REPORT

Plymouth Sound and Estuaries Maintenance Dredging Protocol Baseline Document

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Defence Infrastructure Organisation

Royal HaskoningDHV
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Glossary of Terms

Abbreviation	Definition	Abbreviation	Definition
AL1	Action Level 1	TRaC	Transitional and Coastal Waters
AL2	Action Level 2	TBT	Tributyltin
ADD	Approved Dredge Depth	WFD	Water Framework Directive
As	Arsenic	MCZ	Marine Conservation Zones
ABP	Associated British Ports	MMO	Marine Management Organisation
bCD	below Chart Datum	MHWN	Mean High Water Neaps
BAP	Biodiversity Action Plan	MHWS	Mean High Water Springs
BWL	Boskalis Westminster Limited	MLWN	Mean Low Water Neaps
BTO	British Trust for Ornithology	MLWS	Mean Low Water Springs
Cd	Cadmium	Hg	Mercury
cSAC	Candidate Special Areas of Conservation	MMD	Minimum Maintained Depth
CHC	Cattewater Harbour Commissioners	MSW	Multi-sea winter
Cr	Chromium	NOC	National Oceanography Centre
Cu	Copper	NE	Natural England
DIO	Defence Infrastructure Organisation	NERC	Natural Environment and Rural Communities
DBT	Dibutyltin	Ni	Nickel
DIN	Dissolved Inorganic Nitrogen	OFD	Oil Fuel Depot
EA	Environment Agency	1SW	One sea-winter
EIA	Environmental Impact Assessment	PML	Plymouth Marine Laboratory
HRA	Habitats Regulations Assessment	PBDEs	Polybrominated diphenyl ethers
HAT	Highest Astronomical Tide	PCBs	Polychlorinated biphenyls
HMNB	His Majesty's Naval Base	PAHs	Polycyclic Aromatic Hydrocarbons
IROPI	Imperative Reasons of Overriding Public Interest	pSPA	Potential Special Protection Area
Fe	Iron	RHDHV	Royal HaskoningDHV
JNCC	Joint Nature Conservation Committee	SMP2	Shoreline Management Plan 2
KHM	King's Harbour Master	SSSI	Sites of Special Scientific Interest
Pb	Lead	SAC	Special Area of Conservation
LSE	Likely Significant Effect	SPA	Special Protection Area
LOD	Limit of Detection	SPM	Suspended Particulate Matter
LAT	Lowest Astronomical Tide	TECF	Tamar Estuaries Consultative Forum
MDP	Maintenance Dredging Protocol	THC	Total Hydrocarbon Content
Mn	Manganese	TSHD	Trailing Suction Hopper Dredger

Abbreviation	Definition	Abbreviation	Definition
MCAA	Marine and Coastal Access Act	Wmt	Wet metric tonnes
MBA	Marine Biological Association	Zn	Zinc
MCMS	Marine Case Management System		

Non-Technical Summary

The King's Harbour Master (KHM), Plymouth, has statutory control of the Dockyard Port of Plymouth (His Majesty's Naval Base (HMNB) Devonport), which serves the largest naval base in Western Europe. Commercial operations in the area include Brittany Ferries which operates from (Associated British Ports) ABP Millbay and the commercial wharves in Cattewater which handle cargoes including aggregates, timber and fuel.

Maintenance dredging is regularly undertaken by the Defence Infrastructure Organisation (DIO) on behalf of HMNB Devonport to maintain the depth of the navigable channels and berths. Other statutory harbour authorities in the area (Cattewater Harbour Commissioners (CHC), Sutton Harbour, ABP Millbay Dock and River Yealm Harbour Authority) and private marina operators all have varied levels of requirements for maintenance dredging.

DIO has commissioned Royal HaskoningDHV (RHDHV) to compile an updated Maintenance Dredging Protocol (MDP) Baseline Document as a tool to assess the impacts of maintenance dredging on the marine protected areas in the vicinity of the port and harbours within the Plymouth Sound and estuaries. This document is an update to the previous Baseline Document, which was finalised in 2017. This new Baseline Document builds on the 2017 assessment, takes account of any changes in the dredging regime or condition of the designated sites. The assessment covers the period from 2015 to 2020.

The Baseline Document is based on a desk study of existing and readily available data only. The data gathering exercise has deliberately focused on those environmental parameters that could potentially be affected by maintenance dredging and are of relevance to the integrity of the designated sites.

Maintenance dredging is the activity of removing sediment that has built up in existing channels or basins that have previously been dredged and is considered separately from capital dredging, which is new excavation of the seabed in an area or down to a level not previously dredged. As a general guide the Marine Management Organisation (MMO) considers that if no dredging has taken place on a site during the preceding ten years then the first dredge should be considered capital, however there may be exceptions where siltation rates are low.

The Baseline Document therefore only considers the potential impacts to designated sites from maintenance dredging activities, however information on previous capital dredge works has been presented to provide a full understanding of dredge activities in the area.

Similarly, the assessment does not consider the potential impacts to designated sites as a result of the disposal of dredged material, although information on previous disposal activities has been presented to provide an understanding of sediment movements within the system.

The document presents a baseline of current dredging activities only and does not provide an estimation or assessment of changes to future activities.

Designated Sites

The following sites have been identified as requiring assessment:

- Plymouth Sound and Estuaries Special Area of Conservation (SAC).
- Dartmoor SAC.

- Tamar Estuaries Complex Special Protection Area (SPA); and
- Tamar Estuary Sites Marine Conservation Zone (MCZ).

Maintenance Dredging

The following operators have been identified as having undertaken maintenance dredging previously:

- HMNB Devonport
- CHC
- Plymouth Yacht Haven
- Yacht Haven Quay
- Queen Anne's Battery
- Torpoint Yacht Marina
- Royal William Yard

Data on dredging operations within the study area was obtained through consultation with Cefas, the DIO, the KHM Plymouth, Boskalis Westminster Dredging Company Ltd. and by direct contact with the civilian harbour authorities and marina operators. The average quantity of maintenance dredge material generated within the period 2016-2020 (inclusive) has increased since the last Baseline Document was completed, in part due to a large maintenance dredge campaign undertaken in 2018. The data from dredge returns shows that removal of material during the period 2019-2020 is below the annual average removed in the past 15-year period.

The total quantity of maintenance dredging material disposed of at licensed disposal sites over the 2015 to 2020 period is recorded at 311,443 wet metric tonnes (wmt). Since 2009 the five-year rolling average has varied between approximately 24,040 and 67,214 wmt with a maximum recorded annual maintenance disposal of 121,513 wmt.

Maintenance dredging activities are predominantly undertaken by HMNB Devonport. Between 2015 and 2020 HMNB Devonport maintenance dredging disposal accounted for 63.4% of the total amount and averaging a disposal quantity of 39,509 wmt per annum. Further irregular maintenance dredging is undertaken across a number of marinas within the Tamar and Plym estuaries. Therefore, the assessment of maintenance dredging focuses on the Plym and Tamar estuaries.

Habitats Regulations Assessment

The designated sites and associated features considered relevant for the assessment were assessed in relation to the potential pressures from maintenance dredging activities and the following pressure / feature interactions were considered to have a Likely Significant Effect (LSE).

Qualifying feature/s	Pressure	Likely Significant Effect
Plymouth Sound and Estuaries SAC		
Allis shad	Barrier to species movement. Changes in suspended solids (water clarity).	Yes
Dartmoor SAC		
Atlantic salmon	Barrier to species movement. Changes in suspended solids (water clarity).	Yes

An Appropriate Assessment was undertaken concluding that within some more sensitive areas of the channel it is considered there may be some disturbance to migration for migratory fish species should maintenance dredging activities be undertaken. However, where dredging overlaps with the more sensitive areas of the channel, there are a number of existing seasonal restrictions included within the current marine licences to avoid significant impact on fish migration. It was therefore concluded there will be no Adverse Impact on Site Integrity.

Marine Conservation Zone

The designated sites and associated features considered relevant for the assessment were considered in relation to the potential pressures from maintenance dredging activities and the following pressure / feature interactions were considered to be required to be screened into further assessment.

Qualifying feature/s	Pressure	Screened into further assessment?
Tamar Estuary Sites MCZ		
Smelt	Barrier to species movement. Changes in suspended solids (water clarity).	Yes

A MCZ Stage 1 assessment was undertaken concluding that there will be no significant risk of maintenance dredging activities hindering the achievement of the conservation objectives stated for the MCZ.

Conclusions

It is concluded that the present maintenance dredging practices are sustainable and, subject to standard marine licence conditions being implemented as well as mitigation measures to prevent the overlapping of maintenance dredge activities with sensitive periods for migratory fish species, the activities presented in this document will not have an adverse effect on the features of the Plymouth Sound and estuaries designated sites, nor will they hinder the achievement of the conservation objectives stated for the Tamar Estuary Sites MCZ.

A five-year update is recommended to ensure that the information presented in the Baseline Document remains relevant and up to date. Any further legislative and regulatory changes that affect the content of the Baseline Document will be updated accordingly.

1 INTRODUCTION

Plymouth Sound is the bay where the River Tamar, Plym and Yealm estuaries meet the English Channel, on the south coast of the UK between the counties of Cornwall to the west and Devon to the east. The Plymouth Sound and estuaries have a history of fisheries, industrial and naval use and in more recent times this has expanded into recreational uses such as marinas and boating.

The King's Harbour Master (KHM), Plymouth, has statutory control of the Dockyard Port of Plymouth (His Majesty's Naval Base (HMNB) Devonport), which serves the largest naval base in Western Europe. Commercial operations in the area include Brittany Ferries which operates from (Associated British Ports) ABP Millbay and the commercial wharves in Cattewater which handle cargoes including aggregates, timber and fuel.

Maintenance dredging is regularly undertaken by the Defence Infrastructure Organisation (DIO) on behalf of HMNB Devonport to maintain the depth of the navigable channels and berths. Other statutory harbour authorities in the area (Cattewater Harbour Commissioners (CHC), Sutton Harbour, ABP Millbay Dock and River Yealm Harbour Authority) and private marina operators all have varied levels of requirements for maintenance dredging.

DIO has commissioned Royal HaskoningDHV (RHDHV) to compile an updated Maintenance Dredging Protocol (MDP) Baseline Document as a tool to assess the impacts of maintenance dredging on the marine protected areas in the vicinity of the port and harbours within the Plymouth Sound and estuaries. This document is an update to the previous Baseline Document finalised in 2017 (herein referred to as the '2017 Baseline Document'), which used data available for the period of 2010 to 2016 (RHDHV, 2017).

This new Baseline Document builds on the 2017 assessment, taking account of any changes in the dredging regime or condition of the designated sites. Given the unavailability of relevant data beyond 2020 at the time of writing, the assessment presented within this Baseline Document covers the period from 2015 to 2020. Any future iteration of the Baseline Document for HMNB Devonport must therefore include an assessment of relevant data from 2021 onwards.

1.1 Background and Objectives

The Conservation of Habitats and Species Regulations (2017), as amended ('the Habitats Regulations'), require an Appropriate Assessment to be undertaken for any plan or project likely to have a significant effect on one or more designated sites which form part of the 'National Site Network' (formerly known as European sites), either alone or in-combination with other plans or projects. Those designations comprise Special Protection Areas (SPA) and Special Areas of Conservation (SAC). Appropriate Assessment is also required as a matter of government policy for potential SPAs (pSPA), candidate SACs (cSAC) and listed Ramsar sites for the purpose of considering development proposals affecting them.

Maintenance dredging activities are considered to be a 'plan or project' for the purposes of the Habitats Regulations, and therefore maintenance dredging operations that have the potential to impact a designated site need to be assessed in accordance with the Habitats Regulations.

To avoid the administrative burden of undertaking assessment under the Habitats Regulations for each dredging activity, the 'Conservation Assessment Protocol' was produced (Defra, 2007). The protocol set out an approach for operators and regulators to provide a 'Baseline Document' to present existing and readily available information to describe the current and historical patterns of dredging in relation to the conservation objectives of a designated site. Natural England (NE) has recommended that, where applicable, Marine

Conservation Zones (MCZs), designated under the Marine and Coastal Access Act 2009 (as amended) (MCAA 2009), are included as part of the Baseline Document.

The first MDP Baseline Document for HMNB Devonport was developed for DIO in 2010 (Black and Veatch, 2010) and then updated by RHDHV in 2017. These documents were produced using the protocol guidance and provided a tool for the operators and authorities within Plymouth Sound and estuaries to demonstrate that their maintenance dredging activity was not having an impact on the European designated sites in the vicinity of the Plymouth Sound and estuaries.

This current document therefore represents the Baseline Document as a tool for the assessment of maintenance dredging undertaken by HMNB Devonport and also the statutory harbour authorities in the Plymouth Sound and estuaries area. The objectives of the Baseline Document are therefore to:

- combine relevant existing information about the environmental status of the Plymouth Sound and estuaries area and, in particular, what is known about the potential extent of impacts of previous capital and maintenance dredging undertaken by KHM Plymouth, their agents and other operators within the Plymouth Sound and estuaries area;
- provide the data necessary to allow any maintenance dredging to be assessed in accordance with the Habitats Regulations (a Habitats Regulations Assessment (HRA)) and the Conservation Assessment Protocol on Maintenance Dredging; and
- provide the data necessary to allow any maintenance dredging proposals in the vicinity of the MCZs to be assessed in accordance with the MCAA 2009.

1.2 Report Structure

Table 1.1 summarises the structure of this Baseline Document.

Table 1.1 Plymouth Sound and estuaries Baseline Document report structure

Section	Description
1. Introduction	Provides the background and context of the Baseline Document and outlines the objectives of the document.
2. Scope, data sources and consultation	Outlines the scope of the Baseline Document and study area, providing an overview of the data sources used in developing the 2022 update to the 2017 Baseline Document as well as any consultation undertaken to ensure the document is meeting its objectives.
3. Existing dredging regime	Details the history and operations of dredging within the Plymouth Sound and estuaries.
4. Baseline environment	Presents the baseline conditions including coastal processes and geomorphology, estuarine habitats and ecology, ornithology, sediment and water quality (including baseline information for the Water Framework Directive).
5. Information for the assessment of maintenance dredging	Presents information to inform an assessment of maintenance dredging in relation to designated sites and associated features.
6. Conclusions	Presents the conclusions in relation to an assessment of impacts on the designated sites and recommendations for future updates of the document.

2 SCOPE, DATA SOURCES AND CONSULTATION

The Baseline Document is based on a desk study of existing and readily available data only. The data gathering exercise has deliberately focused on those environmental parameters that could potentially be affected by maintenance dredging and are of relevance to the integrity of the designated sites.

2.1 Content of the Document

Table 2.1 sets out the information the Baseline Document intends to identify, according to the Maintenance Dredging Protocol.

Table 2.1 Information included in the Plymouth Sound and estuaries Baseline Document

Content	Document location(s)
The existing need for maintenance dredging in individual areas	The maintenance dredging regimes and purpose within the Plymouth Sound and estuaries area has been set out in **Section 3.2**.
The existing volumes, frequencies and duration of dredging operations – where possible this is based on actual dredge returns rather than volumes applied for in consents	Details of maintenance and capital dredging regimes within the Plymouth Sound and estuaries area has been set out in **Section 3.2** and **Section 3.4** respectively. A review of available dredge returns data has been undertaken in **Section 3.3**, for maintenance dredging, and **Section 3.5**, for capital dredging.
The precise locations of dredging and disposal	Details of maintenance and capital dredging regimes within the Plymouth Sound and estuaries area has been set out in **Section 3.2** and **Section 3.4** respectively. Details of disposal activities has been presented in **Section 3.6**.
The methods of dredging, transport and disposal, including any restrictions imposed as licence conditions or by physical constraints (e.g. depth, tidal flow, wave or weather conditions	The general methodologies used for maintenance dredging are summarised in **Section 3.1** with individual marine licences detailed within **Section 3.3**, for maintenance dredging, and **Section 3.5**, for capital dredging.
The material type and chemical status (existing and historical)	Material types are detailed in **Section 3.3**, for maintenance dredging, and **Section 3.5**, for capital dredging. A summary of historical sediment chemical data is presented in **Section 4.5**.
The history of dredging and disposal at particular locations, as well as the variability in material type and volumes due to natural changes	Details of maintenance and capital dredging regimes within the Plymouth Sound and estuaries area has been set out in **Section 3.2** and **Section 3.4** respectively. The baseline environment for coastal processes, including sediment sources transport and historical estimations of the sediment budget is provided in **Section 4.1**.
Details of any monitoring requirements previously imposed through licences, and the outcomes of such monitoring	N/A – no requirements for monitoring have been previously imposed.

Content	Document location(s)
Details of any beneficial use and sediment cell maintenance schemes, or mitigation and compensation schemes entered into	No beneficial use or other schemes as described have been undertaken. Further information has been provided in **Section 3.6**.
Details of any other relevant information from past studies or previous applications that have possible direct or indirect links to the maintenance dredging	**Section 4** sets out further relevant information with regards to the wider environment in relation to maintenance dredging activities.

The Baseline Document should also include information supplied by NE and others (e.g. the Marine Management Organisation (MMO), the Centre for the Environment, Fisheries and Aquaculture Science (Cefas), and the Environment Agency (EA)) on the condition characteristics of the designated sites, and in particular the interest features of the site and their conservation objectives, which could be affected by maintenance dredging.

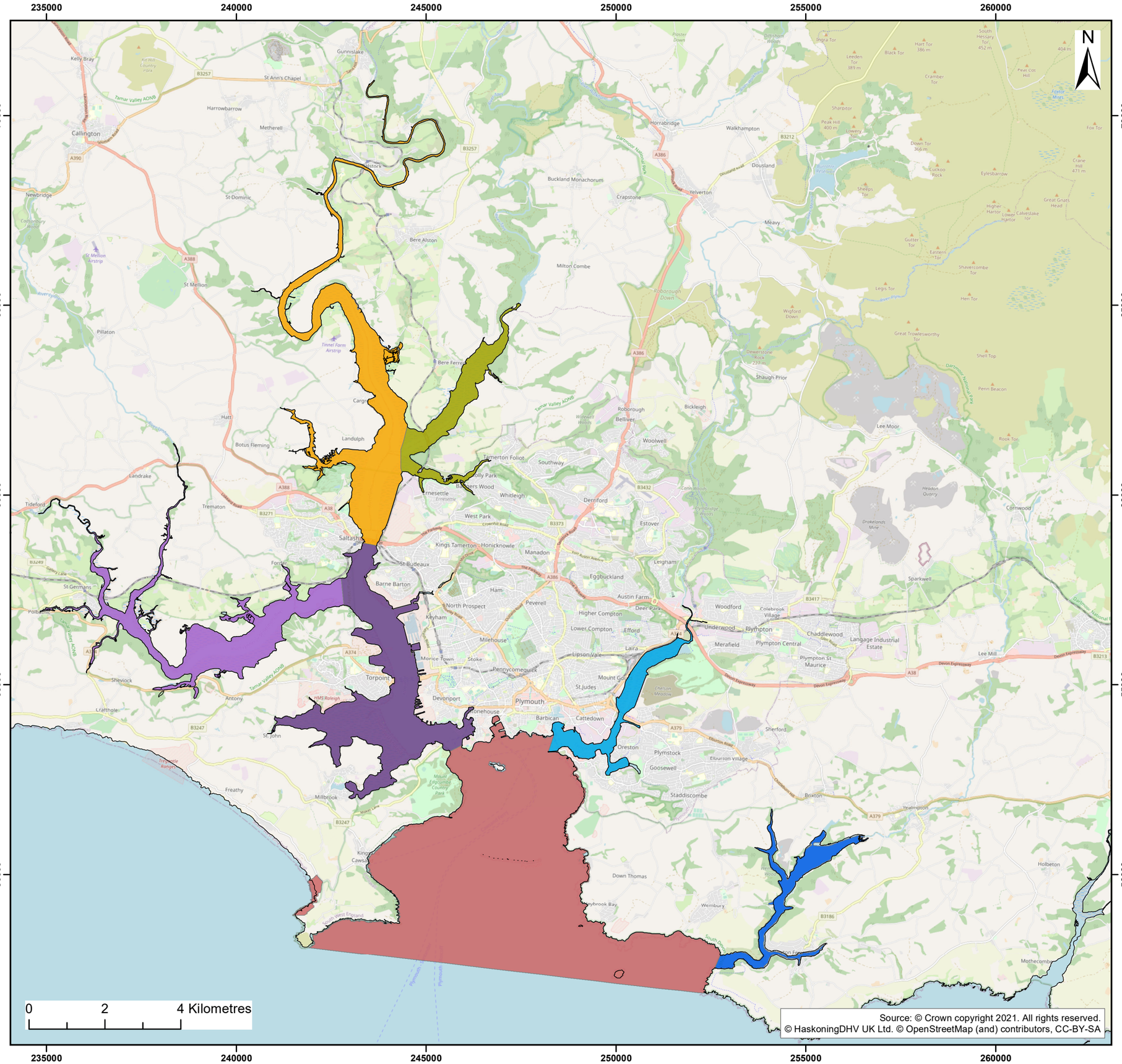
2.2 Scope of the Document

The scope of the Baseline Document has been defined below in terms of the geographical study area; the activities considered in the assessment; and the designated sites considered relevant to those activities.

