locations specifically as noise produced by percussive piling was considered to be the worst case. However, indicative noise levels that dredging operations might create is provided in Table 23.

Table 23 Typical noise levels from a trailer suction hopper dredger

Dredger	Distance from Dredge area (m)	Noise level dB LAeq
TSHD (109dBA)	50	67
	100	61
	300	52
	500	47
	1000	41

5 DISCUSSIONS AND RECOMMENDATIONS

5.1 The potential effect on the SPA

The aim of this document is to summarise the baseline conditions within the study area that are relevant to the conservation status of the European Marine Site. Based on this, consideration can be given to whether the existing maintenance dredging regime is likely to cause (or has caused) a change in the condition of the SPA.

Maintenance dredging has the potential to affect the Tees and Cleveland Coast SPA and Ramsar site through the following parameters:

- Changes to habitats as a result of hydrodynamic change leading to changes in the morphology of the estuary.
- Increases in levels of suspended sediment during dredging operations. This could potentially impact on the food resource of the SPA interest features; particular the little tern which feeds on sandeels and small fish in the mouth of the estuary.
- The remobilisation and redistribution of sediments which may be contaminated within the study area. These sediments could potentially impact on the intertidal benthic organisms used by the waterbirds as a feeding resource.
- Increased disturbance. Potentially, an increase in noise levels could impact on SPA waterbird populations. This is of particular concern during the winter period when waterbirds feed and gather energy.

Due to the nature of the Hartlepool dredging requirements (i.e. mostly within a relatively confined harbour area) and the distance of the SPA from the study area, the impact of maintenance dredging is not considered likely to be an issue both now and in the future. Additionally, the SSSI condition assessment concludes that the area is currently in favourable condition. As a result, the potential impact of maintenance dredging on the designated area to the north of Hartlepool Docks is not considered further in this document.

5.1.1 <u>The potential for impact of maintenance dredging on the morphology of the SPA</u>

Maintenance dredging in the Tees estuary has been undertaken at a relatively steady rate over the past decade, in the same manner by the same plant. As such, the release of fine material and changes to morphology will have been at similar rates over this time period. The maintenance dredging on the Tees estuary is, therefore, very much part of the existing overall estuary regime.

Seaton Channel is the most sensitive location for maintenance dredging in that it forms the main pathway for sediment transport to Seal Sands, an area within the SPA currently deemed unfavourable in the SSSI condition assessment. It is therefore likely that the condition assessment for this area of the SPA will also be deemed unfavourable.

The reasons for the unfavourable condition relate to the growth of *Enteromorpha* mats on the intertidal area, thought to be due to poor water quality. Agricultural run off is listed as a particular factor. Outside of the SSSI assessment, impacts on *Enteromorpha* have also been linked to changes in sediment supply. The action of maintenance dredging could therefore potentially contribute to the *Enteromorpha* mat growth via changes to sediment transport pathways. The potential impact on water quality is discussed in Section 5.1.3 below.

Maintenance dredging campaigns have been relatively infrequent in this location and when they occur, are relatively small in terms of volume and timescale. It is therefore unlikely that maintenance dredging has had a significant impact on the already existing highly variable natural sediment processes (Royal Haskoning, 2006) and therefore impact on Seal Sands. Additionally, from studies undertaken to inform the EIA for NGCT, the timing of the dredging operation within the tidal cycle has the potential to both supply fine material onto Seal Sands or to preferentially export the material down Seaton Channel into the turning circle and/or to be dispersed further offshore. The sediment supply to Seal Sands associated with maintenance dredging in this area can therefore be altered depending on the desired effect. For example, a working agreement currently exists with Natural England whereby the Seaton Channel is dredged on a rising tide thus increasing, albeit intermittently, sediment supply to Seal Sands.

Elsewhere in the Tees estuary, the only other potential impact of maintenance dredging is likely to be the dredging of material close to the side slopes of the seawards part of the approach channel. This could potentially cause destabilisation of these slopes and thus impact on the intertidal habitats of the SPA through collapse and therefore direct loss. The method of dredging adopted, however, limits the potential for this to occur. Two trenches are maintained on either side of the navigation channel at the toe of the side slopes to help trap material. It is from these areas, rather than the slopes, that material is removed as part of the maintenance activities. This limits the potential for direct impact on the adjacent intertidals (which are largely behind the training walls) and therefore the habitat features of the SPA.

If maintenance dredging continues at similar rates as presently occurs, it can be reasonably assumed that the sediment regime will remain as it broadly is. Since the condition assessments for the SSSI sites highlight that it is likely that the condition of the majority of the SPA is currently favourable, a change in this status due to current ongoing maintenance dredging is unlikely. Where areas are likely to be determined to be unfavourable, such as Seal Sands for example, the current condition status is not thought to be due to existing maintenance dredging practices. Additionally, control measures are currently in place.