2.2.1 Study area

The study area for the Baseline Document covers the following main areas (see **Figure 2.1**):

- River Tamar.
- River Tavy.
- River Lynher.
- Hamoaze and St. John’s Lake (including the Dockyard).
- River Plym.
- River Yealm; and,
- Plymouth Sound.



Legend:

Mean High Water

Plymouth Sound and Estuaries

- Hamoaze and St. John's Lake
- Plymouth Sound
- River Lynher
- River Plym
- River Tamar
- River Tavy
- River Yealm

Client: Defence Infrastructure Organisation	Project: HMNB Devonport MDP Baseline Document

Title: Plymouth Sound and Estuaries MDP Baseline Document Study Area

Figure: 2.1 | Drawing No: PB4532-113-200

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Co-ordinate system: British National Grid

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2.2.2 Activities

Maintenance dredging is the activity of removing sediment that has built up in existing channels or basins that have previously been dredged and is considered separately from capital dredging, which is new excavation of the seabed in an area or down to a level not previously dredged. As a general guide the MMO considers that if no dredging has taken place on a site during the preceding ten years then the first dredge should be considered capital, however there may be exceptions where siltation rates are low.

The Baseline Document therefore only considers the potential impacts to designated sites from maintenance dredging activities, however information on previous capital dredge works have been presented to provide a full understanding of dredge activities in the area.

Similarly, this document does not consider the potential impacts to designated sites as a result of the disposal of dredged material, although information on previous disposal activities has been presented to provide an understanding of sediment movements within the system.

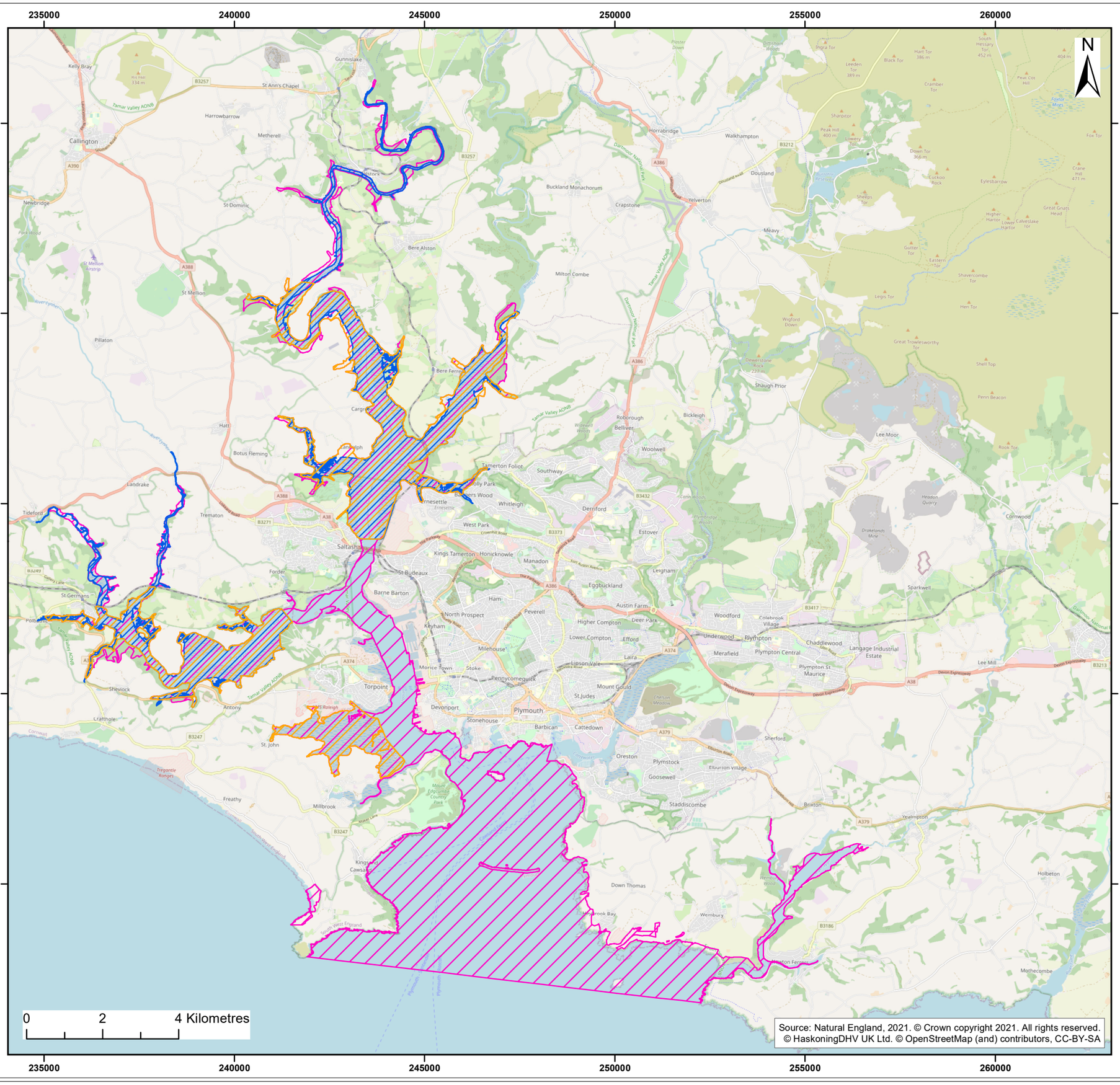
The document presents a baseline of current dredging activities only and does not provide an estimation or assessment of changes to future activities. Potential for changes to the current maintenance dredging regime is considered briefly in **Section 7** (Conclusions).

2.2.3 Designated sites

As set out in **Section 1**, sites to be included within the Baseline Document include designated sites which form part of the 'National Site Network' (formerly known as European sites) as well as MCZs. The following sites identified within the study area are as follows (see **Figure 2.2**):

- Plymouth Sound and Estuaries SAC.
- Tamar Estuaries Complex SPA; and
- Tamar Estuary Sites MCZ.

The assessment has been extended to also include the Dartmoor SAC as one of the qualifying features of the SAC is the migratory Atlantic Salmon, *Salmo salar*. This species is known to migrate between the sea and the Tamar and Plym rivers and is therefore considered.



Legend:

Designated sites

- Tamar Estuary Sites MCZ
- Plymouth Sound and Estuaries SAC
- Tamar Estuaries Complex SPA

Client: Defence Infrastructure Organisation	Project: HMNB Devonport MDP Baseline Document

Title:

Plymouth Sound and Estuaries
Relevant Designated Sites

Figure:	Drawing No:
2.2	PB4532-113-201

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Co-ordinate system: British National Grid

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2.3 Data Collection and Consultation

2.3.1 Tamar Estuaries Consultative Forum

A call for evidence was issued to members of the Tamar Estuaries Consultative Forum (TECF) in 2020.

KHM Plymouth chairs the TECF, a partnership of organisations and local authorities with statutory responsibility towards the management of the Plymouth Sound and Tamar Estuaries Marine Protected Area (MPA). The Forum meets three times a year to review progress on the objectives of the Tamar Estuaries Management Plan, discuss activities, incidents and developments that may impact the marine environment, and to provide a consistent, holistic and collaborative management approach for the MPA. Members of the TECF include DIO, ABP, Cattewater Harbour Commissioners, EA, MMO, NE and Sutton Harbour.

2.3.2 Environmental Information Regulations

Requests for information and data under the Environmental Information Regulations (EIR) 2004 were made to the following relevant public authorities to collate data:

- Cefas.
- NE; and
- EA.

2.3.3 Relevant dredging and disposal marine licences

Information on relevant dredging and disposal marine licences has been collated from the MMO's Public Register and Explore Marine Plans service. The DIO would also like to thank the contributions of further information and / or data from the following organisations:

- Boskalis Westminster Dredging Company Ltd.
- Cattewater Harbour Commissioners.
- ABP Millbay.
- River Yealm Harbour Authority.
- Plymouth Yacht Haven.
- Yacht Haven Quay.
- Turnchapel Wharf.
- Queen Anne's Battery.
- Mayflower International Marina.
- King Point Marina; and
- Sutton Harbour Marina.

2.3.4 Consultation

Consultation with NE to ensure the environmental baseline information presented is correct and to confirm the method and conclusions of the assessments has been undertaken. Consultation with NE was

undertaken in Summer 2022 and a summary of the outcomes of consultation, as agreed in a call on the 24th August 2022, is provided in **Table 2.2**.

Table 2.2 NE consultation undertaken for the 2022 Baseline Document update

Summary of comment(s) received from NE	Summary of updates made	Section reference
Request to highlight the powers of KHM and other relevant Statutory Harbour Authorities in respect of maintenance dredging and works.	Information added where available.	**Sections 3.2.1, 3.2.2, 3.2.3, 3.2.4** (Sutton Harbour Marina) **Section 6.2.2**
Suggestion to update the document to include details of PBDE levels found within the sampling for the HMNB Devonport 8 and 9 Wharf capital dredge.	Data on PBDEs has been added.	**Section 4.5.6**
Request to review the 'Restoring Estuarine and Coastal Habitats with Dredged Sediment' handbook and include relevant information.	The 'Restoring Estuarine and Coastal Habitats with Dredged Sediment' handbook has been reviewed and relevant information has been incorporated.	**Section 3.6**
Recommendation to include further information from the Advice on Seasonality matrices provided by NE within **Table 4.4**, particularly with regard to smelt spawning seasons.	**Table 4.4** has been amended to include further information from NE's Advice on Seasonality.	**Section 4.3**
Suggestion to give consideration to lower risk pressures	Additional pressures identified by NE have been incorporated into the HRA and MCZ assessments.	**Section 5.2.3** **Section 5.3.1** **Section 5.4.1** **Section 5.5.1** **Section 6.3.2** **Section 6.4.2**
Request that clarity is provided on whether indirect impacts upon Sites of Special Scientific Interest (SSSIs) are possible.	An assessment of potential impacts upon the features of relevant SSSIs has been included.	**Section 5.6.1** **Section 6.5**
Recommendation to review the Tamer Estuaries Consultative Forum (TECF) Biosecurity Plan projects and research to inform the assessment of invasive non-native species.	The TECF Biosecurity Plan has been reviewed with relevant information incorporated.	**Section 6.2.1**
Request to tabulate the overall conclusions of the Appropriate Assessment and MCZ Stage 1 assessment	Appropriate Assessment and MCZ Stage 1 assessment tables have been included.	**Section 6.3.3** **Section 6.4.3**

3 EXISTING DREDGING REGIME

The Plymouth Sound and estuaries area supports a range of waterfront activities that give rise to the need for regular maintenance dredging. Maintenance dredging can be defined as regular dredging activity which is undertaken to remove accumulated sediments from within berths and therefore maintain the berth at the appropriate agreed depth.

The following harbour authorities operate within the Plymouth Sound and estuaries area:

- KHM for Dockyard Port of Plymouth (HMNB Devonport).
- Cattewater Harbour Commissioners.
- Sutton Harbour Company.
- ABP Millbay Dock; and
- River Yealm Harbour Authority.

Within the Dockyard Port area there are a number of marinas, namely:

- Plymouth Yacht Haven (within Cattewater).
- Yacht Haven Quay (within Cattewater).
- Turnchapel Wharf (within Cattewater).
- Queen Anne's Battery (within Cattewater).
- Torpoint Yacht Marina (in the lower Tamar, off the Hamoaze).
- Mayflower International Marina (in the lower Tamar, immediately above The Narrows).
- Royal William Yard (in the lower Tamar, immediately above The Narrows).
- Millbay Marina (within Millbay Dock, off Plymouth Sound).
- King Point Marina (within Millbay Dock, off Plymouth Sound); and
- Sutton Harbour Marina (locked basin off Plymouth Sound).

Maintenance dredging is dominated by HMNB Devonport, with its dredged access channel, dredged berths and enclosed basins, however the commercial wharves at Cattewater and a number of marinas also regularly undertake maintenance dredging. Dredging is regularly undertaken through trailing suction hopper dredgers (TSHD) which remove the material for disposal at sea. This is supported by widespread use of plough (bed leveller) dredging to remove high spots at marinas and individual berths as well as submersible pump dredging to carry out the dredging where access is difficult for larger dredge vessels. Other dredging techniques have been used at some sites and include:

- Backhoe dredging.
- Grab dredging; and
- Water injection techniques.

Data on dredging operations within the study area were obtained through consultation with the KHM Plymouth, Boskalis Westminster Ltd. (BWL) and by direct contact with the civilian harbour authorities and marina operators. BWL is the sole maintenance dredging contractor to DIO on behalf of KHM.

3.1 Dredging Methodology

A typical maintenance dredging campaign consists of a pre-dredge survey to ascertain the amount of sediment to be dredged (accumulated silt between minimum maintained depth (MMD) and approved dredge depth (ADD)), the dredging operation to remove / move the identified sediment and a post-dredge survey to confirm the operation. The main dredging methods are as follows:

- **Using a TSHD to remove sediment from the berths and dispose at a licensed disposal ground.** This approach has been historically employed at HMNB Devonport and the commercial wharves. This dredging method involves a self-propelled vessel trailing a suction pipe with a draghead attached to the end, along the seabed. The draghead is pulled slowly along the bed by forward motion of the vessel. The suction pipe is connected to pumps on board the vessel that provide suction to the draghead which in turn 'sucks up' a mixture of water and silt. The draghead can be equipped with cutting teeth for the agitation of firmer sediment or water jets to aid softer material into suspension. The silt and water travel up the suction pipe and are deposited in a hopper located in the vessel. The vessel continues to dredge until the capacity of the hopper is reached. A range of TSHDs are licensed for use during the maintenance operations. The hopper capacities of the vessels used at HMNB Devonport have ranged from 1,500m^3 to 6,000m^3. Once the hopper capacity is reached, the vessel then stows the suction pipe and draghead on board and transits to the disposal site.

  At the disposal site the material in the vessel's hopper is discharged by 'bottom dumping'. This discharge method entails the opening of the doors located in the bottom of the vessel's hopper and allowing the material to fall to the seabed under gravity. The material dredged for the maintenance works at Devonport is silt. Due to the nature of the dredging method, a full hopper consists of approximately 25% to 35% silt with the remainder being water. Excluding time for positioning and dependant on hopper capacity, a hopper can be filled in 30 to 60 minutes providing no hard material is encountered. The bottom dumping of the dredgings can take as little as five minutes but time at the disposal site can be up to an hour to allow for positioning, bad weather etc.

- **Dispersive plough dredging.** The plough dredging method involves a self-propelled vessel which operates by lowering a beam, blade or box plough (depending on material) to the required depth, usually ADD, or the seabed (if significantly higher) and traverses the area with the plough. The plough sails through the dredging area, turning and lifting the blade from the seabed as necessary, until the required level has been achieved (by pushing the high areas in to the void spaces). The volume of material in the dredge area will not significantly change as the material is being redistributed within it and no material is being taken out of the area. The quantification of the volume moved by ploughing will depend on the vertical reference used. Ploughing is generally targeted to achieve ADD. Ploughing does not give rise to a significant re-suspension of sediment but if the sediment ploughed is soft it may be sufficiently disturbed to rise in suspension.

  In October 2010, a report was produced to present an assessment of data from a real time monitoring buoy deployed to establish maximum turbidity levels within the Tamar Estuary (Hydrodynamic bv, 2010). The monitoring buoy was located to the west of Weston Mill Lake Basin, and data collected between September 2008 and August 2010. The results showed that changes in turbidity from the TSHD and plough dredging operations are localised to the berth area and that turbidity associated with the dredging methods are within levels of natural variation found within the estuary. Two technical notes have been appended which provide further details on the monitoring and assessment carried out at Weston Mill Lake (**Appendix A3.1**).

- **Submersible pump methods.** Some pockets within the maintained areas cannot be accessed by conventional dredging plant as the physical area is too small or cannot be ploughed out as there is an obstruction. A submersible pump pumps the accumulated sediment from the hard to access area

to an adjacent maintained area (the temporary discharge area). The material will then be taken to the disposal area during the course of the routine maintenance dredging.

The submersible pump can be mounted in two main ways. It can be attached to a floating plant platform. A small pontoon with a small deck mounted crane (Hiab, A-frame or similar) would be used and the submersible pump would be slung from the crane hook and lowered into the water to the required depth. The pump discharge would then be connected to a floating line reaching to the temporary discharge area. The submersible pump can also be mounted from a land-based crane, which has a sufficient reach, and operated in a similar sweeping motion to cover the area.

There are also three further methods that have been or are used for maintenance dredging. These are backhoe dredging, grab dredging and water injection dredging. Backhoe and grab dredging are used as normal practices but on a small scale and water injection dredging has been used in the past at two marinas (Royal William Yard in 2007 and Plymouth Yacht Haven in 2011). There are no current maintenance licences where water injection dredging is currently undertaken in the Plymouth Sound and estuaries area.

3.2 Maintenance Dredging Activities

3.2.1 HMNB Devonport

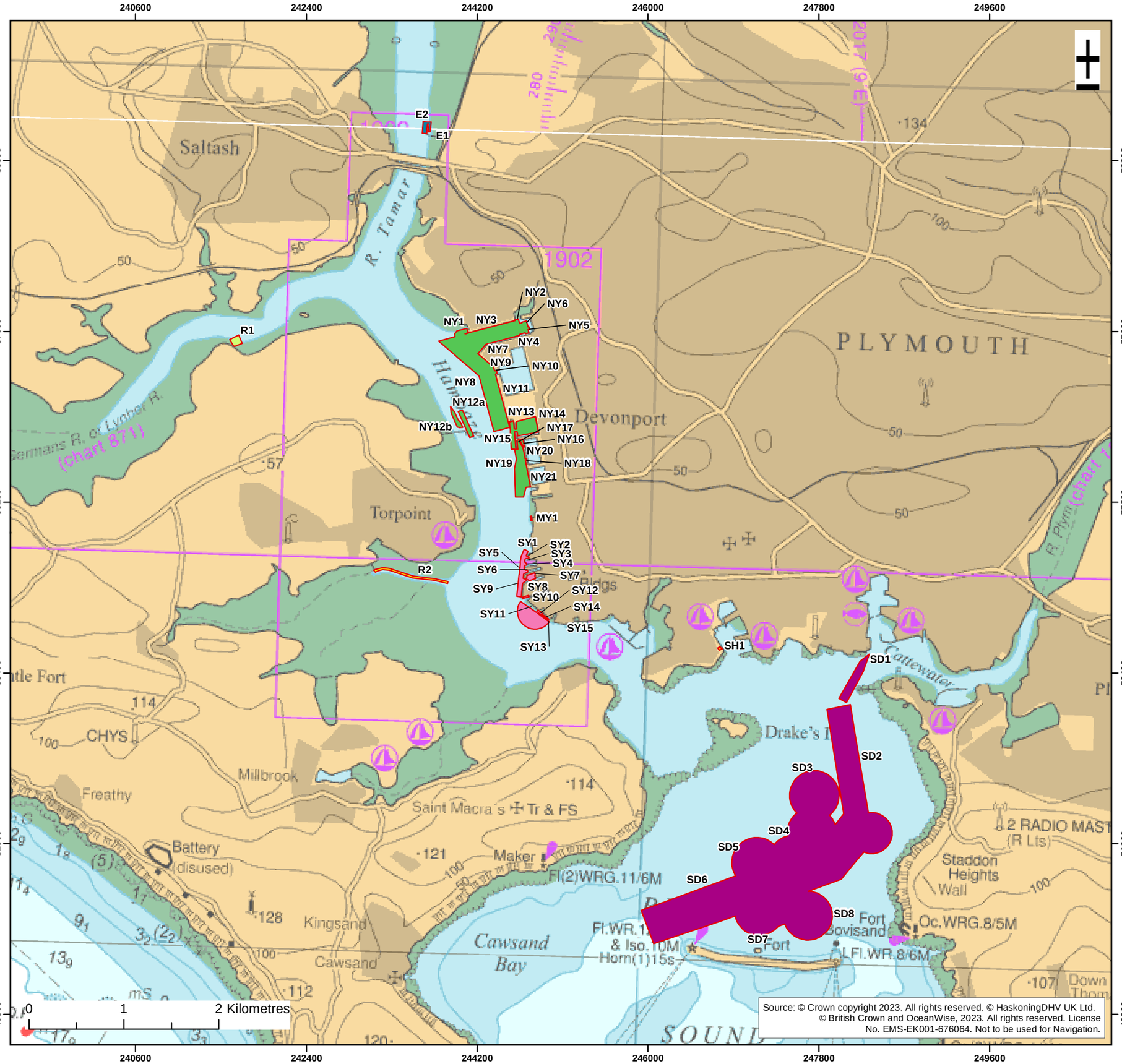
KHM Plymouth has statutory control of the Dockyard Port of Plymouth. KHM's powers derive from the Dockyard Ports Regulations Act of 1865, which covers general powers for all KHM's in Dockyard Ports. Detailed rules and regulations are contained in the Dockyard Port of Plymouth Order 2020. A marine licence is required for dredging activities within HMNB Devonport.

The Naval Base in Devonport is subject to essential, regular maintenance dredging to ensure adequate under keel clearance to all vessels using the facility. Due to the Dockyard's location within the Tamar Estuary, it is subject to the accretion of sediment transported around the estuary by tidal and fluvial flow. This sediment accretion is the target of the maintenance dredging operations. Maintenance dredging is required to maintain the operational depths in the approaches and berth pockets of the Dockyard and allow the MOD to maintain its tactical and strategic defence commitments. Dredging has been ongoing at Devonport since at least the 19th Century.

The area within HMNB Devonport that requires dredging stretches from just north of the Tamar Bridge to anchorage areas inside of the Plymouth Sound Breakwater. There are also a number of singular locations outside of this main area. For ease of description the maintained areas have been split up into:

1. Ernesettle.
2. Jupiter.
3. North Yard (including Weston Mill).
4. South Yard and Morice Yard.
5. Trevol.
6. Stonehouse (Longroom Camber).
7. Plymouth Sound.

These areas can be seen in **Figure 3.1**.



Legend:

- HMNB Devonport Maintenance Dredge Areas

HMNBD Maintenance Dredge boxes outer boundary

- Ernesettle
- Jupiter
- North Yard including Weston Mill
- South Yard and Morice Yard
- Trevol
- Stonehouse – Longroom Camber
- Plymouth Sound

Client: Defence Infrastructure Organisation	Project: HMNB Devonport MDP Baseline Document

Title: HMNB Devonport Maintenance Dredge Areas

Figure: 3.1 | Drawing No: PB4532-113-202

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In order to provide clarity for the Regulators when applying for consent to dredge and dispose of the dredged material, historically a further nomenclature was also derived which split the main areas up into still smaller arbitrary dredge boxes. The dredge boxes are delineated by lines on a map but in reality are not separated or differentiated in any way other than the required operating depth within them which may sometimes differ.

The locations and maintained levels of these dredge boxes are provided in **Appendix A3.2**.

At the time of writing a maintenance dredge and disposal licence (L/2018/00478) is currently in place for dredge and disposal operations within the HMNB Devonport maintenance dredge area. This licence was granted on 19th December 2018 and is valid until the 19th December 2028. The marine licence consents the dredging and disposal of a total of 500,000m^3 (725,000 wet tonnes) of silt and 50,000m^3 (95,000 wet tonnes) of sand over the 10-year period, although the licence restricts yearly disposal quantities to 150,000 wet tonnes. Plough and submersible pump methods are also consented (i.e. methods that involve the relocation of surface sediments and do not remove material from the system).

The maintenance dredging is carried out in occasional campaigns (usually twice a year) which last generally one to three weeks. Typically, a major campaign has occurred once every one to two years. Historically, dredged material has been disposed of at the Rame Head disposal site, before moving to a slightly changed site location of Rame Head South. Since 2017, material has been disposed of at Plymouth Deep disposal site.

Seasonal restrictions on maintenance dredging activities in relation to avoiding impacts to migratory fish species are in place for maintenance dredging in HMNB Devonport. Current constraints on the maintenance operations within the North Yard berths require work to the outer areas of the Dockyard (greater than 50m from the wharfs, as indicated by the red line in **Figure 3.2**) to be performed in the winter between December and March. **Table 3.1** outlines the berths impacted by the demarcation line. There are also a number of further seasonal restrictions for maintenance dredge works within HMNB Devonport, which have also been outlined in **Table 3.1**.

Maintenance dredging activities of the historical dredge box NY12 (Yonderberry Jetty Berth at the Thanckes Oil Fuel Depot (OFD)) have been undertaken within the maintenance dredging regime. Dredge box NY12 was previously included in the marine licences for the activity up to 2017. However, NY12 was not included in the application for the current 10-year marine licence, as capital works to build a new fuel jetty to replace the existing Yonderberry Jetty as part of the Thanckes OFD project (see **Section 3.4**) were to be undertaken including capital dredging, construction of the new jetty and demolition of the old jetty.

The capital dredge and disposal works under licence L/2017/00223 have been completed and new dredge boxes NY12a and NY12b have been added onto the current version of the maintenance dredge licence (L/2018/00478/2) (**Figure 3.1**). A variation to the marine licence for maintenance dredging campaigns at HMNB Devonport was approved on 26th October 2022. The variation introduced an additional demarcation line on the west side of the channel to mitigate potential effects on migratory fish (**Figure 3.2**). The position of this demarcation line is in accordance with the mitigation implemented for the Thanckes OFD capital dredge (L/2017/00223). The variation request did not request any increase in dredge volumes.

Label	X	Y
A	243965	56945
B	244120	56760
C	244319	56588
D	244482	55974
E	244559	55758
F	244662	55638
G	244715	55356
H	244721	55278
I	244121	55881
J	244000	56156
K	243918	56211

243200 244000 244800 245600

56800 56000 55200

NY1 NY2 NY3 NY4 NY5 NY6 NY7 NY8 NY9 NY10 NY11 NY12* NY13 NY14 NY15 NY16 NY17 NY18 NY19 NY20 NY21

A - South West Corner Dredge Box NY1

B - North West Corner Dredge Box NY9

C - Western "Elbow" Corner of Dredge Box NY9

J – North West corner of dredge box NY12a

K – North West corner of dredge box NY12b

I – South West corner of dredge box NY12a

D - South West Corner Dredge Box NY11

E - South West Corner Dredge Box NY15

F - South West Corner Dredge Box NY20

0 250 500 Metres

Legend:

- HMNB Devonport Maintenance Dredge Areas
- Demarcation Line
- **HMNBD Maintenance Dredge boxes outer boundary**
- North Yard including Weston Mill

Client: Defence Infrastructure Organisation	Project: HMNB Devonport MDP Baseline Document

Title: HMNB Devonport Demarcation Line

Figure: 3.2 | Drawing No: PB4532-113-203

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Table 3.1 HMNB Devonport summary of seasonal restrictions on maintenance dredging activities

Dredge Box Code (see Appendix A3.2)	**Restriction**
E1-2	Dredging is restricted to December to March. If dredging is required February to April, prior written approval from the MMO (in consultation with NE) is required.
R1	Dredging is restricted to December to March.
R2	No restrictions.
NY1-2	No restrictions.
NY3	Dredging is restricted to December to March for areas of this berth to the west of the demarcation line (**Figure 3.2**).
NY4-7	No restrictions.
NY8	Dredging is restricted to December to March.
NY9-11	No restrictions.
NY12a	Dredging is restricted to December to March.
NY12b	No restrictions.
NY13-18	No restrictions.
NY19	Dredging is restricted to December to March for areas of this berth to the west of the demarcation line (**Figure 3.2**).
NY20-21	No restrictions.
MY1	No restrictions.
SY2-10	No restrictions.
SY11	Dredging is restricted to December to March.
SY12-15	No restrictions.
SH1	No restrictions.
SD1	Dredging is restricted to January to March.
SD2-8	Dredging is restricted to December to March.

3.2.2 Cattewater Harbour Commissioners

Cattewater Harbour Commissioners are a statutory harbour authority and under the Cattewater Harbour Order 1915 (Cattewater - Pier and Harbour Order Confirmation (No.2) Act 191) CHC are empowered to deepen, dredge, scour and excavate the harbour. Therefore, under Section 75 of the MCAA 2009 (as amended), CHC are exempt from needing a marine licence for dredging activities within their jurisdiction.

At the time of writing a maintenance disposal licence (L/2018/00123) is currently in place for disposal operations at Plymouth Deep. This licence was granted on 19th March 2018 and is valid until 18th March 2028.

The maximum total material to be disposed of in each consecutive three-year period between 19th March 2018 and 18th March 2024 is 70,000 wet tonnes. The maximum total material to be disposed of in the four-year period between 19th March 2024 and 18th March 2028 is 70,000 wet tonnes.

The areas maintained by CHC are presented in **Table 3.2** and displayed in **Figure 3.3**, although the only areas that require regular maintenance dredging are the Cattedown, Corporation and Victoria wharves. The main methods include TSHD and plough dredging, although a grab dredger has been used.

Table 3.2 Areas Currently Maintained by Cattewater Harbour Commissioners

Dredge Area	Max Maintained Depth (m bCD)
Channel West	5.5
Channel Central and East	5.0
Sutton Channel South	2.5
Sutton Channel North	2.0
Victoria Wharves	6.0
Cattedown Wharf East	6.3
Cattedown Wharf West	7.6
Oreston Channel	2.0
Pomphlett Wharf	2.0
Off Pomphlett Wharf	2.0
Corporation Wharf	2.0

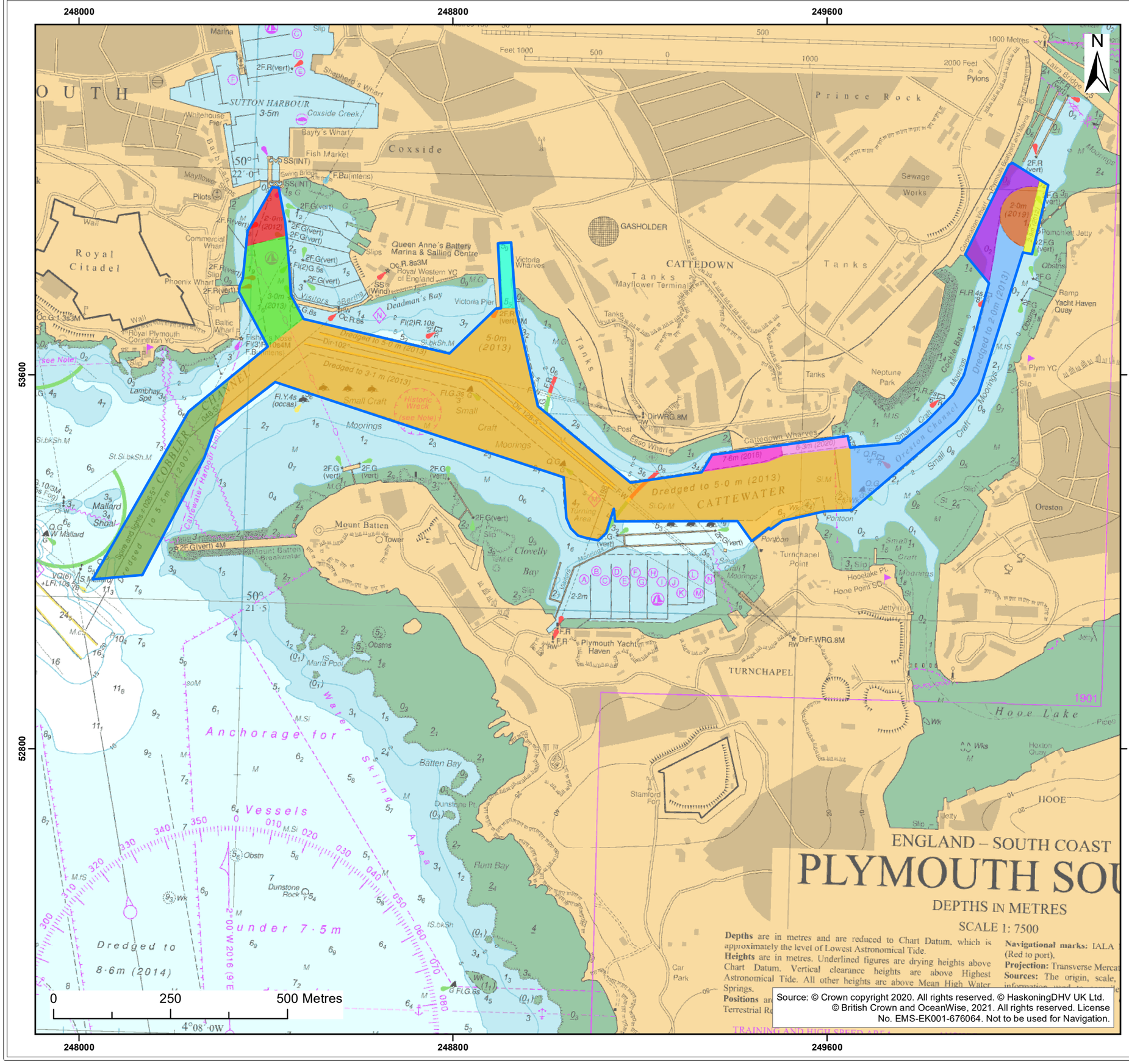
Plough maintenance dredging is carried out in regular campaigns (usually twice a year) which last generally one to three weeks. Typically, a TSHD or grab dredge and disposal campaign has occurred once every 1 to 2 years. Historically, dredged material has been disposed of at the Rame Head disposal site, before moving to a slightly changed site location of Rame Head South. As of 2017, material has been disposed of at Plymouth Deep disposal site.

Dredged material is predominantly silt although the wider maintenance dredge material includes areas of gravel, sand and clay.

Seasonal restrictions on maintenance dredging activities in relation to avoiding impacts to migratory fish species are in place for maintenance dredging as outlined in **Table 3.3**.

Table 3.3 CHC summary of seasonal restrictions on maintenance dredging activities

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
TSHD within the main channel	Dredging permitted with no spatial or temporal restrictions			Dredging permitted during the daytime only		Dredging permitted with no spatial or temporal restrictions			Dredging permitted during the daytime only	No dredging to be undertaken		
Plough dredging within the main channel	Dredging permitted with no spatial or temporal restrictions			Dredging permitted during the daytime only		Dredging permitted with no spatial or temporal restrictions			Dredging permitted during the daytime only	No dredging to be undertaken		
TSHD / Plough dredging within the berths and non-channel areas	All dredging permitted											



Legend:

- Maintenance Dredge Area
- 1 - Channel West
- 2 - Channel Central & East
- 3 - Sutton Channel South
- 4 - Sutton Channel North
- 5 - Victoria Wharves
- 6 - Cattedown Wharf West
- 7 - Cattedown Wharf East
- 8 - Oreston Channel
- 9 - Pomphlett Wharf
- 10 - Off Pomphlett Wharf
- 11 - Corporation Wharf

Client: Defence Infrastructure Organisation	Project: HMNB Devonport MDP Baseline Document

Title: Cattewater Harbour Commissioners Maintenance Dredge Areas

Figure: 3.3 | Drawing No: PB4532-113-204

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3.2.3 ABP Millbay Dock

It is understood that Millbay Dock is owned and operated by ABP under the Plymouth Great Western Dock Act 1846, with powers extended in the Plymouth Great Western Docks Act 1855, and that a marine licence is required for dredging activities. However, no maintenance dredging is currently required within Millbay Dock.

3.2.4 Marina Operator's

Plymouth Yacht Haven

Much of Plymouth Yacht Haven is naturally deep enough for marina operations but the inner berths were formed by capital dredging to 2.5m bCD in 1996. Although regular maintenance dredging has not been required, maintenance plough dredging was carried out in 2004 and 2008, and water injection dredging undertaken in 2011.

In December 2017 and early 2018 a maintenance dredge was undertaken by backhoe dredging under marine licence L/2017/00362. The marine licence consented the dredge of 59,900m^3 (113,810 wet tonnes) of silt. Dredge target depths were 2.5m bCD. The marine licence restricted dredging to between 1st December and 31st March within the inner berths and between 1st February and 31st March for the outer berths (see **Figure 3.4**). The marine licence has now expired.

The excavated material was removed by backhoe dredger mounted on a spud-leg pontoon and loaded onto a hopper barge and deposited at Plymouth Deep.

There are currently no plans for further maintenance dredging (Personal communication, December 2020).

Yacht Haven Quay

The area around the boat launching jetty and the layby pontoons was originally dredged to 2.0m bCD. Although regular maintenance dredging has not been required, maintenance of the access to the boat launching jetty and the layby pontoons was undertaken by backhoe dredging in 2018. Works were undertaken under marine licence L/2017/00307. The marine licence consented the dredge of 8,000m^3 (15,200 wet tonnes) silt. Dredge target depths were between 1.0m bCD to 2.0m bCD across the site. The marine licence restricted dredging to between 1st February and 31st March. The marine licence has now expired. The excavated material was removed by backhoe dredger mounted on a spud-leg pontoon and loaded onto a hopper barge and deposited at Plymouth Deep.

There are currently no plans for further maintenance dredging (Personal communication, December 2020).

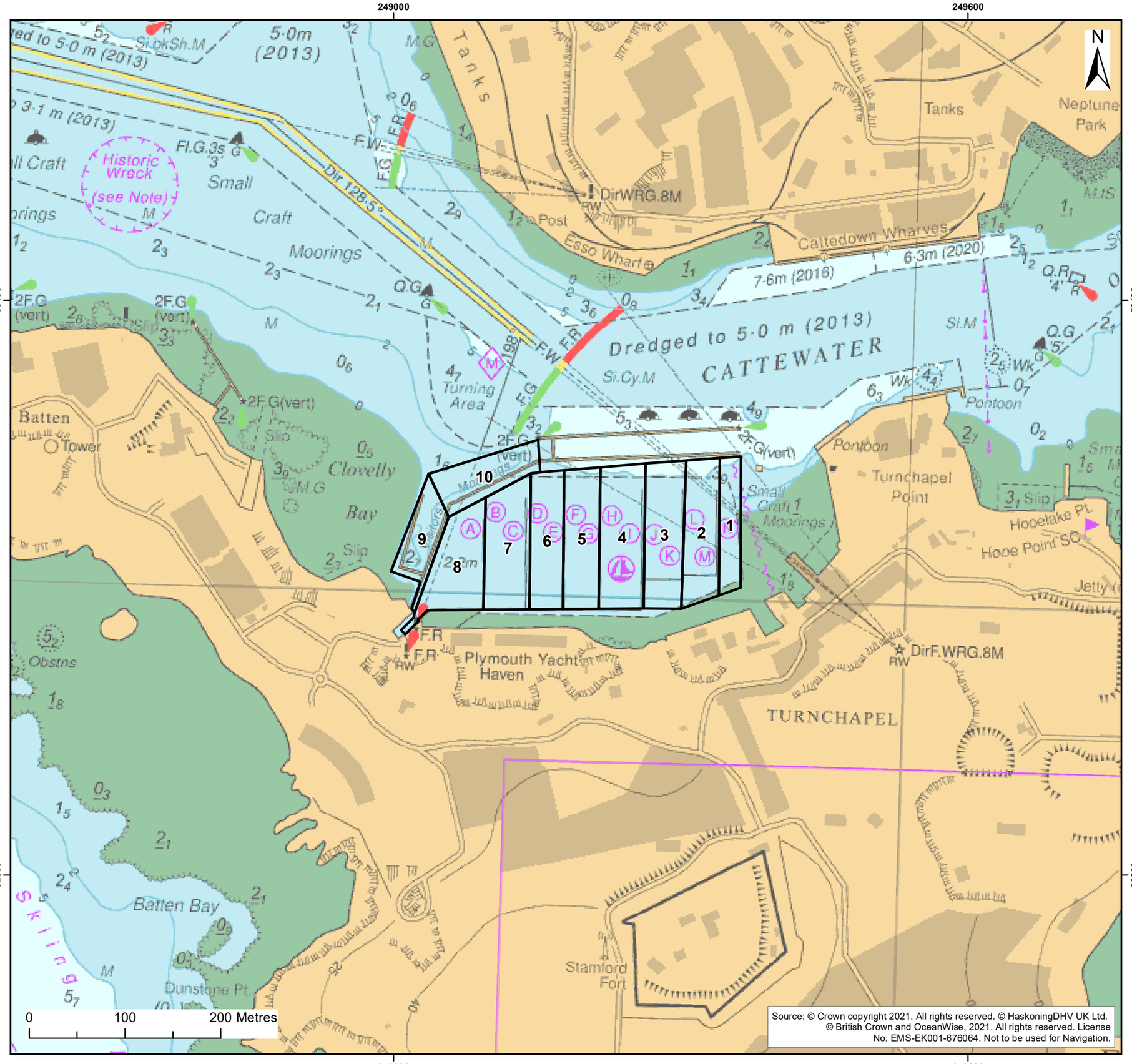
Turnchapel Wharf

Capital dredge works were undertaken at this location in 2018 (see **Section 3.4.4**). There are currently no plans for further maintenance dredging (Personal communication, December 2020).

Queen Anne's Battery

A marina wide maintenance dredge was undertaken by backhoe dredger in 2000 with disposal at the Rame Head South disposal ground. This was repeated, with sectors of the harbour being targeted on a rolling programme over two to three years, starting in December 2009. Disposal quantities are estimated at 7,250 tonnes, with disposal at the Rame Head South disposal ground. The campaign in 2000 appears in the MMO records as a licence of 9,500 tonnes but the actual quantity disposed is not recorded. 4,000 tonnes is recorded as being disposed of in 2009, and 12,300 tonnes in 2011.

There are currently no plans for further maintenance dredging (Personal communication, December 2020).