Given the above, it is not believed that the current maintenance dredging regime has or is likely to cause a change in condition of the SPA. The potential for the control of sediment pathways to Seal Sands has already been agreed with the regulator and relevant statutory body and will be reviewed as necessary. A significant change from present dredging practice, or substantial amounts of capital dredging, would however, warrant a review of this conclusion because of the potential for those activities to represent a change from the present situation (for example, the proposals for capital dredging Seaton Channel by Able UK).

5.1.2 The potential indirect impact on the SPA associated with the resuspension of contaminated sediment

From the information collated it can be concluded that, although the sediment quality guidelines applied indicate areas where contaminant levels could potentially impact on *in-situ* marine ecology, information gained from site specific ecotoxicological studies concludes that the levels of contaminants do not have a significant impact on the marine ecology of the Tees estuary (see Section 4.4.2) in the majority of locations studied. The exception is the level of contamination recorded close to the existing Shell Jetty.

The issue specific to the SPA is not the general marine ecology of the estuary, rather the potential for impact associated with re-suspension of these sediments and subsequent deposition on the intertidal areas of the SPA. Impacts on the marine ecology could then impact on waterbird feeding activities.

Information provided by the EIA studies for the NGCT, however, highlights that deposition on sensitive areas (i.e. areas within the SPA) of dredged material re-suspended into the water column, only occurs on Seal Sands and when dredging is undertaken in the lower reaches of the estuary and in the vicinity of the Seaton Channel Turning Circle (this does not include the Shell Jetty area). The volume of material removed by maintenance dredging is also significantly less and over a much shorter timescale than the dredge for the capital scheme. An impact resulting from the existing maintenance dredging, which could potentially change the favourable condition of the SPA, is therefore unlikely. This is confirmed by the condition assessment undertaken for the SSSI, where unfavourable condition, is not thought to be due to sediment contamination of the designated habitats.

5.1.3 The potential indirect impact on the SPA due to changes in water quality

The potential impact on the SPA due to water quality relates to two issues. The first is the possible deterioration of water quality in relation to contamination re-suspended as a result of the dredging. The second is the potential impact of re-suspended sediment on the transparency and turbidity of the water. Both issues could potentially impact on the general health of the estuary and therefore the food resources on which the interest features rely.

In terms of contamination, data collated for the past five years shows relatively good water quality in terms of the presence of substances listed in the Dangerous Substances Directive. Relatively few examples where levels have exceeded threshold levels have been recorded and those that have occurred are unlikely to have resulted from maintenance dredging practices. This is due to the size, frequency and small timescales associated with maintenance dredging campaigns. Additionally, since areas are continuously maintained, there is less risk associated with the build up of contaminants.

Changes to background turbidity and transparency of the water column as a result of dredging could potentially impact on food resources such as the sandeels used by little tern. However, due to the short term nature of the maintenance dredging campaigns and the predominant sediment type (sands) in the area in which the terns feed (less likely to have a high organic carbon content and therefore oxygen demand and settle out quickly due to larger grain size), re-suspension of sediments is likely to be kept to a minimum. It is therefore unlikely that maintenance dredging will impact on the features on which the SPA species rely and therefore cause a change in condition status.

5.1.4 The potential for a direct impact on waterbird species due to noise disturbance

In comparison to the measured background noise levels and given the likely distance of the dredger to the designated site, the noise levels associated with maintenance dredging are not considered to be excessive. Rather, they are likely to be at or below existing ambient levels. Additionally, maintenance dredging is undertaken over very short timescales. Maintenance dredging is therefore unlikely to cause a change in the condition status of the SPA as a result of disturbance.

5.1.5 Conclusions

From the review of the baseline data presented here, the existing maintenance dredging activity being undertaken in the study area does not appear to be having or has historically had, an impact on the designated site which would alter its condition. From the condition assessments provided for the SSSIs, it can be assumed that the majority of the SPA would be deemed to be in favourable condition, with the exception of Seal Sands.

Where the condition assessments for the relevant SSSIs state that the condition of the site has been affected, practices related to land management are given as the reasons for unfavourable condition. For example, the presence of *Enteromorpha* mats on Seal Sands is reported to be due to poor water quality associated with agricultural practices. These conclusions must be reviewed, however, if a significant change in maintenance dredging practices occur as a result of new developments.

5.2 Recommendations

In accordance with the Draft Protocol, it is recommended that this Baseline Document is developed over time to incorporate new information as it becomes available.

Of particular note are the issues associated with the deposition of sediment on Seal Sands and the possible changes to the growth of *Entermorpha* mats by altering the sediment transport pathways. Although it is unlikely that the existing maintenance dredging is having a significant impact on these mats, as part of a wider estuary project, monitoring proposals have been developed. These proposals have been designed to monitor the sedimentation issue over the next five years and provide an opportunity to discuss the results and any possible working practices which could be adopted to alter any impacts measured. For example, the existing working practices in Seaton Channel as a result of this monitoring, may be altered.

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