Legend:

Plymouth Yacht Haven Maintenance Dredging Zones

Client: Defence Infrastructure Organisation	Project: HMNB Devonport MDP Baseline Document

Title: Plymouth Yacht Haven Maintenance Dredging Zones

Figure: 3.4 | Drawing No: PB4532-113-205

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Torpoint Yacht Marina
A maintenance dredge of Torpoint Yacht Marina was undertaken by submersible pump (venturi dredger) in 2016, moving silt deposits from within the marina into the main channel of the Tamar, 10m outside of the marina gate. Works were undertaken under marine licence L/2016/00223/1, consenting the dredge of up to 1,500m^3 (2,400 wet tonnes). No disposal returns are available for these works. The marine licence has now expired.

Mayflower International Marina
The marina does not currently require maintenance dredging (Personal communication, December 2020).

Royal William Yard
Water injection dredging was undertaken in late 2007 (quantity not known). No information on potential future operations was available during the 2022 update of the Baseline Document.

Millbay Marina
No maintenance dredging is currently undertaken within Millbay Marina. No information on potential future operations was available during the 2022 update of the Baseline Document.

King Point Marina
A capital dredge was carried out at King Point Marina in 2010.

A marine licence (L/2021/00273/1) was issued by the MMO to Sutton Harbour Company on 16th September 2021 for a new 9-year maintenance dredge licence for King Point Marina. The marine licence consents the removal of up to 10,000m^3 of material from the inner basin area during the validity of the licence. Only a maximum depth of up to 1m of material is to be removed.

Dredging will be undertaken using a long reach 360-degree excavator mounted on a self-propelled dredge barge or pontoon, loading material onto self-propelled split hopper barges.

A maximum amount of 1,600 wet tonnes of silt will be dredged and disposed of per year and disposed of at Plymouth Deep.

The marine licence conditions dredging activity to only be carried out between 1st February and 31st March.

An average dredging / disposal campaign will have a duration of up to a maximum of three weeks. Dredging campaigns will be undertaken on an ‘as and when needed basis’. Based on the current rate of siltation observed, it is anticipated that a campaign will be programmed to be undertaken approximately once every three years.

Sutton Harbour Marina
It is understood that Sutton Harbour is owned and operated by Sutton Harbour Holdings under the Sutton Harbour (Plymouth Port) Act of 1847. The Sutton Harbour (Plymouth Port) Act of 1847 may include provisions for the powers to dredge, however Sutton Harbour Marina, which is a locked basin, does not require regular maintenance dredging. The harbour carries out a hydrographical survey on a biannual basis and has seen no significant silting from the survey data to suggest dredging would be required in the near future.

3.2.5 River Yealm

The River Yealm is part of Plymouth Sound (South) but is not subject to maintenance dredging (Personal communication, December 2020).

3.3 Maintenance Disposal Returns

Data on dredging operations within the study area was obtained through consultation with Cefas, the DIO, the KHM Plymouth, Boskalis Westminster Dredging Company Ltd. and by direct contact with the civilian harbour authorities and marina operators.

A summary of maintenance dredge disposal quantities over the past six years (2015 to 2020) are presented in **Table 3.4**, and the full data (dating back to 1985) is provided in **Appendix A3.3**. In 2015, no maintenance dredging and disposal was undertaken. Please note these returns do not include plough or submersible pump dredging methods.

Table 3.4 Maintenance dredging returns (wet metric tonnes (wmt)) for 2015 - 2020

Year	Quantity HMNB Devonport (wmt)	Description	Quantity CHC (wmt)	Description	Quantity Others (wmt)	Description
2015*	-	-	-	-	-	-
2016	76,373	TSHD	8,269	Cattedown Wharves, TSHD	-	-
2017	56,716	TSHD	-	-	-	-
2018	21,592	North Yard, TSHD	840**	Cattedown Tanker Berth, TSHD	99,081	Plymouth Yacht Haven / Yacht Haven Quay, Backhoe
2019	27,586	TSHD	5,706	Cattedown Wharves, TSHD and Grab	-	-
2020	15,280	TSHD	-		-	-
Total 6 years	**197,547**	**-**	**14,815**	**-**	**99,081**	**-**

* 2015 HMNB Devonport maintenance disposal volumes were restricted due to a lack of a marine licence.
** No disposal returns available. Volumes provided on MMO's Marine Case Management System (MCMS).

Table 3.4 shows the total quantity of maintenance dredging material disposed of at licensed disposal sites over the 2015 to 2020 period is recorded at 311,443 wmt. Between 2015 and 2020 HMNB Devonport maintenance dredging disposal accounted for 63.4% of the total amount and averaging a disposal quantity of 39,509 wmt per annum (when excluding 2015).

Appendix A3.4 provides a summary of historical maintenance dredge return data. The total amount of maintenance material disposed over historical periods has been presented in **Table 3.5**.

Table 3.5 Historical maintenance dredging disposal totals

Period	Total disposal quantity (wmt)	Average disposal quantity per annum (wmt)
1985 – 2000	2,075,055	129,691
2001 – 2005	981,142	196,228
2006 – 2010	191,201	38,240
2011 – 2015	161,477	32,295
2016 – 2020	311,443	62,289

Figure 3.5 shows the five-year rolling average from 2010 to 2020 for maintenance disposal returns.

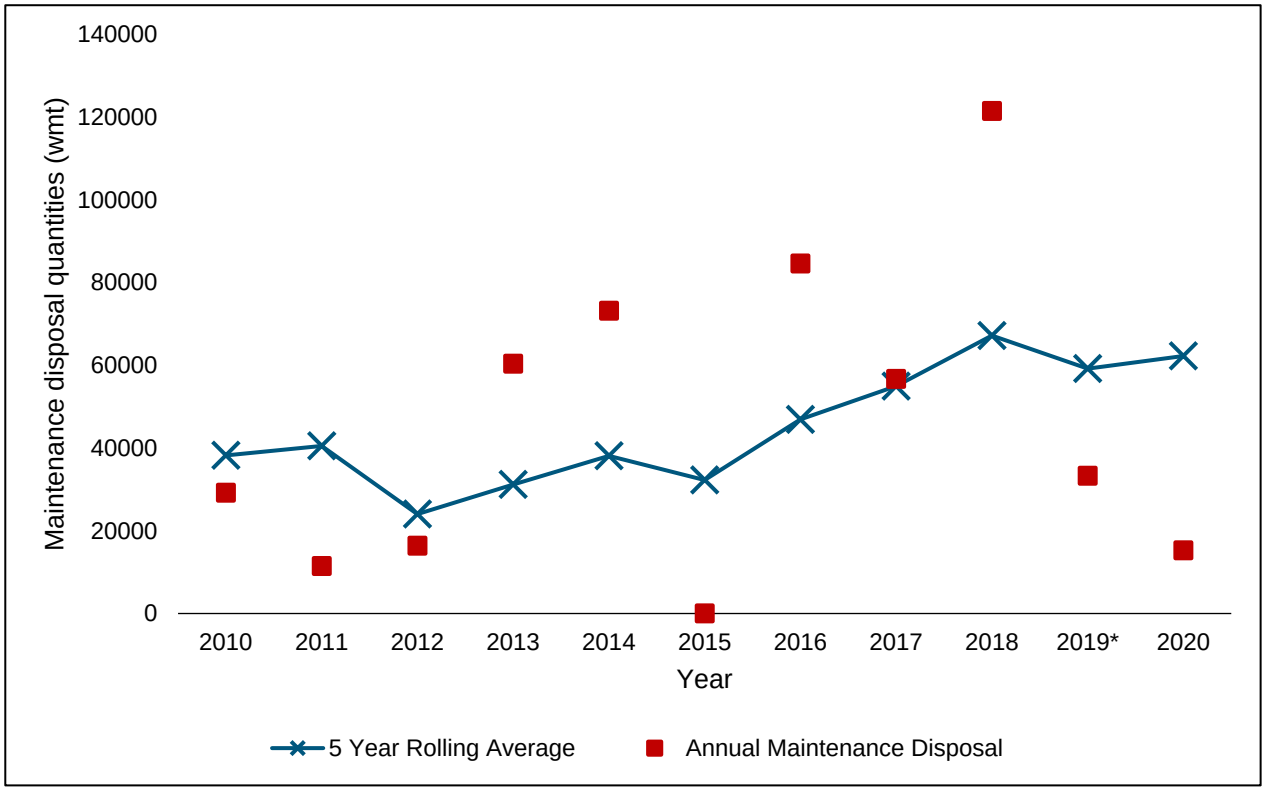


Figure 3.5 Five year rolling average 2010 - 2020 maintenance disposal quantities

**Disposal return quantities supplemented by additional data from the MCMS where disposal returns not available.*

Since 2010 the five-year rolling average has varied between approximately 24,040 and 67,214 wmt with a maximum recorded annual maintenance disposal of 121,513 wmt (see **Appendix A3.4**).

3.4 Capital Dredging Activities

Capital dredging is usually undertaken to create a new harbour, berth or waterway or deepen or widen an existing channel. Capital dredging is defined by the MMO as any dredging activity which is either in an area that has not been previously dredged or an area that has not been dredged within the past 10 years.

Given the historic and current maritime and military importance of Plymouth Sound and estuaries, there is a long history of capital dredging within the area.

3.4.1 HMNB Devonport

Thanckes Oil Fuel Depot (Yonderberry Jetty) Capital Dredge

A number of capital dredge campaigns between 2018 and 2020 have been undertaken within the vicinity of Yonderberry Jetty at the Thanckes Oil Fuel Depot, as part of a project to build a new fuel jetty to replace the existing Yonderberry Jetty.

Capital dredging was required to provide a berth pocket adjacent to the front (east) face of the new jetty head location and to provide a navigation channel to the fuel pontoon berth at the rear (west side) of the new jetty head location.

Works have been undertaken under marine licence L/2017/00223, which consented the dredge and disposal of up to 37,000m^3 (61,440 tonnes) of a mixture of silt and shillet material. Both TSHD and grab dredging methods have been used for capital removal of material with further plough and bed levelling activities. Capital removal of material was completed in 2020, with no further removal of material planned. Disposal of material was undertaken at Plymouth Deep disposal site.

Seasonal restrictions on dredging activities in relation to avoiding impacts to migratory fish species were in place for the works in this location. Dredging activities undertaken under L/2017/00223 could not be undertaken while other dredge activities were being undertaken within 700m of the works area and dredging was restricted to December to March east of the jetty head.

Berth NY12 (Yonderberry Jetty) was previously included within the maintained berths, however the area was removed from the marine licence for maintenance dredging during the Thanckes OFD (Yonderberry Jetty) upgrade and associated capital dredge (L/2018/00478/2). Capital dredging activities associated with the Thanckes OFD have since finished, resulting in a new berth pocket on the landward side of the jetty and a slightly larger berth pocket on the riverward side of the jetty, both will require future maintenance dredging. A marine licence variation request for these new dredge areas (NY12a and NY12b) was submitted to the MMO and the areas were added to the current maintenance dredging licence in 2022.

The berth pocket will be maintained at a MMD of 11.6m bCD with an ADD of 12.2m bCD. The navigation channel will be maintained at an MMD of 5.0m bCD and ADD of 5.6m bCD.

8 and 9 Wharf Capital Dredge and Disposal

At Wharf 8 and Wharf 9 within HMNB Devonport, capital dredging is required to provide 1.5m under keel clearance for new assets. A marine licence was issued by the MMO to undertake a capital dredge of Wharf 8 and Wharf 9, increasing the dredge depth from the current approved dredge depth of 11.6m BCD and 11.3m BCD (respectively) to 12.2m BCD (L/2022/00239/2). The volume of material consented to be dredged was 80,000m^3, equating to 135,500 wet tonnes of material that could be disposed of. A campaign under this marine licence was undertaken in 2022.

The material consented to be removed through capital dredging consists of a layer of muddy sediments on top of weathered bedrock (slate and quartzite), consolidated muds, sands and gravels. The bedrock is locally known as ‘shillet’. Dredging methods consented are a mix of TSHD and back-hoe dredging with disposal offshore at Plymouth Deep disposal site (PL035). Plough / bed leveller dredging to smooth the bed of Wharf 8 and Wharf 9 following dredging was also included on the marine licence.

A separate HRA was submitted in support of the capital dredge marine licence application (Royal HaskoningDHV, 2022a). The HRA included an Appropriate Assessment of interactions between dredging pressures and migratory fish species Allis shad and Atlantic salmon. On the basis that the sediment plume associated with the capital dredge of Wharf 8 and Wharf 9 would be temporally and spatially limited, and that the dredging activity would happen within the demarcation line for dredge works within the Tamar Estuary where year-round dredging is considered suitable (Royal HaskoningDHV, 2017), there would be no adverse effect on integrity on either qualifying feature.

3.4.2 Cattewater Harbour Commissioners

No capital dredge works have been undertaken on behalf of CHC over the past six years. Potential future capital dredging campaigns to deepen areas are currently being considered by CHC.

Corporation Wharf (Victoria Wharves Ltd)
A number of capital dredge campaigns at Corporation Wharf were undertaken through TSHD between November 2015 and February 2016.

Works were undertaken under marine licence L/2013/00396, which consented the dredge and disposal of up to 7,150m^3 (10,000 tonnes) of sand. Disposal of material was undertaken at both Rame Head South and Lantic Bay disposal sites.

Seasonal restrictions on dredging activities in relation to avoiding impacts to migratory fish species were in place for the works in this location. Dredging activities undertaken under L/2013/00396 were restricted to November to February.

3.4.3 ABP Millbay

No capital dredge works have been undertaken over the past six years.

3.4.4 Marina Operators

Turnchapel Wharf
Previously an MOD site, Turnchapel Wharf has recently undergone development for commercial uses. As part of this redevelopment a capital dredge was undertaken by backhoe dredging in 2018. Works were undertaken under marine licence L/2017/00361 to allow for all tide berthing in relation to the rearrangement and extension of berthing pontoons. The marine licence consented the dredge of 6,400m^3 (12,160 wet tonnes) of silt. Dredge target depths were -2.0m CD. The marine licence restricted dredging to between 1st February and 31st March.

Whilst no dredge returns are available for this marine licence, Local Notice to Mariners at the time noted dredging activities within Turnchapel Wharf. Based on the marine licence methodology, the excavated material was removed by backhoe dredger mounted on a spud-leg pontoon and loaded onto a hopper barge and deposited at Plymouth Deep. It was confirmed the capital dredge has been completed (Personal communication, December 2020).

3.4.5 River Yealm

No capital dredge works have been undertaken over the past six years.

3.5 Capital Disposal Returns

Data on dredging operations within the study area was obtained through consultation with Cefas, the DIO, the KHM Plymouth, Boskalis Westminster Dredging Company Ltd. and by direct contact with the civilian harbour authorities and marina operators.

A summary of capital dredge quantities over the past six years (2015 to 2020) are presented in **Table 3.6**, and the full data (dating back to 1985) is provided in **Appendix A3.3**.

Table 3.6 Capital dredging returns (wmt) for 2015 - 2020

Year	Quantity HMNB Devonport (wmt)	Description	Quantity CHC (wmt)	Description	Quantity Others (wmt)	Description
2015	-	-	8,165	Corporation Wharf, TSHD	-	-
2016	-	-	7,211	Corporation Wharf, TSHD	-	-
2017	-	-	-	-	-	-
2018	18,860	Thanckes OFD, TSHD	-	-	12,160*	Turnchapel Wharf, Backhoe
2019	-	-	-	-	-	-
2020	35,991	Thanckes OFD, Grab	-	-	-	-
Total 6 years	**54,851**	**-**	**15,376**	**-**	**12,160**	**-**

* No disposal returns available. Consented disposal volume provided for the purposes of this document.

Table 3.6 shows the total quantity of capital dredging material disposed of at licensed disposal sites over the last six years (2015 – 2020) is recorded at 82,387 wmt.

Appendix A3.4 provides a summary of historical capital dredge return data. The total amount of capital material disposed over historical periods has been presented in **Table 3.7**.

Table 3.7 Historical capital dredging disposal totals

Period	Total disposal quantity (wmt)	Average disposal quantity per annum (wmt)
1985 – 2000	1,784,456	111,529
2001 – 2005	602,218	120,444
2006 – 2010	48,400	9,680
2011 – 2015	95,992	19,198
2016 – 2020*	67,011	13,402

* Includes the Turnchapel Wharf estimated disposal volume not included in disposal returns (see **Table**).

3.6 Disposal Activities

The Waste (England and Wales) Regulations 2011 (as amended) sets out the Waste Hierarchy, a legal requirement for waste prevention and management in legislation and policy. The waste hierarchy requires the producer / holder of a waste to demonstrate that the priorities identified in **Table 3.8** have been considered in a priority order, to determine the most suitable waste management option for all wastes prior to removal from site.

Table 3.8 The Waste Hierarchy, definitions and relevant applications for dredged material

Waste Hierarchy	Definition*	Application for Dredge Material**
Prevention	Most favoured option. Using less material in design and manufacture. Keeping products for longer; re-use. Using less hazardous materials.	Not undertaking dredging activities unless necessary.
Preparing for re-use	Checking, cleaning, repairing, refurbishing, whole items or spare parts.	The re-use of dredged material refers to the potential to re-use dredged sediments as a sediment in a manner that will benefit society and the natural environment. Options include mid-river disposal, mudflat or beach re-charge schemes and habitat creation schemes.
Recycling	Turning waste into a new substance or product. Includes composting if it meets quality protocols.	The recycling of dredged material is the use of dredged sediments in the creation of a new substance or product (such as construction material).
Other recovery	Includes anaerobic digestion, incineration with energy recovery, gasification and pyrolysis which produce energy (fuels, heat and power) and materials from waste; some backfilling.	The treatment of sediment to be used for another purpose (i.e. processes to remove contamination). Some of these options are not considered viable for dredged material.
Disposal	Least favoured option. Landfill and incinerations without energy recovery.	Disposal to sea or landfill.

* Definitions taken from Defra (2011). Guidance on applying the Waste Hierarchy.
** Adapted from MMO (2020) and Manning *et al.* (2021)

Within the Plymouth Sound and estuaries area, dredged material has historically been disposed of at sea. Maintenance dredging activities are essential to maintain the depths within the operational berths and approaches within the area.

The Rame Head disposal site (PL030) was originally used, before moving to the slightly changed site location of Rame Head South (PL031). As noted in **Section 3.4.2**, the Lantic Bay (PL060) disposal site has also been used on one occasion. In March 2017, the new Plymouth Deep (PL035) dredged material disposal site was opened by the MMO following a full site characterisation. Since then, all disposal to sea of dredged material from the study area has been undertaken at this disposal site. A site characterisation report is available for this site and demonstrates that there will be no environmental impact on the surrounding designated sites as a result of disposal of material at this site (within the site capacity) (Cefas 2016, 2017a, 2017b, MMO 2017a, 2017b).

The presence of contaminants is typically one of the primary reasons why dredged material cannot be used beneficially for habitat restoration (Manning *et al.,* 2021). It is also recognised that there are currently very few examples of recovery from dredged material (such as biomass or energy recovery).

There has been no known re-use or re-cycling schemes for maintenance dredge material within the Plymouth Sound and estuaries area over the last six years. As noted in **Section 2.3**, KHM Plymouth chairs the TECF, a partnership of organisations and local authorities with statutory responsibility towards the management of the Plymouth Sound and Tamar Estuaries MPA. The Forum meets three times a year and there has been a standing agenda point for the review of potential beneficial use options within the area. No known options for beneficial use of dredged materials has been raised.

4 BASELINE ENVIRONMENT

This section describes the existing environmental conditions within the Plymouth Sound and estuaries area relevant to the designated sites. Current conditions within the site are set out along with any notable historical changes that have affects these conditions.

4.1 Coastal Processes and Geomorphology

To inform this Baseline Document, a review of recent data was undertaken. Between 2016 and 2020 there have been no major additional studies or large developments with supporting Environmental Impact Assessments (EIAs) which could further inform the understanding of the hydrodynamics and sedimentary regimes operating within Plymouth Sound and estuaries.

The following section summarises information concerning the hydrodynamics and sedimentary regimes which operate within Plymouth Sound and estuaries and influence the designated sites.

4.1.1 Geomorphology

Plymouth Sound and estuaries is located in the south-west of England, lying between the counties of Devon and Cornwall. Plymouth Sound is an open bay, with the inner section of the Sound protected by an artificial breakwater.

The geomorphological characteristics of the south-west coast between Start Point and Rame Head (the western bank of Plymouth Sound) are described in the Durlston to Rame Head Shoreline Management Plan 2 (SMP2) (South Devon and Dorset Coastal Advisory Group, 2011). The Plymouth Sound and estuaries is the largest estuary complex along the coastline and is described as a ria, a partially submerged river valley (South Devon and Dorset Coastal Advisory Group, 2011), which has been flooded as a result of rising sea levels since the Holocene marine transgression (circa 10,000 years BP). Four large rivers, the River Tamar, the River Tavy, the River Lynher and the River Plym, combine at Plymouth Sound, to form the mouth of the estuary complex. The River Yealm and Yealm Estuary also joins the southern extent of the Sound and there are also a number of smaller creeks and streams which discharge into the estuary complex.

The south-west coastline is characterised by long sections of cliffs, indented with numerous small coves and pocket beaches. These formations continue into the mouth of the estuary at Plymouth Sound, with low lying cliffs at Wembury, Bovisand and Cawsand (South Devon and Dorset Coastal Advisory Group, 2011). The cliffs and fronting wave platforms of the Sound are formed from resistant rock types, and the SMP2 noted that erosion of this coast over the past century has been negligible (South Devon and Dorset Coastal Advisory Group, 2011). The geology of the south-west region (and the varying resistance of the geology to erosion) is one of the biggest contributing factors to the geomorphological nature of the coastline.

The River Tamar extends approximately 34km from the weir at Gunnislake to the mouth of the estuary complex at Plymouth Sound. The geology surrounding the Tamar River predominantly consists of upper Devonian rocks, with lower Devonian rocks at the mouth of the estuary complex at Plymouth Sound (Thomas, 2001). To the north-west of Gunnislake, in the heart of the Tamar catchment area, Carboniferous rocks are dominant (Thomas, 2001).

4.1.2 Tidal regime

The duration of the ebb tidal flow in the estuary complex is longer than the duration of the flood, however flood tidal currents are significantly faster than ebb tidal currents (Debut, 2007). The tidal flow within the Plymouth Sound estuary complex is therefore considered to be flood dominant (Debut, 2007).

Tidal range within the estuary complex varies, with a larger tidal range upstream of the 'Narrows', in the central Tamar, and a decreasingly lower tidal range towards the head of the estuary at Gunnislake (Plymouth Marine Laboratory (PML), 2004). No tidal data for the Plymouth Sound area has been identified to inform this report, however tidal datums are predicted by the National Oceanography Centre (NOC) at the Royal Naval Dockyard, Devonport (immediately upstream of The Narrows).

Tidal datums at the HMNB Devonport are shown in **Table 4.1**. Maximum tidal ranges, calculated by taking the difference between the highest astronomical tide (HAT) and the lowest astronomical tide (LAT), are 5.91m at Devonport. With a maximum tidal range of over 4m the estuary complex can be described as macrotidal.

Table 4.1 Tidal range data (in metres) between 2008 to 2016 (NOC, 2016)

Location	Highest Astronomical Tide (HAT)	Mean High Water Springs (MHWS)	Mean High Water Neaps (MHWN)	Mean Low Water Neaps (MLWN)	Mean Low Water Springs (MLWS)	Lowest Astronomical Tide (LAT)	Maximum Tidal Range (HAT-LAT)
No. 1 Jetty, Royal Naval Dockyard	6.05m	5.53m	4.43m	2.23m	0.80m	0.14m	5.91

The tidal volume of the estuary, upstream of the Narrows, on a spring tide is approximately 78.5 million m^3 (Debut, 2007). Maximum peak tidal current velocities are experienced approximately 20km upstream of the Narrows, in the central Tamar (Debut, 2007). Timing of peak flood current velocity is progressively later with distance towards the head of the estuary (Debut, 2007).

4.1.3 Waves

The orientation of the Devon coast results in it being exposed to the full force of south-westerly waves originating from the Atlantic. This creates a high-energy environment along the open coast, where sediment deposits tend to only be retained in sheltered embayments (South Devon and Dorset Coastal Advisory Group, 2011).

Inside the estuary complex wave exposure (from the dominant south-westerly waves) is limited due to the protection afforded by Rame Head, the Plymouth Breakwater and Drake's Island. Waves within the estuaries are therefore largely limited to being locally wind generated (South Devon and Dorset Coastal Advisory Group, 2011).

The SMP2 does not identify information concerning the extent to which waves generated within Plymouth Sound affect the sub-estuaries (Cattewater, Lynher and Tamar). It is likely that any effects would be limited due to the narrow entrances to the Tamar and Plym. Within the Tamar there are few long fetches due to the morphology of the estuary (narrow and meandering), therefore only relatively small waves, generated by strong winds, are able to form (Debut, 2007).

4.1.4 Freshwater input

There are four main rivers which combine in the estuary complex. The source of freshwater inputs to the Sound are the Tamar (entering the Hamoaze in the north), Tavy and Lynher (entering the Hamoaze in the north-west), together with the Plym (entering Plymouth Sound via the Cattewater) and the River Yealm.

The dominant freshwater input into the Plymouth Sound comes from the Tamar River. In the Tamar flow velocities fluctuate between seasons with recorded monthly average flows of 5m³/s in June and 38m³/s in January, however instantaneous flow velocities can exceed 100m³/s (Marine Biological Association (MBA), 2003). It has a long-term mean flow of 23 m^3/s compared with an average flow of approximately 1 m^3/s from the River Plym (Uncles *et al.,* 2015). Although the dominant freshwater input into the estuary complex is from the Tamar, the Tavy and Lynher also contribute 30% and 20% respectively to the overall total via the Hamoaze (MBA, 2003).

4.1.5 Salinity, turbidity and mixing

Turbidity maximum is normally associated with the fresh / saltwater interface, but occasionally occurs further upstream. As a result of tidal pumping, there is a tendency for the turbidity maximum for the Tamar to be located towards its head during normal flow conditions, occurring in the low salinity upper reaches and characterised by fine sediment in suspension (50µm to 100µm particle diameter). During summer, the peak turbidity maximum is normally encountered close to Gunnislake Weir (0km to 10km downstream).

However, during periods of high river flow (predominantly in winter) fluvial discharge affects the fresh/saltwater interface and the turbidity maximum can move seawards. The position of the maximum is dependent on the relative strengths of fluvial discharge and tidal streams. In winter it moves down estuary between 15km to 25km from the weir. At the extreme 25km position, the turbidity maximum is located between Saltash Bridge (24km) and Weston Mill Lake (26km) (Debut, 2007).

4.1.6 Storm events

Storms and rainfall, when linked to greater than average tides, can result in the movement of large quantities of sediment within the Tamar and associated estuaries. This can result in up to 30,000m³ of sediment being redistributed within the estuary during a single event (PML, 2004). In PML's (2004) study to assess the impact of dredging activity within the Tamar, PML suggests that storm events within the estuary have more of an impact on resuspension of sediment than dredging activity undertaken within the estuary.

Observations from the PML L4 buoy, located within the English Channel outside of Plymouth Sound, during a time series collected from 2009 to 2015 indicate that background suspended sediment concentrations in the Sound are typically 1 mg/l, but during high suspended sediment events (either by storm resuspension or by river runoff) concentrations can exceed 25 mg/l for periods of 10 hours or more. The data set included a number of data artefacts including sensor saturation at 25 mg/l, biofouling and changes of sensor specification. Further results indicated that concentrations may be even higher for periods of time (Cefas, 2017a).

4.1.7 Sediment sources

The sediment load of the estuaries is strongly dependent on fluvial discharge, the freshwater inflow being the largest source of sediment. The sediments of the estuary system are dominated by fine mud and silt, although there are some sand and shingle areas at the river outfalls into the Sound. The deposited intertidal and suspended sediment of the Tamar consists of cohesive silt and clay mixtures (Debut, 2007). As a result of this mud dominated system, there are extensive areas of mud flats in the three contributing sub estuaries.

These tend to be within the middle and upper estuaries and associated tributaries (i.e. St John's Lake in the Tamar).

Previous hydrodynamic and geomorphological studies of the Plymouth Sound and estuaries complex have suggested that that there is a net loss of sediment over time (PML, 2004). However, comparison of navigational charts between 1895 and the present day (2004) showed that there had been no significant changes in the aerial extent of inter-tidal mud although there was clear deepening of navigational channels.

Analysis of historic data by the SMP2 indicated that there is *"very little sediment exchange between the Plymouth estuary system and the open sea" (*South Devon and Dorset Coastal Advisory Group, 2011). Uncles *et al.* (2015) concluded that concentrations of suspended particulate matter (SPM) within the Sound were low (<10 mg/l) but that the SPM is mainly derived from Tamar estuarine waters. It was noted that times of high freshwater run-off (i.e. storm events) would lead to much greater SPM concentrations in the Sound as the Tamar Estuary flushes fresh water and high sediment loads into it.

Given the low SPM values associated with freshwater input from Tamar estuarine waters, it is considered likely that sediment remains within the estuaries and is gradually reworked, unless removed by dredging activity. However, there is expected to be the removal of larger volumes of sediment associated with storm events (see **Section 4.1.6**).

Siltation within the Tamar Estuary appears to be dependent upon different hydrodynamic actions in different parts of the estuary, including:

- **Deposition of fluvial sediments originating from the upper Tamar** – this is a continual process in areas where there is a reduction in flow velocity caused by localised deepening or widening of the channel. It is variable depending upon the amount of river discharge, i.e. sediment load. This process affects all areas (including Ernesettle Jetty, Yonderberry Jetty, riverside wharf dredge boxes and off river basins).
- **Deposition of marine sediments** – marine sediments, of a similar nature to the fluvial sediments, are present within the Tamar. However, they appear to be in significantly lower concentrations. Marine sediments are transported by tidal action and deposited in still water. There is the likelihood that marine sediments will be a relatively significant source of siltation to off-river tidal basins, where the contribution of fluvial sediment is smaller; and
- **The position of the estuary turbidity maximum** – (see **Section 4.1.6**).

4.1.8 Sediment transport

The south-westerly wave dominated coast tends to give rise to a potential eastward transport of sediment along the south Devon coast. However, there is a lack of sediment in the coastal system due to retention in sheltered embayments between headlands (e.g. such as Plymouth Sound).

Within the Tamar Estuary there appears to be a dynamic and cyclical suspended sediment transport system. Previous studies of seasonal sediment movement and fluxes of suspended solids indicate that during normal flow conditions there is a net transport of sediment towards the head of the Tamar Estuary by tidal pumping. However, this is modified by seasonal flow conditions leading to movement of the turbidity maximum (see **Section 4.1.6**). Whilst during normal conditions sediment accumulates at the head of the estuary, the movement of the turbidity maximum seaward during high flow can result in recharging of sediment into the mid estuary region (MBA, 2003).

A key finding of previous work is that there is a net seaward flux of sediment in the lower Tamar Estuary, whilst in the upper estuary the net flux is upstream as a result of tidal pumping (Debut, 2007). Seasonal variation within the Tamar appears to give rise to changes in the estuary's bed sediments. In summer, silty, mobile sediment occurs on the bed of the main channel and mud banks within 1km of the weir at Gunnislake. These sediments are then encountered for several kilometres down estuary. Typical median particle size in these silty bed sediments is between 20µm to 30µm (Debut, 2007). Down estuary from the turbidity maximum to the mouth of the estuary, the surface sediment layer of the mud flats and mud banks become more consolidated. The silt and clay fraction of these sediments increases from the mouth of the estuary complex to the turbidity maxima near the head (60 to 99% of dry weight), however, there appears to be a large amount of local variability (Debut, 2007).

The Tamar is a macrotidal estuary which is subject to climatic and tidal variations which influence sediment transport. These variations can be on a daily to seasonal temporal scale. During the tidal cycle, re-suspended sediment (typically 5µm to 50µm in size) is transported to the head of the estuary by ebb-flood tidal asymmetry. The re-suspended sediment continuously accumulates in the upper estuary turbidity maximum zone (Debut, 2007). During winter conditions, fine sediment is found not to occur within 3km of the weir head at Gunnislake. However, mobile sediment is more abundant down estuary, varying from 50% silt at 3km from the weir, up to 90 to 95% at 13km (Debut, 2007). A sandy region with 30 to 50% silt content then occurs between 13 and 16km from the weir. Silt content then increases to about 80% near the mouth of the Tavy, before falling to approximately 60% at the Narrows. In areas of high silt content, water content tends to be approximately 70% by weight (Debut, 2007).

In winter, changes in flow conditions result in much of the accumulated sediment at the head of the estuary being flushed to recharge the mid-estuary (Debut, 2007). Variation in tidal currents (see **Section 4.1.5**) results in sediment rarely being eroded from the bed during neap tides. However, during spring tides, bed sediments become highly mobile. Spring tidal conditions are associated with the turbidity maximum in the low salinity region of the Tamar.

Further down the Tamar Estuary, tidal pumping causes a net movement of sediment seaward (Debut, 2007). It has previously been estimated (PML, 2004) that the seasonal cycle of freshwater flow causes 164,000m^3 of sediment to migrate up the estuary in summer during low flow conditions, and then move down estuary in winter as a result of high river flow conditions. This was calculated from the depth of the shoal which forms at the fresh / saltwater interface, which has been observed within 10km of Gunnislake Weir in the summer but between 10km and 20km of the weir in the winter.

4.1.9 Sediment budget

The sediment budget for an estuary is derived from inputs (sediment from river catchments, marine waters, primary production within the estuary, atmospheric depositions and leaf fall), outputs or losses to the coastal sea / marine system offshore, and additionally through human intervention (i.e. dredging). Without accurate data and real time measurements, the calculation of a sediment budget is highly subjective.

The Tamar sediment budget was calculated by PML in 2004. **Table 4.2** summarises the estimates used by PML and updates the estimate to include the disposal quantities in the Tamar between 2000 and 2020 (as presented in **Appendix 3.4**). Note that the potential for removal of sediment from the system by submersible pump and ploughing methods is not included in the disposal return data.

Table 4.2 Net change in both volume and mass of wet sediment per year derived from estimates of the various sediment sources and sinks (adapted from PML, 2004)*

Component	Estimated sediment volumes in m^3 (wet)		Estimated sediment in (wet) tonnes based on 1.45 tonnes per m^3	
	Lower Estimate	Upper Estimate	Lower Estimate	Upper Estimate
Fluvial sediment	75,000	153,000	108,750	221,850
Marine-derived	12,000	24,000	17,400	34,800
Biological production	5,000	9,000	7,250	13,050
Atmospheric dust	100	100	145	145
Leaf fall	7,000	30,000	10,150	43,500
Export	-4,000	-19,000	-5,800	-27,550
Total (excluding dredging data)	95,100	197,000	137,895	285,795
PML estimate of annual dredging removal (in 2004)	-145,000	-217,000	-210,250	-314,650
Net change based on PML dredging estimates	-49,900	-19,900	-72,355	-28,855
Capital and maintenance dredging returns average per year (2000 to 2020)	-84,761	-84,761	-122,903	-122,903
Net change based on dredging returns data (2000 to 2020)	**10,339**	**112,239**	**14,992**	**162,892**

* Inputs (sources) are positive and exports (sinks) negative. Upper and lower values are given in each category to illustrate the uncertainty in each estimate. Data taken from PML (2004) in m^3, then converted into wet tonnes using a calculation of 1.45 tonnes per m^3. Dredging returns average per year (2000 to 2020) has no upper and lower estimate as these are actual recorded volumes.

Most of the smaller numbers in **Table 4.2** are very approximate best estimates with the important comparison being between the estimated fluvial input and the dredging. Dredging quantities estimated by PML (2004) were calculated from Defra disposal licensing data for the period 1985 to 2003, ranging between zero and 700,000 tonnes (dry weight[1]) per annum, with typical values of 100,000 to 150,000 tonnes per annum. Average quantities per year for maintenance dredging returns are taken from records held by Cefas on behalf of the MMO, which are presented in full in **Appendix 3.3** of this document.

Much of the literature regarding the sediment budget of the Tamar Estuary complex suggests that the sediment regime is in balance, i.e. sediment inputs equal sediment removal through dredging plus natural

[1] *Sedimentation and maintenance dredging are variously referred to by wet or dry weight or by volume. For the purposes of licensing, the volume removed is usually measured as an in situ volume which is converted to a wet tonnage by a bulk density factor of 1.45 tonnes per m3 for silt. Sediment budgets often start from an estimate of the dry weight of the sediment particles which may have specific gravities in the range 2.2 to 2.7. If these settle out as a layer of mud which is 70% water, 30% solids (by volume) the bulk density is approximately 1.4 tonnes / m^3.*

export to sea (PML, 2004 and Debut, 2007). In comparison to the 2004 PML estimates, the estuary has seen a decrease in the overall average quantities of material being dredged, and therefore when these quantities are included within the sediment budget calculations, **Table 4.2** shows a net increase in sediment within the estuary system.

However, whilst mathematically the sediment budget calculations confirm the accretion of sediment, the overall amount is small enough for the system to be considered to be still in balance.

4.1.10 Bathymetric surveys

The study by PML in 2004 looked at the historic impact of dredging activity on intertidal habitat in the Plymouth Sound and estuaries (PML, 2004). The report focused on four key areas of the estuary: Cattewater, Plymouth Sound, Hamoaze and the Tamar River. As the focus was on the impact on the estuary habitat, the report did not look at bathymetry of the dockyard basins in HMNB Devonport or at Millbay and Sutton Harbours. The findings of this report were presented within the 2010 Baseline Document but are summarised again here.

This study found that historic patterns of capital and maintenance dredging of the channel areas appeared to have no long-term effect on the extent of intertidal mud in the estuary. The report suggests that widening and deepening of the channels and berths could lead to a small reduction in currents and therefore increased levels of sedimentation. It stated that channels may have an ‘equilibrium profile’ and that, if river discharges and tidal currents remain constant, sedimentation is enhanced until the channel reaches its former cross-sectional area (PML, 2004).

The report showed that over a 100-year period up until 2004 there had been approximately a 2% loss in area of intertidal habitat attributable to dockyard development and land reclamation. Deepening of the main channels and maintenance dredging activity had no detectable, long term effect on the area of intertidal habitat in the estuary.

The greatest maintenance dredging activity in the Plymouth Sound and estuaries area occurred during 2004, with total maintenance dredge disposal volumes for subsequent years fluctuating below that peak (see **Appendix 3.4**).

4.1.11 Anthropogenic influences

The volume of water in the estuary complex below the LAT has increased by approximately 4 million m³ over the last 100 years (PML, 2004). This includes Cattewater, Hamoaze, Plymouth Sound and the Tamar. This is considered to be due to capital dredging of the berths and navigational channels.

One of the most significant structures within the study area is the Plymouth Breakwater built in 1812. This provides shelter to the inner Sound from open water wave conditions. This in turn leads to a significant decrease in wave energy on the northern part of the Sound (South Devon and Dorset Coastal Advisory Group, 2011).

In addition, parts of the shoreline are defended by hard defence structures, such as those at: Plymouth City frontage, Mountbatten Point, Picklecomb Point, Cawsand and Kingsand (South Devon and Dorset Coastal Advisory Group, 2011).

The City of Plymouth, and associated historic land claims, dominate and restrict the mouth of the sub estuaries that enter the Sound, particularly with respect to the Tamar and the Plym. Further upstream along the River Tamar, on the western bank adjacent to National Trust Cotehele, work on a habitat creation

scheme to return approximately 1.5ha of farmland to floodplain was completed in September 2021. The project, led by a consortium of the National Trust, EA and NE, involved installing an embankment to protect the existing quay car park, excavating channels into the field and removing a 15m-length of the 19th century bank to allow river water to flood the area.

4.1.12 Sea level rise

The UK coastline is evolving due to changes over the last 10,000 years as a result of flooding to the North Sea Basin and Solent, following the Holocene marine transgression. There are also changes in land (isostatic) and sea (eustatic) levels as a result of the release of downward pressure following the retreat of ice (125,000 years BP). Thermal expansion of the sea, together with an increase in volume due to melting of ice at a global scale is also playing a part due to human induced climate change.

The UK Climate Projection (Met Office, 2018) predicts changes in relative sea level for coastal areas around the UK, where the influence of land movements are taken in to consideration. The projected sea level rise, with a high emissions scenario, for the period 2007 up to and including 2299 at the Plymouth Sound and estuaries is shown in **Figure 4.1**.

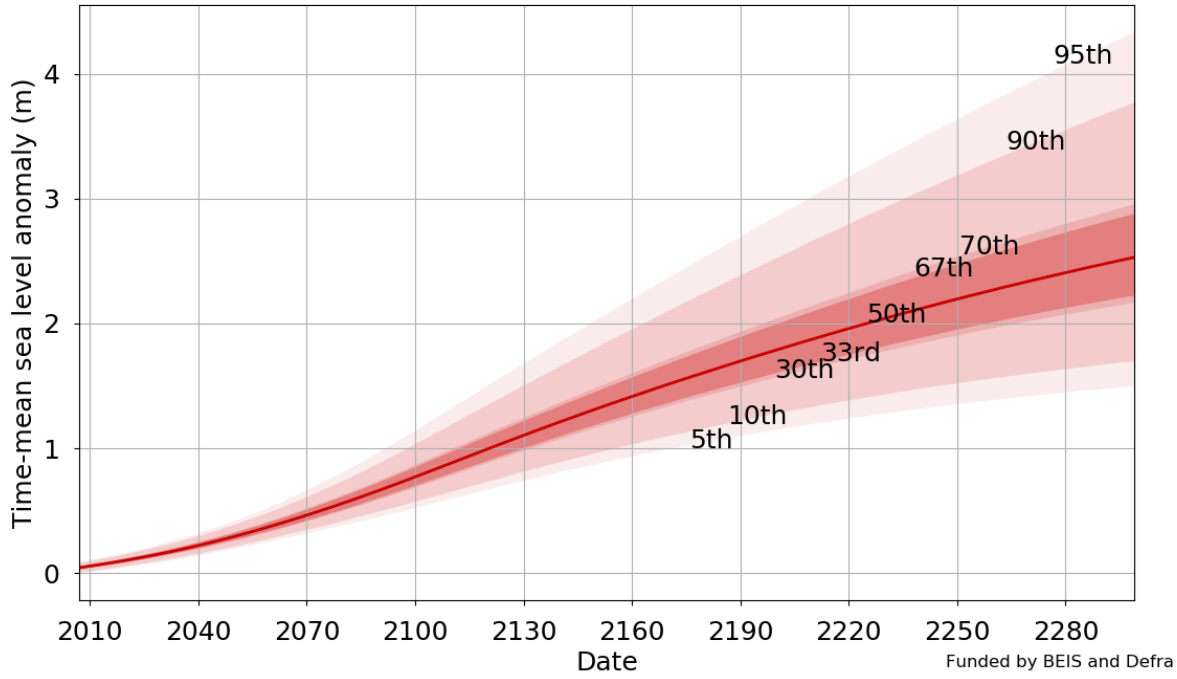


Figure 4.1 Relative sea level rise projections under a high emissions scenario (RCP 8.5) for Plymouth Sound and estuaries taken from UK Climate Projection 18 (Met Office, 2018)

4.2 Estuarine Habitats and Ecology

Plymouth Sound and the Tamar Estuary comprise a complex site of marine inlets. The high diversity of reef and sedimentary habitats and salinity conditions give rise to diverse communities that are representative of ria systems and some unusual features. The area is characterised by its extensive sublittoral sandbanks which are considered to be one of the best areas in the UK for this habitat. Extensive mudflats present throughout the area are a highly productive system, forming a critical part of the food chain. They contain extensive and varied infaunal communities, rich in bivalves and other invertebrates.

Rare communities of slender sea pens (*Virgularia mirabilis*) are found in the subtidal muddy habitats north of the breakwater, which is uncommon in the south of the UK. Nationally scarce fan mussels (*Atrina fragilis*) have been recorded in the sediment around Plymouth Hoe and on the Yealm Estuary at Cofflete Creek the nationally scarce tentacled lagoon worm (*Alkmaria romijni*) has been recorded. Hard substrate in the form of rocky reefs contributes to the uniqueness of the area and supports a range of nationally scarce species such as the pink sea fan (*Eunicella verrucosa*) and species rich intertidal reef communities (NE, 2017a).

4.2.1 Intertidal habitats and ecology

Cattewater

The Cattewater area, from Cattewater to West Hoe, has been significantly developed and there is now very little natural coastline remaining. The natural line of the rocks is interspersed with artificially built concrete walls and quays and steps leading down to the foreshore. Littoral and sublittoral limestone reefs which descend steeply to the water extend along the northern shore from West Hoe to Batten Bay. These rocks are broken and fissured and have been extensively bored by *Hiatella arctica* (bivalve) and *Polydora* spp (spionid worms) leaving a pitted surface which provides habitat for a rich array of fauna including the *Dendrodoa grossularia* (gooseberry sea squirt) which favours crevices and overhangs (Langston *et al*., 2003). Pebbles and boulders are present in coves and channels (Evans, 1947). Due to the distance from Plymouth Breakwater the shoreline is exposed to heavy wave action in southerly winds.

Plymouth Sound

The entrance to Plymouth Sound is a wide rocky inlet with the Yealm joining from the east at Wembury Bay to meet the rias of the rivers Tavy, Tamar and Lynher. The Yealm is a large shallow inlet, its sheltered waters providing excellent habitat for communities of sponges and worms on the mixed sediments of the lower shore.

In Cawsand Bay in the west of the Sound the slope of the beach is fairly even and gravel and shingles are present in pools and gullies (Evans, 1947). The east of Plymouth Sound is comprised of boulders and small loose masses from the cliff face. The coastline here is exposed to strong wave actions and the rocky shores include exposed limpet and barnacle dominated communities, deep sheltered gullies in which red seaweed communities are prominent. Also present are sheltered rock pools which vary from very deep pools with kelp to shallow pools dominated by corraline seaweeds such *Furcellaria lumbricalis* (red seaweed), *Bifurcaria bifurcata* (brown seaweed) and the invasive Japanese wireweed *Sargassum muticum*.

Hamoaze

The western shore of the Hamoaze, including St John's Lake and the Lynher Estuary, has extensive mudflats which are exposed at low tide. Whilst much of this is bare mudflat there are also large areas which are covered by *Enteromorpha* (green alga). In this area eel grass beds exist comprised mainly of the narrow leaved eelgrass, *Zostera angustifolia,* as well as the locally distributed dwarf eelgrass, *Zostera noltii*. In this area there are small patches of species-rich saltmarsh which are dominated by common cord grass, *Spartina anglica.* Of note is the occurrence of sea purslane, *Halimione portulacoides,* a small grey shrub which is rare in this region. The area is fringed by shingle beaches and shallow rock cliffs which support stunted trees and scrub.

In contrast the eastern shore of the Hamoaze is dominated by seawalls and quays which are interspersed by small areas of mudflat and sandbanks.

River Tamar

The upper reaches of the Tamar Estuary complex provide sheltered mudflat, saltmarsh and reef habitats which experience a diversity of salinity and tidal exposures. This diverse estuarine environment supports a number of features of ecological importance including coarse sediments on the shore and biogenic reefs

formed by the blue mussel, *Mytilus edulis* (NE, 2019a) which are protected as features within the Tamar Estuary Sites MCZ. These living reefs are ecologically important as they provide a home or refuge for seaweeds and animals including barnacles, winkles and small crabs. The mudflats support invertebrate communities including moderately species-rich polychaete worm communities. The rocky shore of the River Tamar is of high value for the marine life that it supports. Dense populations of the *Cordylophora lacustris* (hydroid), a species of national importance, are recorded in the sublittoral zone.

Glauco-Puccinellietalia maritimae (Atlantic salt meadows) are found throughout the estuary complex with the gradual salinity gradient resulting in a natural transition to brackish and freshwater communities, including reedbeds which are found in the upper reaches of the Tamar. Atlantic salt meadows are one of the features of the Plymouth Sound and Estuaries SAC. The most extensive marsh in the estuary is Egypt Saltmarsh, located on the eastern bank of the Tamar approximately mid-way up the estuary (Widdows *et al.,* 2007).

Saltmarsh occurs as far upstream as Cotehele Quay and is typically dominated by the common saltmarsh-grass, red fescue (*Festuca rubra)* and *Elymus pycanthus* (sea couch). Two nationally scarce species of grass are known from the site: stiff saltmarsh-grass, *Puccinellia rupestris,* and bulbous fox-tail, *Alopecurus bulbosus.* This habitat also supports the only UK population of *Schoenoplectus triqueter* (triangular club-rush). The locally common parsley *Oenanthe lachenalii* (water-dropwort) is also found in some areas, and there are stands of sea-purslane, which is unusual in Cornwall.

The benthic macrofauna of the Tamar Estuary show a distinctive salinity driven gradient in distribution and community structure along the estuary (Widdows *et al.,* 2007). The extensive intertidal mudflats are characterised by deposit feeding communities which are dominated by the main macrofaunal species including polychaetes *Hediste diversicolor* (ragworm), *Nephtys hombergii* (catworm) and *Arenicola marina* (lugworm), and the bivalve mollusc *Scrobicularia plana*. The intertidal mudflats provide an important feeding ground for overwintering birds.

4.2.2 Subtidal habitats and ecology

Cattewater

The sublittoral extent of the limestone reefs which stretch along the northern shore are dominated by a dense hydroid and bryozoan turf with anemones and ascidians. Small patches are dominated by kelp, in particular an area off Batten Bay where the species *Laminaria ochroleuca* is found (Hiscock and Moore, 1986) together with the rare sea slug *Okenia elegans* and trumpet anemone *Aiptasia mutabilis.*

At West Hoe a nationally scarce species, the fan mussel *A. fragilis* was found to exist in close proximity to the shipping lane (Marine Conservation Society, 2004).

Plymouth Sound

The characteristic sandbank communities extend to the subtidal zone with the primary area within the estuary being situated at the mouth of the Yealm which is notable for its extensive eelgrass beds. Areas of sand not colonised by eelgrass have a particularly diverse community of burrowing species. Epifauna include the sea potato *Echinocardium cordatum*, razor shells *Ensis ensis*, the netted dogwhelk *Hinia reticulata* and gobies *Pomatoschistus* spp.

Habitats within the Sound support a diverse range of species, many of which are typical to southern Mediterranean-Atlantic conditions, including *Hoplangia durotrix* (carpet coral) which favours rocky reefs in the shallow sublittoral zone.

The artificial breakwater lying across the entrance to Plymouth Sound composed of limestone blocks, shelters the harbour from wave action. The southern face of the breakwater is particularly species rich with abundant dead man's fingers *Alcyonium digitatum*, bryozoa and a variety of erect hydroids (Langston *et al.,* 2003). In comparison the northern, more sheltered side of the breakwater supports subtidal mud communities and has a particularly high biomass of organisms such as the angular crab *Goneplax rhomboides*. The anemone *Edwardsia claparedii*, brittlestars *Ophiura* spp., the opisthobranch mollusc *Philine aperta* and sea pen *V. mirabilis* are also recorded in this location (Moore *et al*., 1999). Other species of interest are the large burrowing shrimps *Callianassa subterranea*, *Upogebia delturna* and *U. Stellata* (Reay, 1998).

Kelp forests in the outer Sound are found on infralittoral reefs and in contrast to the more sheltered waters around Batten Bay are dominated by *Laminaria hyperborea*.

Hamoaze

The Hamoaze and Lynher Estuary are characterised by soft subtidal sediments with some areas of subtidal rocky reef which support small areas of kelp forest within the Hamoaze and small areas of biogenic blue mussel reef in the Lynher Estuary which are included as features of the Tamar Estuary Sites MCZ.

River Tamar

In the upper reaches of the estuary rocky reefs are found, an unusual habitat given the low salinity conditions, but one that is of high value for the marine life that it supports. Rocky reefs are an important habitat being dominated by numerous species including fragile and rare species of soft corals, sea fans, anemones, sponges, bryozoans and hydroids including dense populations of the hydroid *Cordylophora caspia*. Large erect sponges are known to occur in the hard substrata surrounding the Royal Albert Bridge (to the north of the Hamoaze). Blue mussel beds and native oyster (*Ostrea edulis*) have been recorded in the Tamar and are included as features of the Tamar Estuary Sites MCZ.

4.3 Migratory Fish

There are a number of migratory fish species which pass through the Plymouth Sound and estuaries area. These species and the relevant designations are summarised in **Table 4.3**. Relevant migratory periods outlined for the identified species using the River Tamar and River Plym for migration has been outlined in **Table 4.4** and **Table 4.5** respectively. A summary of the current marine licence conditions relating to seasonal restrictions to avoid impact on migratory fish is presented in **Appendix A4.1**.

Table 4.3 Migratory fish species present in the Plymouth Sound and estuaries area

Species	Designation
Allis shad (*Alosa alosa*)	Qualifying feature of the Plymouth Sound and Estuaries SAC Species of Principal Importance (Natural Environment and Rural Communities (NERC) Act 2006) UK Biodiversity Action Plan (BAP) Priority Species
Atlantic salmon	Qualifying feature of the Dartmoor SAC Species of Principal Importance (NERC Act 2006)
Sea trout (*Salmo trutta*)	Species of Principal Importance (NERC Act 2006)
European smelt (*Osmerus eperlanus*)	Designated feature of the Tamar Estuary Sites MCZ Species of Principal Importance (NERC Act 2006) UK BAP Priority Species
European eel (*Anguilla anguilla*)	Species of Principal Importance (NERC Act, 2006)

Species	Designation
	UK BAP Priority Species IUCN Red List 'critically endangered' The Eels (England and Wales) Regulations 2009
River and sea lamprey (*Lampetra fluviatilis* and *Petromyzon marinus*)	UK BAP Priority Species
Twaite shad (*Alosa fallax*)	Species of Principal Importance (NERC Act, 2006), UK BAP Priority Species

Table 4.4 Movements of migratory fish species in the River Tamar (Purple: migratory periods and other behaviour within the designated sites as a whole, based on NE's Advice on Seasonality; Blue: migratory periods for the estuary provided by historical consultation with NE and EA, peak months marked with **P**)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
River Tamar												
Allis shad (upstream)												
Allis shad (upstream)					P	P						
Allis shad (spawning, freshwater)												
Allis shad (downstream)												
Allis shad (estuarine feeding)												
Atlantic salmon (upstream)						P	P	P	P	P		
Atlantic salmon (downstream)												
Sea trout (upstream)					P	P	P					
Sea trout (downstream – smolts)												
Sea trout (downstream – kelts)												
European smelt (upstream)												
European smelt (spawning, freshwater)												
European smelt (downstream, adults)												
European smelt (downstream, juveniles)												
European eel (downstream)												
European eel (upstream)												
River and sea lamprey												
Twaite shad					P	P						

Table 4.5 Movements of migratory fish species in the River Plym (Purple: migratory periods and other behaviour within the estuary, based on historical consultation with NE and EA; Blue: migratory periods for the estuary based on more recent consultation with NE and EA, peak months marked with **P**)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
River Plym												
Atlantic salmon (upstream)												
Atlantic salmon (upstream)										P	P	P
Atlantic salmon (downstream)												
Atlantic salmon (downstream)				P	P							

4.3.1 Atlantic salmon and sea trout

Estuaries are important habitats for ocean and river migrating salmon and sea trout. The Tamar is one of the premier salmon rivers in the West Country. Atlantic salmon and sea trout are diadromous, spawning in freshwater and feeding at sea.

Adult Atlantic salmon predominantly return to spawn in the river in which they spent their juvenile lives, a process known as 'homing'. The adult salmon find their way back to the spawning grounds using their sense of smell (olfaction). Smell plays an important role throughout the life of salmon, with adults identifying their home river through imprinting to the smell of the river during their migration to sea at the smolt stage.

The homing behaviour of the fish effectively isolate each population from each other, although some gene exchange can take place when fish 'stray' into another river and spawn there. As each river catchment presents different conditions, consideration of migratory periods for salmonids in the region must be undertaken by river rather than as one population.

Within the Plymouth Sound and estuaries area, Atlantic salmon are designated as part of Dartmoor SAC, and salmon use the River Plym to migrate. However, the Tamar has also recorded a different population of salmon who migrate up to Gunnislake Weir where their migratory route is blocked.

River Tamar

Since the 1970's and early 1980's, there has been a decline in commercially and ecologically important fish species, e.g. salmon and sea trout caught in the Tamar. This situation is similar to other rivers within the region, such as the Exe and Taw (EA, 2019b).

There are many factors which can influence the survival of the life-stages of salmon and trout populations. Some factors include siltation of eggs and fry, industry, changes in the wider environment, milder climates and deterioration of water quality. Concern about the rapidly declining numbers led to a complete ban on net fishing between 2004 and 2014.

The EA undertake regular monitoring of salmon and sea trout stocks in the Tamar as part of the Tamar Salmon and Sea Trout Index River Monitoring. The most recent report was released in November 2020, reporting on monitoring undertaken in 2019. In 2019, the estimated salmon run (sea to freshwater migration) was below the current 10-year average although river flows between May and August were very low compared to the 10-year average which may have delayed the start of the main run (EA, 2020).

Monitoring data is reported for one sea-winter salmon (1SW), (salmon that reach maturity after one year at sea, returning to their river in summer), and multi-sea winter (MSW) salmon (salmon that reach maturity

after two or more years at sea). In 2019 in the Tamar (EA, 2020), a review of data between 2004 and 2009 identified a trend of 1SW salmon returning earlier in the year. The report concluded the 1SW migratory peak has changed from August to October to June to July. MSW salmon tend to return much earlier in the year (their peak is between May to July).

For sea trout, the EA reported (EA, 2020) that large sea trout (fish that have spent one or more winters at sea) had declined on the Tamar and since 2015, large sea trout had reduced from approximately one third to one fifth of the total sea trout run. The 2019 sea trout run was 22% below the 10-year series average.

Atlantic salmon are known to migrate upstream between April and December, with peak numbers between June and October. Downstream migration is undertaken between April to June.

River Plym

Atlantic salmon migrate through the Plym Estuary and up to Dartmoor SAC. Atlantic salmon on the Plym have a later migratory run and are known to migrate upstream between June and January, with peak numbers between September and January. Downstream migration is undertaken between March and May with peak numbers in April and May.

Whilst no data is available, a salmon spawning stock assessment completed in 2016 (undertaken to inform the implementation of the Salmon and Sea trout bylaws) classified Atlantic salmon within the River Plym as “At Risk” and predicted the Plym would remain classified as ‘At Risk’ up to 2021. However, as a result of the 2017 stock assessment a 2022 classification of ‘Probably at Risk – Improvement’ is predicted (EA, 2018a).

No salmon monitoring data is publicly available for the River Plym. A request for information from the EA confirmed that there is no routine fish monitoring programme undertaken in the River Plym. The salmon migratory data provided in **Table 4.5** are based on consultation responses from the EA and NE regarding marine licence applications from dredging operators undertaking works within the estuaries.

Some publicly available data has been found through the reporting of rod-caught salmon for the Plym – this has been included for completion (see **Table 4.6**). However, it should be noted that rod-caught salmon statistics represent data for the whole of the Plym and statistics are not considered in relation to effort and consistency in reporting. On the Plym the salmon closed season is currently from the 16th December to 31st March. No monthly catch data is provided past 2017.

Table 4.6 Monthly rod-caught salmon catch returns for the River Plym between 2010 and 2020 (EA Salmonid and freshwater fisheries statistics) Grey denotes the closed season

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	-	-	-	-	-	-	-	-	2	1	12	3
2011	-	-	-	-	-	-	-	3	4	3	9	12
2012	-	-	-	-	-	1	-	1	1	4	5	2
2013	-	-	-	-	-	-	-	-	-	4	4	-
2014	-	-	-	-	1	1	-	-	-	3	3	3
2015	-	-	-	-	-	-	-	-	-	2	5	1
2016	-	-	-	-	-	-	-	-	1	-	1	-
2017	-	-	-	-	-	-	1	-	2	1	3	1
2018	-	-	-	-	-	-	-	-	-	2	1	2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	-	-	-	-	-	-	-	1	-	3	1	-
2020	-	-	-	-	-	-	-	1	-	6	4	1

4.3.2 Allis shad

The River Tamar is the only river in the UK where allis shad are known to spawn and it is a protected species of the Plymouth Sound and Estuaries SAC. Allis shad naturally spawn in freshwater, many kilometres from the tidal limit however, on the Tamar the spawning area is in the tidal reach downstream of Gunnislake Weir. Whilst wider migration takes place between April and July, the species is known to migrate into the estuary in early summer, between April and May (Maitland and Hatton-Ellis, 2003).

Allis shad juveniles are understood to remain in fresh and / or estuarine waters (i.e. at the tidal limit) during the summer, migrating into the estuary in the autumn and into the sea the following spring (Aprahamian *et al.,* 1998). During their time in the estuary juveniles tend to be found at the surface and close inshore. A proportion of the juvenile population may remain in the river or estuary for a second year (Aprahamian *et al.,* 2003).

A monitoring report on Allis shad and smelt in the Tamar was published by the MBA and the EA (Cotterell and Hillman, 2016). This report presented the findings from a monitoring study undertaken by the MBA and EA in 2015 to investigate the distribution of these two species within the upper Tamar Estuary and River and upper Lynher Estuary and River. The report found that only one area of the upper Tamar Estuary, at Cottage Run, appeared to be used for Allis shad spawning and that adult shad were primarily recorded by anglers between Gunnislake Weir Pool and Lower Cottage Run which are upstream and downstream of the spawning site respectively.

In 2019 Allis shad spawning was observed from mid-May until early August, predominantly in the tidal freshwater reaches of the Tamar (likely blocked from further upstream migration by Gunnislake Weir) (EA, 2020). Based upon sampling results between 28th May 2019 and 3rd July 2019, spawning took place in the River Tamar (lowest spawning sites are in the upper tidal reaches) within a minimum of two estimated periods: 28th May to 4th June 2019 and 15th to 20th June 2019. An Allis shad was caught in Gunnislake Fish Trap on 31st May 2019, which supports these estimated timings (Hillman, 2020).

Hillman (2020) also suggested that Allis shad require warm water temperatures for spawning (above 16 to 18 degrees) which on the Tamar tend not to be present until late June and July.

It is concluded that Allis shad during their upstream migration are likely to be present within the Tamar Estuary between April and May. Allis shad juveniles undertake estuarine feeding and downstream migration throughout the year but will tend to be found close inshore

4.3.3 Smelt

The River Tamar is also an important estuary for breeding smelt and the species is protected within the Tamar Estuary MCZ (Maitland, 2003a and Velterop, 2013).

Smelt are known to spawn around the tidal limit at Gunnislake Weir, which is currently the only recorded spawning location in the south west of England. Large numbers of adults have been recorded migrating to and spawning in this area (Maitland, 2003a and Velterop, 2013). The habitats just below Gunnislake Weir include sections of clean gravel essential for successful development of the larvae. Threats to smelt populations include pollution and overfishing. Smelt are also threatened by the loss of their habitat,

especially spawning grounds, which may be destroyed by silting or construction. In the River Tamar, it is assumed that they are also prevented from migrating further upstream by Gunnislake Weir (Cotterell and Hillman, 2016).

Smelt are thought to form large shoals in the lower reaches of estuaries in winter before ascending to spawn in spring (NE, 2017b) however there is very limited evidence on smelt migratory behaviour available. Adult smelt were recorded in the upper estuary during the spawning season and appeared to congregate in the middle estuary (upstream of Cargreen) in Spring prior to spawning and they were not recorded within the lower estuary (Cotterell and Hillman, 2016).

Further surveys have since been undertaken by the EA and MBA in 2017 and 2018, funded by NE, to identify smelt spawning areas in the Upper Tamar Estuary. In both years large numbers of smelt eggs were observed in mid to late February. The monitoring reported that the data provided a good understanding of the locations where smelt spawn in the Tamar Estuary Sites MCZ (although this information does not appear to be publicly available), as well as providing information on the environmental conditions required by smelt for spawning (EA, 2018b).

Smelt surveys by the EA on behalf of NE took place on the Tamar Estuary in 2018 to determine the timing and distribution of spawning sites. In February 2018, smelt eggs were found at the lower end of Cottage Run. Additionally, fyke net trapping on the 22nd and 23rd of February 2018 trapped 46 adult smelt, of which 85% were male. Previous research in Scotland indicates as the spawning run progresses there is a shift towards male-dominance in the later stages of the run. This therefore suggests that the smelt run was in its later stages by the end of February in 2018 (EA, 2019a).

Monitoring in 2020 was reduced due to high river flows, but evidence suggested that smelt had spawned between February and early March (EA, 2020).

It is therefore concluded that smelt are likely to have passed through the Tamar Estuary by February.

4.3.4 Other species

The River Tamar also supports European eel, river and sea lamprey and Twaite shad but not at levels of conservation importance. All species will migrate up-river to spawn in brackish or freshwater, and juvenile fish will migrate downriver to mature in the open sea. The presence of these species in the Tamar Estuary, particularly the sea lamprey, indicates that the Tamar provides a healthy river environment as they are sensitive to pollution (Maitland, 2003b).

4.4 Ornithology

The Tamar Estuaries Complex SPA was designated in June 1997. It qualifies as a SPA under Article 4.1 for supporting 18.5% of the British population of avocet *Recurvirostra avosetta* over winter and at least 9.3% of the British population of migrating little egret *Egretta garzetta.*

As discussed in **Section 4.2** extensive intertidal mudflats of the estuary system have diverse infaunal communities rich in bivalves and other invertebrates which provide feeding grounds for waterbirds in numbers of international importance.

Table 4.7 sets out the most up to date population data for the qualifying species of the SPA in comparison to the population at designation. This information has been taken from British Trust for Ornithology data (BTO) on populations of nationally and internationally important species of birds under the EU Birds Directive that use the Tamar Estuaries Complex SPA (Frost *et al*, 2021).

Table 4.7 WeBS high tide counts, for Tamar Estuary complex

Features	Population at designation (English Nature, 1996)	Population (5-year peak mean 2010/11 – 2014/15)	Population (5-year peak mean 2015/16 – 2019/20)
Avocet (*Recurvirostra avosetta*) – non-breeding	194 (5-year peak mean 1990/91 to 1993/94)	323	241
Little egret (*Egretta garzetta*)	102 (peak count in 1995)	83	83

4.4.1 Avocet

The avocet is an Annex I waterfowl species for which the Tamar Estuaries Complex SPA is designated. Numbers of avocet at this site vary considerably year to year. The five-year mean peak for the most recent period shows an increase in numbers from that at designation and the annual data on the BTO data shows fluctuations from 200 to over 400 across the most recent wintering periods (Frost *et al.*, 2021). This species is found in the upper reaches of the Tamar Estuary where it is known to feed on insects, crustaceans and occasionally small fish.

4.4.2 Little egret

The little egret is an Annex I waterfowl species for which the Tamar Estuaries Complex SPA is designated as it supports more than 1% of the national population in the non-breeding season. Prior to designation numbers of little egret peaked at 102 in 1995 which was more than 20% of the British population. Whilst overall numbers of little egret in Britain have increased, numbers in the Tamar Estuary Complex have remained relatively steady at between 70 and 100. A decline to 58 was seen in the 2012/13 winter which reduces the five-year peak mean to a low 77 for the period 2009/10 to 2013/14, however numbers for the most recent five-year period show a recovery (**Table 4.7**) (Frost *et al*., 2021). Small numbers of little egret are now present year-round however nationally important numbers of individuals are only recorded in autumn and spring.

Little egrets use all areas of the site and are particularly dispersed during feeding and at high tide roost. They feed in saltmarsh throughout the complex as well as in areas of muddy sediment covered by shallow water. Evening and overnight roosts can be located at considerable distances from the feeding grounds. Important roost sites in the area include Sheviock Wood, Kingsmill Lake and Drake's Island (Devon Birdwatching and Preservation Society, 2010). Little egrets are present year-round and breed in the area surrounding the site in the summer. Whilst not designated for the breeding season impacts to the local breeding populations are likely to affect the over-wintering population, many of which are the same individuals, so should be considered in plans or projects.

4.4.3 Other species

In addition to supporting these two Annex I species, the Tamar Estuary Complex SPA is of national importance for its wintering populations of around 6,000 wildfowl and 10,000 waders. The upper estuary regularly supports black-tailed godwit, *Limosa limosa*, in winter in numbers up to 180, 4% of the British wintering population (Frost, *et al.*, 2020). Other waders which feed on the productive mud flats particularly in the west of the complex include dunlin, *Calidris alpina*, curlew*, Numenius arquata,* oystercatchers, *Haematopus ostralegus*, and redshank, *Tringa totanus*. There is also a large gull roost of black-headed gulls, *Chroicocephalus ridibundus.*

The upper reaches of the Tamar Estuary support whimbrel, *Numenius phaeopus*, greenshank, *Tringa nebularia*, spotted redshank, *Tringa erythropus*, and green sandpiper, *Tringa ochropus*, all uncommon wintering species in Britain, together with large numbers of golden plover, *Pluvialis apricaria* (an Annex I species). Further south, the St John's Lake area west of Hamoaze supports; widgeon, *Anas penelope,* mute swan, *Cygnus olor*, Brent goose, *Branta bernicla*, shelduck, *Tadorna tadorna*, and teal, *Anas crecca.*

Analysis of 10 bird species in the Tamar Estuary undertaken by PML (2004) found that numbers were being 'generally maintained' with the exception of widgeon, which had declined since the 1980's. BTO data gathered more recently generally supports this assessment with populations of assemblage species (with some in-year variations) being maintained at a similar average over the past 10 years, with the exception of dunlin numbers of which have decreased by half over the last five-year period (Frost *et al*., 2020).

4.5 Sediment Quality

4.5.1 Overview

The catchments which drain into Plymouth Sound have a long history of human activity. This includes mining, agriculture, industry, ship building and more recently urbanisation. This activity can lead to contamination of sediments within the estuaries, and the Sound.

In order to determine the significance of the levels of contaminants found within the sediment, chemical sediment analysis is required. In the UK, if material is being considered for disposal at sea, results are compared with the Action Level system developed by Cefas under the FEPA (1985) licensing process, and since formalised in the OSPAR Convention Guidelines for disposal of dredged material at sea (OSPAR, 2014).

Action Levels are not statutory contamination concentrations but are used as part of a 'weight of evidence' approach adopted for determining licences for the disposal of dredged material at sea. Action Levels are provided for comparison in **Table 4.8**. These values are likely to be used in conjunction with a range of other assessment methodologies (e.g. comparison with historic data, knowledge of site environmental conditions, physical characteristics of disposal material, and possibly bioassays).

Action Levels are therefore not a single pass or fail criteria but can provide a trigger for additional assessment. In general, contaminant levels in dredged material that are below Action Level 1 (AL1) are unlikely to influence a licensing decision. In contrast, contamination levels above Action Level 2 (AL2) are generally considered unsuitable for disposal at sea, and as a result may require comparative risk assessment and consideration under other waste streams and related licensing and regulation. Contaminant levels between AL1 and AL2 require further consideration and testing before a decision can be made.

Table 4.8 Cefas Action Levels (mg/kg)

Contaminant	Cefas AL1	Cefas AL2
Arsenic	20	100
Cadmium	0.4	5
Chromium	40	400
Copper	40	400
Lead	50	500

Contaminant	Cefas AL1	Cefas AL2
Mercury	0.3	3
Nickel	20	200
Zinc	130	800
Organotins (tributyltin (TBT) and dibutylin (DBT))	0.1	1
Total Hydrocarbon Content (THC)	100	-
Polycyclic Aromatic Hydrocarbons (PAHs)	0.1	-
Polychlorinated Biphenyls (PCBs) ICES 7 congeners	0.01	-
PCBs ICES 25 congeners	0.02	0.2

The majority of the data regarding levels of contaminants within Plymouth Sound and estuaries has been obtained from the MMO's public register.

The geographical areas considered with regards to sediment quality are the same as those areas outlined in **Section 2.2** (see **Figure 2.1**) as follows:

- River Tamar.
- Hamoaze and St. John's Lake (including the Dockyard).
- River Plym; and
- Plymouth Sound.

A summary of the publicly available sediment data results in each area has been provided in **Appendix A4.2**, providing the following data for each location for each year that data is available.

- Min: The minimum value for a given contaminant found within a general area.
- Max: The maximum value for a given contaminant found within a general area.
- Ave: Average value (mean) for the range of values for a given contaminant within a general area.

No publicly available data has been identified for the following areas (see **Figure 2.1**):

- River Tavy.
- River Lynher; and
- River Yealm.

4.5.2 Heavy metals

Concentrations of arsenic (As) within sediment are strongly influenced by the metaliferous geology of the river catchments which drain into the site, particularly in respect to the Tamar, Tavy and Lynher (MBA, 2003). As a result, background As concentrations in the sediments of the Plymouth Sound and estuaries are elevated. The historic legacy of mining and processing in the river catchments contributes to this. However, these concentrations are an order of magnitude lower than other historic mining areas, such as the Fal and Hayle in Cornwall (MBA, 2003).

There is a strong correlation between As and iron (Fe) concentrations within estuarine sediments in the Tamar. This is related to the chemical reaction which causes the flocculation of Fe out of solution when river water mixes with seawater. During this process other heavy metals, such as As are scavenged by the formation of particulate Fe oxyhydroxide. Movement of contaminants will thus be greatly influenced by the movement of the turbidity maximum (see **Section 4.1.5**). This is reflected by the seasonal trends and spatial variability of cadmium (Cd), copper (Cu), Fe, manganese (Mn), lead (Pb), zinc (Zn), mercury (Hg), chromium (Cr) and nickel (Ni). Given the close linkage with sediment movement, contamination will be influenced by fluvial inputs of new material (highest in periods of high river flow), seasonal fluctuations in tidal pumping and movement of sediment. Grain size will also have a significant influence on contaminant concentrations due to chemical bonding with clay particles. In low river flow summer conditions, fine sediments with higher contaminant concentrations accumulate at the head of the estuary. In winter, with higher flow conditions, fine sediments and associated contamination occur in the mid estuary. These are then pushed upstream to the head of the estuary when low flow conditions return, as a result of tidal pumping.

However, the enrichment (by Pb and Hg) of sediments to seaward, around the Hamoaze indicates that there are additional anthropogenic sources. These may include outfalls and waste disposal. Cd concentrations in the upper Plym may have also originated from industrial sources. In addition, there may be localised sources of Zn contamination linked to the use of sacrificial anodes on vessels and recreational craft (MBA, 2003).

There may also be an increase in concentration of heavy metals (As, Zn, Pb and Cu) with sediment depth in the upper Tamar / St. John's Lake. This could reflect the decline from peak mining activity in the 19th Century. However, these concentrations appear to have been maintained to the present day as a result of run-off and leaching (MBA, 2003).

An analysis of the historic and recent heavy metal data, where available, is considered below.

River Tamar

Historical data for the Tamar indicates that monitored heavy metals (As, Cd, Cu, Pb, Hg, Ni and Zn) are all below AL1 (MBA, 2003). Cefas data for samples taken in 1998 indicated that the minimum and maximum figures for Zn, Pb, Ni, Hg, Cu and Cr were above AL1, but not above AL2. The maximum figure for As in this area was above AL2. In the case of Cd there appeared to be areas of the Tamar with contamination below AL1.

Hamoaze and St. John's Lake (including the Naval Dockyard)

Contaminant information exists for the north part of St John's Lake around Carbeile Mill. The Cefas database indicates samples were collected in 1999. These showed that As, Cu, Hg and Pb levels were between AL1 and AL2. Cr, Cd and Ni were all below AL1. Zn results ranged from below AL1 to between AL1 and AL2.

The 2010 Baseline Document (Black and Veatch, 2010) presented Cefas data for the Dockyard area for 2004 and 2006. In 2004, the maximum identified values for Cu, Hg and Pb were identified as above AL2. However, in 2006 the maximum values recorded for these metals were found to be between AL1 and AL2. Additionally, the mean results for both years were below AL2. Minimum, average and maximum levels for As, Ni and Zn were all found above A1, but below AL2, for both 2004 and 2006. In 2006 all results were found to be below AL1 for Cr.

In 2010 the Ernesettle Jetty area exceeded AL2 for As. The Deepwater Camber area exceeded AL2 for Pb. In 2014 trace metal levels exceeded AL2 for Hg but were generally below AL2 for all other trace metals. The mean contaminant levels were all below AL2.

In 2015, sampling found maximum results above AL2 for As, Cu, Pb and Zn, with average As levels above AL2. Metal re-sampling in 2016 identified further areas with results above AL2 for Hg, Pb and Zn only. Further sampling in 2017, 2020 and 2021 identified no areas above AL2 for all trace metals.

River Plym

Historically, sediment samples within the Plym, which outfalls into Cattewater have been below AL1 for As, Cd, Hg and Zn (MBA, 2003). Two areas of the Cattewater have been sampled according to the Cefas database. These are Queen Anne's Battery Marina and Cattewater Harbour. There is ambiguity in the location of the second set of results as the harbour is identified as being in the Tamar, whereas Cattewater is the outfall of the Plym. Results for Queen Anne's Battery Marina indicated that maximum figures for Cd were encountered above AL2, this is also the case for Cattewater Harbour.

However, there were also parts of these two areas where Cd was below AL1. Cu was consistently between AL1 and AL2 across both areas. Hg and Pb showed maximum and average contamination readings across both areas which were between AL1 and AL2, although there were sites where contamination was below AL1. Cr and Ni were both below AL1 for both areas. The only difference between these two parts of the Cattewater was that Zn levels were shown to be above AL2 at some sampling points. However, both areas also displayed sites where Zn was below AL1.

Sampling undertaken in 2015, 2016 and 2021 demonstrated exceedances of AL1 for most metals but no exceedances of AL2. Where exceedances were recorded, they were relatively close to the AL1 concentration and therefore are not considered to be significantly greater than baseline concentrations found within UK waters.

Plymouth Sound

Sampling of the deep-water anchorages has historically (2004, 2010, 2014, 2015, 2017 and 2020) indicated generally low levels of contamination, whereby a number of samples marginally exceeded AL1. No samples exceeded AL2.

4.5.3 Organotins

Previous work indicates that a combination of legislation to ban the use of organotins (TBT and DBT) antifouling paint on recreational craft under 25m in length, together with containment procedures within the naval dockyard has reduced inputs to the Tamar Estuary (MBA, 2003). TBT appears to behave seasonally in a similar manner to metals (see **Section 4.5.2**). However, it should be noted that changes in pH, temperature, salinity, suspended solids, etc. dictate deposition and remobilisation from sediments with historic contamination.

Potential sources of TBT within or adjacent to the site include: Devonport Dockyard, Millbay Docks, Cattedown Wharves and numerous marina facilities around the Plymouth Sound and Estuaries site. Although sources can include fresh applications, it should be noted that where non-TBT replacement coatings are being used, TBT will need to be removed as part of vessel maintenance when old coatings are stripped. The MBA (2003) reported that the dockyard had instigated a system of collection and removal to a waste site at Chelson Meadow. Given the long-term decline in TBT use and removal by maintenance the issue of new releases will have declined since the late 1980's. However, reworking of sediments can lead to the release of TBT and derivatives (DBT). Previous work related to TBT in biota is documented within MBA, 2003.

An analysis of the historic and recent TBT and DBT data, where available, is considered below.

River Tamar
1998 Cefas data indicated that TBT levels on the Tamar were below AL1. This is in keeping with previous historic information (MBA, 2003).

Hamoaze and St. John's Lake (including the Naval Dockyard)
Maximum levels of TBT in 1999 showed that sites within the Carbeile Mill area were above AL1, although minimum and average figures show variation with sites ranging from below AL1 to between AL1 and AL2.

The 2010 Baseline Document (Black and Veatch, 2010) presented Cefas data for the Dockyard area (2004 and 2006) that indicated that minimum, average and maximum TBT contamination levels across the dockyard area were below AL1. Sampling undertaken in 2010 and 2014 demonstrated that levels of organotins were generally below the limits of detection, however, there were two instances in 2010 when the levels of TBT exceeded AL1.

Sampling in the Dockyard area in 2015 found all results for DBT below AL1, whilst the maximum result for TBT was between AL1 and AL2. In 2017, one sample location found both DBT and TBT had a maximum result above AL2. In 2020 and 2021 results were all below AL1 for both DBT and TBT.

River Plym
Cefas data for Queen Anne's Battery Marina and Cattewater Harbour (undated but known to be prior to 2011) indicated average levels of TBT contamination were between AL1 and AL2. However, there were areas of the Cattewater Harbour where TBT levels were below AL1. At Queen Anne's Battery Marina however, levels were consistently between AL1 and AL2.

Sampling in the Plym Estuary found there were no exceedances of AL1 for organotins in the sampling undertaken in 2015, 2016 or 2021.

Plymouth Sound
All historical sample data identified (2004, 2010, 2014, 2015, 2017 and 2020) within the deep-water anchorages were either below the limits of detection or below AL1 for organotins.

4.5.4 PAHs and Total Hydrocarbons

Previous studies indicate that there is a toxic threat to the estuary derived from polycyclic aromatic hydrocarbons (PAH). There is evidence to suggest that decline in mussel health in areas of the estuary (Beggars' Island) could be linked to PAH contamination of sediments (PML, 2004). Previous work related to PAH in biota is documented within a report by MBA (2003).

River Tamar
No data available.

Hamoaze and St. John's Lake (including the Naval Dockyard)
Analysis of the levels of PAHs indicates that the dockyard area has significantly higher levels of these contaminants for PAHs and total hydrocarbons. For example, AL1 for total hydrocarbons is 100ppm. In 2010 and 2014 the majority of samples exceeded AL1 for PAHs. In 2014 the mean total hydrocarbons for two groups of sites within HMNB Devonport was 449ppm and 1,183ppm. The maximum level of total hydrocarbons was 888ppm and 14,117ppm.

Recent sampling in the Dockyard area found average total hydrocarbons results decreased from 832.83ppm (2015) to 563.70ppm (2017), to 380.81ppm (2020), and 125.41ppm (2021) although the highest individual total hydrocarbon content of 4,570ppm was identified in 2020.

River Plym
In 2015, 2016 and 2021 sampling within the Plym found exceedances of AL1 for the majority of PAHs for which analysis was undertaken. Many were marginal exceedances although there were a number of individual PAHs with concentrations greater than 1ppm. These were for fluoranthene and pyrene, commonly identified in sediments exposed to sources of petroleum/fuels.

Plymouth Sound
Analysis of the levels of PAHs in the Plymouth Sound area between 2014 and 2020 has found a range of average total hydrocarbons results from 79.40ppm (below AL1) to 667ppm (above AL1).

4.5.5 PCBs

An analysis of the historic and recent PCB data, where available, is considered below. PCBs are not commonly tested for the purposes of maintenance dredging and therefore there are limited results available.

River Tamar
The 2010 Baseline Document (Black and Veatch, 2010) presented PCB figures from the Tamar in 1998 were below AL1, although sites with PCB levels above AL2 were detected.

Hamoaze and St. John's Lake (including the Naval Dockyard)
The 2010 Baseline Document (Black and Veatch, 2010) presented minimum, maximum and average levels for PCB contamination from samples taken in 1999, which were consistently above AL1.

In 2014, the majority of sampled areas were found to be above AL1 for both ICES 7 and the Total 25 Congeners. The maximum value for sampling in 2014 was found to be above AL2.

Sediment sampling undertaken in support of the marine licence application for the Wharf 8 and Wharf 9 capital dredge found that one of 10 samples taken contained concentrations of PCBs above Cefas AL1. However, this elevation was very close to the AL1 threshold (Royal HaskoningDHV, 2022b).

River Plym
The 2010 Baseline Document (Black and Veatch, 2010) presented Cefas data for Queen Anne's Battery Marina and Cattewater Harbour (undated, but known to be prior to 2011), which indicated that maximum and average levels of PCB contamination were above AL2. However, there were areas of the Cattewater where PCB levels were below AL1.

In 2021, sampling at Cattewater found exceedances of AL1 for both ICES 7 and the Total 25 Congeners and no exceedances of AL2 for the Total 25 Congeners were identified (there is no AL2 available for ICES 7).

Plymouth Sound
In 2014, some areas were found to be above AL1 for both ICES 7 and the Total 25 Congeners and no exceedances of AL2 for the Total 25 Congeners were identified (there is no AL2 available for ICES 7).

4.5.6 PBDEs

PBDEs are not commonly tested for the purposes of maintenance dredging and therefore there are limited results available. There are no ALs for PBDEs.

Hamoaze and St. John's Lake (including the Naval Dockyard)
Sediment sampling undertaken in support of the marine licence application for the Wharf 8 and Wharf 9 capital dredge found 74% of sample results (10 samples tested for 12 PBDEs) were below the Limit of Detection (LOD) (Royal HaskoningDHV, 2022b).

All locations were found to be below the LOD for BDE100, BDE153, BDE154, BDE17, BDE28, BDE66 and BDE85. The ranges of results (mg/kg dry weight) for the remaining PBDEs across all sample locations are:

- BDE138 (LOD 0.00002 mg/kg): 0.0000203 mg/kg (only one sample found above LOD)
- BDE183 (LOD 0.00002 mg/kg): 0.0000231 to 0.0000263 mg/kg
- BDE209 (LOD 0.0001 mg/kg): 0.0302 to 0.132 mg/kg
- BDE47 (LOD 0.00002 mg/kg): 0.0000261 to 0.0000843 mg/kg
- BDE99 (LOD 0.00002 mg/kg): 0.0000202 to 0.0000832 mg/kg

4.5.7 Summary

The data indicates that the sediments of the area contain contaminants at a range of concentrations varying from low levels to highly elevated and that within relatively small areas and over short periods of time there can be considerable variation in those levels.

Areas of heavy metals contamination above AL2 have historically been found within the wider River Tamar and Hamoaze area (including HMNB Devonport Dockyard area). Although these maximum values above AL2 are not consistent across all areas (average results tend to be below AL2) and areas of AL2 material is not identified consistently each year (i.e. heavy metal contamination within the area is transient). Sources of the contaminants appear to be both current and historical and as discussed in **Section 4.5.2** background levels of contaminants exist within the Tamar estuarine system.

In 2017 in the HMNB Devonport Dockyard area, organotin maximum levels exceeded AL2 at one location, however in all other years and areas organotin results were either below the LOD or below AL1. Organotin AL2 exceedances within the area are therefore considered to be isolated anomalies.

PAH results throughout the wider area regularly exceed AL1, although total hydrocarbon values vary significantly across areas and also temporally. PCB data is limited as it is not regularly tested, however there is consistent elevation above AL1 within the area, although with only isolated incidences above AL2. Similarly, PBDE data is limited as it is not regularly tested, however results from the HMNB Devonport Dockyard area for the 8 and 9 Wharf capital dredge identified 74% of sample results (10 samples tested for 12 PBDEs) were below the LOD.

The data collated represents both highly specific areas within that system that require, or have required, some form of dredging, as well as some sets of wider sediment contaminant surveys. However, given the limited geographical coverage, the data cannot be used to accurately represent the contaminant levels of the whole of the Plymouth Sound and estuaries area.

4.6 Water Framework Directive

The following section details the current Water Framework Directive (WFD) status of the water bodies.

4.6.1 Introduction

The Water Framework Directive (WFD) is transposed into national law by means of the Water Environment (WFD) (England and Wales) Regulations 2017 (as amended). These Regulations provide for the implementation of the WFD, from designation of all surface waters (rivers, lakes, transitional (estuarine) and coastal waters and ground waters) as water bodies to the requirement for achievement of good ecological status or good ecological potential by 2027.

The WFD applies to all water bodies, including those that are man-made, and all activities that have the potential to impact water bodies must be considered.

Classification schemes for both estuarine and coastal waters from MHWS out to one nautical mile (nm) have been developed in response to the WFD. The scheme classifies the status of Transitional and Coastal Waters (TRaC) using information on the ecological, chemical and hydromorphological quality of a body of water.

The WFD provides the main mechanism to control and improve water quality in all types of watercourses, alongside ensuring that water bodies meet certain requirements for marine ecology and hydromorphology. European designated sites are also recognised in their own right under the WFD as Protected Areas and therefore the monitoring and management systems in place to ensure compliance with this directive are relevant to this Baseline Document.

4.6.2 Water body status

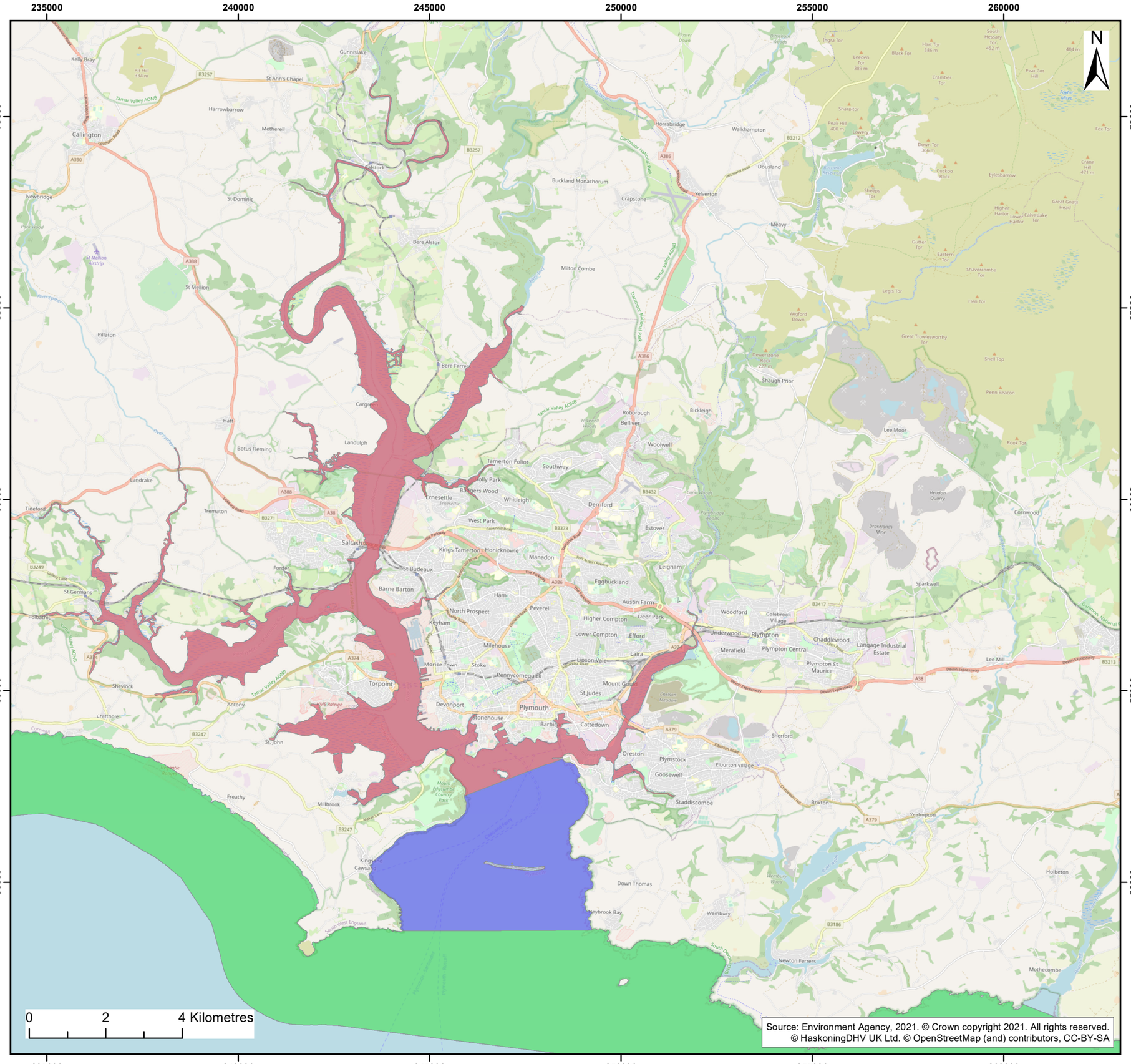
WFD water bodies in the study area have been identified using the EA's Catchment Data Explorer online tool[2]. The WFD water bodies identified as within the study area are shown in **Figure 4.2** and are listed below:

- Plymouth Tamar estuarine water body; and
- Plymouth Sound coastal water body.

Plymouth Coast coastal water body has also been included as it is downstream of the two identified waterbodies.

Summaries of the baseline information available regarding the status and objectives of the above water bodies are provided in **Table 4.9**.

[2] *https://environment.data.gov.uk/catchment-planning/*



Legend:

WFD water bodies

- Plymouth Tamar
- Plymouth Coast
- Plymouth Sound

Client: Defence Infrastructure Organisation

Project: HMNB Devonport MDP Baseline Document

Title: Plymouth Sound and Estuaries WFD water bodies

Figure:	Drawing No:				
4.2	PB4532-113-206				
Revision:	**Date:**	**Drawn:**	**Checked:**	**Size:**	**Scale:**
01	30/03/2021	JT	MS	A3	1:100,000

Co-ordinate system: British National Grid

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Table 4.9 Plymouth Sound and estuaries relevant WFD water body information

Water body parameter	Description		
WFD water body name	Plymouth Coast	Plymouth Sound	Plymouth Tamar
Water body ID	GB620806110003	GB650806230000	GB520804714300
River basin district name	South West	South West	South West
Water body type (estuarine or coastal)	Coastal	Coastal	Estuarine
Water body total area (km^2)	126.83	17.88	30.21
Overall water body status	Moderate (2019)	Moderate (2019)	Moderate (2019)
Ecological status	Good (2019)	Moderate (2019) (levels of dissolved inorganic nitrogen)	Moderate (2019) (no reasons provided)
Chemical status	Fail (2019) (due to concentrations of PBDEs[3] and mercury)	Fail (2019) (due to concentrations of PBDEs, benzo(g,h,i)perylene and mercury)	Fail (2019) (due to concentrations of PBDEs, mercury and organotins)
Target water body status and deadline	Good by 2015	Good by 2027	Good by 2021
Hydromorphology status of water body	Supports Good	Supports Good	Supports Good
Heavily modified water body and for what use	No	No	Yes – flood protection and navigation, ports and harbours
Higher sensitivity habitats present	• Subtidal kelp beds (7.69km^2) • Subtidal seagrass (0.65km^2)	• Subtidal kelp beds (2.47km^2) • Subtidal seagrass (0.25km^2)	• Intertidal seagrass (0.40km^2) • Mussel beds (0.27km^2) • Saltmarsh (2.85km^2) • Subtidal kelp (0.41km^2)

[3] *PBDE = Polybrominated diphenyl ether*

Water body parameter	Description		
			• Subtidal seagrass (0.049km^2)
Lower sensitivity habitats present	• Cobbles, gravel and shingle (0.51km^2) • Intertidal soft sediment (2.17km^2) • Rocky shore (1.15km^2) • Subtidal rocky reef (63.94km^2) • Subtidal soft sediments (22.41km^2)	• Cobbles, gravel and shingle (0.068km^2) • Intertidal soft sediment (0.18km^2) • Rocky shore (0.84km^2) • Subtidal rocky reef (3.75km^2) • Subtidal soft sediments (9.46km^2)	• Cobbles, gravel and shingle (0.0137km^2) • Intertidal soft sediment (17.11km^2) • Rocky shore (0.64km^2) • Subtidal rocky reef (0.63km^2) • Subtidal soft sediments (9.16km^2)
Phytoplankton status	High	High	Not assessed
History of harmful algae	Not monitored	Not monitored	Yes
WFD protected areas within 2km	• Plymouth Sound and Estuaries SAC • Wembury Bathing Water	• Plymouth Sound and Estuaries SAC • Kingsand Bathing Water • Cawsand Bathing Water • Bovisand Bathing Water	• Plymouth Sound and Estuaries SAC • Tamar Estuaries Complex SPA • Lynher Estuary Shellfish Water

In summary, all three water bodies are at Moderate overall status and are also Failing chemical status. This is due to levels of flame retardant compounds (PBDEs), mercury and its compounds, a polyaromatic hydrocarbon, benzo(g,h,i)perylene (Plymouth Sound coastal water body only) and organotin compounds (tributyltin (TBT) and dibutyltin (DBT)) (Plymouth Tamar estuarine water body only). Plymouth Sound and Plymouth Tamar water bodies are also at Moderate ecological status due to levels of dissolved inorganic nitrogen.

The chemical status of all three water bodies is reported to have deteriorated between 2015 and 2019. A summary of this is presented in **Table 4.10**.

Table 4.10 Comparison of failing chemical parameters between 2015 and 2019

Water Body	Failing chemical parameters (2015)	Failing chemical parameters (2019)
Plymouth Tamar	-	PBDEs, mercury and organotins
Plymouth Sound	-	PBDEs, benzo(g,h,i)perylene and mercury
Plymouth Coast	-	PBDEs and mercury

PBDEs are an emerging contaminant of concern for which information on concentration levels around the UK is poor. The risk posed by these persistent chemicals will be assessed at least every ten years until the data show a declining trend or no elevated levels and no inputs. Therefore, PBDE's are flagged as failing within the water bodies as not enough information is known about their concentration levels. A reason for the inclusion of mercury and organotin compounds is not provided, however the sediment chemical analysis results from recent maintenance dredge campaigns, presented in **Section 4.5.2** above, indicate that these contaminants are not at levels of concern within the dredged material.

In terms of Dissolved Inorganic Nitrogen (DIN), there is reference to diffuse pollution from agricultural activities and point source pollution from water industry sewage works on the EA's Catchment Data Explorer, both of which can contribute to nitrogen levels within the estuary. Again, there is no evidence to suggest that the maintenance dredging and disposal activities are contributing to this parameter's failing issues with diffuse pollution, wastewater and mining discharges. The source of nitrogen to the estuary is therefore anticipated to be from sources on land as opposed to dredging and disposal operations.

5 DESIGNATED SITES

5.1 Overview

There are a number of different designated sites within the Plymouth Sound and estuaries area. The purpose of this Baseline Document is to provide a tool for the assessment of impacts of maintenance dredging on these sites (SACs and SPAs under the Habitats Regulations and MCZs under the MCAA 2009).

This section sets out the baseline information on the relevant SAC, SPA and MCZ sites, but also includes information on the Sites of Special Scientific Interest (SSSIs) that are within and adjacent to the SACs, SPAs and MCZs as the features of importance that they are designated for underpin these sites. This approach also allows the Baseline Document to be used as an assessment of potential impacts on the relevant designated sites and SSSIs in the area.

The following sites identified within the Plymouth Sound and estuaries study area (see **Section 2.2**) are as follows:

- Plymouth Sound and Estuaries SAC.
- Tamar Estuaries Complex SPA; and
- Tamar Estuary Sites MCZ.

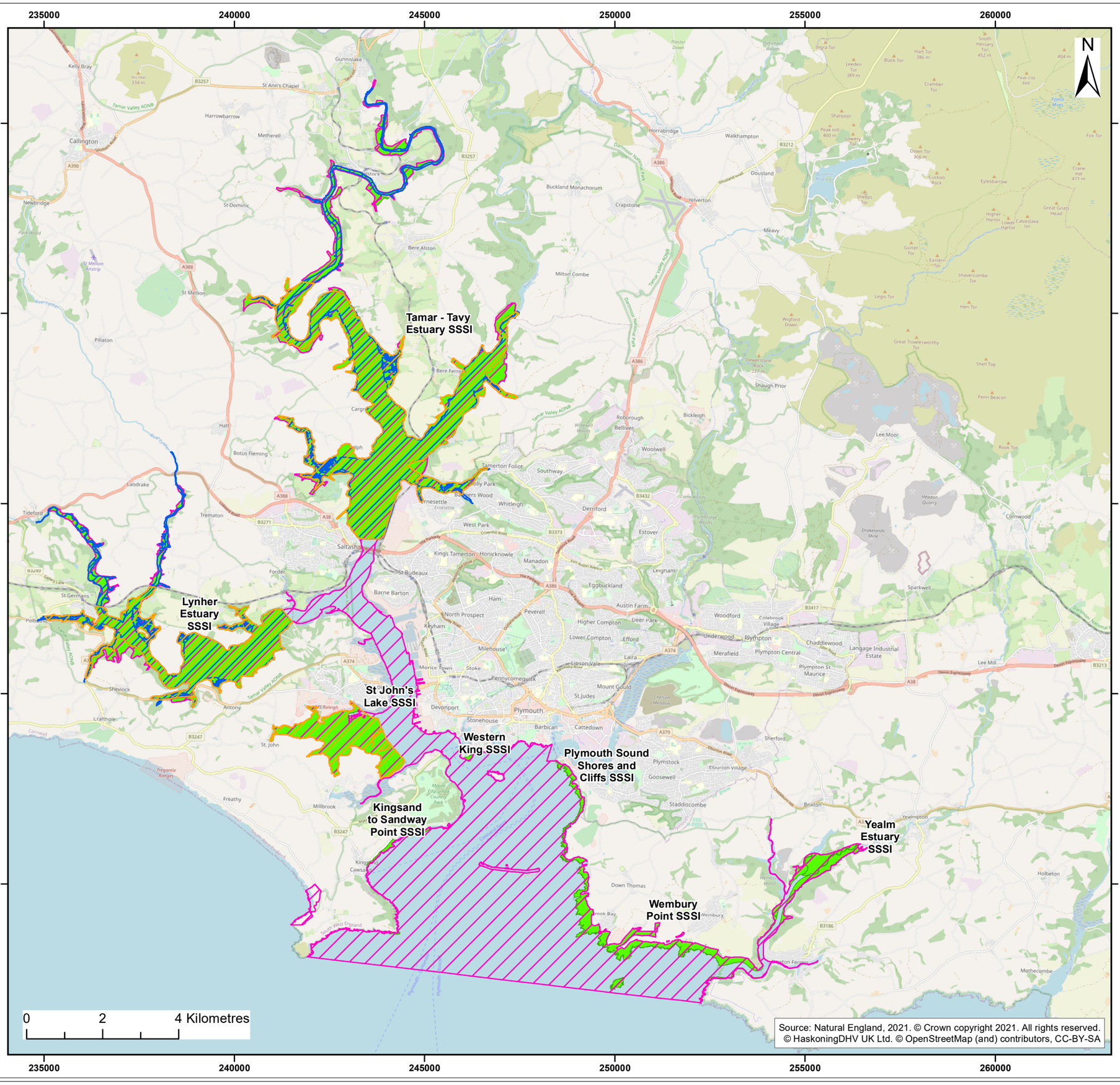
The assessment has been extended to also include the Dartmoor SAC as one of the qualifying features of the SAC is the migratory Atlantic Salmon. This species is known to migrate between the sea and the Tamar and Plym rivers and is therefore considered.

The following further SSSIs have marine or intertidal features and are within the Plymouth Sound and estuaries study area (see **Section 2.2**):

- Tamar Tavy SSSI.
- Lynher Estuary SSSI.
- St John's Lake SSSI.
- Western King SSSI.
- Plymouth Sound Shores and Cliffs SSSI.
- Kingsand to Sandway Point SSSI.
- Wembury Point SSSI; and
- Yealm Estuary SSSI.

The designated sites are displayed in **Figure 5.1**.

This section presents an overview of the information available on each of the sites, their sensitivity to maintenance dredging and whether the site will be taken forward to the impact assessment.



Legend:

Designated sites

- Tamar Estuary Sites MCZ
- Plymouth Sound and Estuaries SAC
- Tamar Estuaries Complex SPA
- Sites of Special Scientific Interest SSSI

Client: Defence Infrastructure Organisation	Project: HMNB Devonport MDP Baseline Document

Title:

Plymouth Sound and Estuaries
Relevant Designated Sites and SSSIs

Figure:	Drawing No:
5.1	PB4532-113-207

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01	30/03/2021	JT	MS	A3	1:100,000

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5.2 Plymouth Sound and Estuaries SAC

The Plymouth Sound and Estuaries SAC (including the Sound itself together with Wembury Bay and the River Yealm) is regarded to be of international conservation importance due to diverse salinity conditions, sedimentary and reef habitats. The wide variety of habitats give rise to communities that are representative of ria systems with unusual features, such as populations of Mediterranean and Atlantic species rarely found in British waters (NE, 2021a).

5.2.1 Conservation Objectives

The conservation objectives for the Plymouth Sound and Estuaries SAC apply to the site and the individual species, and / or assemblage of species for which the site has been classified (the "Qualifying features").

The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring:

- the extent and distribution of qualifying natural habitats and habitats of the qualifying species.
- the structure and function (including typical species) of qualifying natural habitats.
- the structure and function of the habitats of the qualifying species.
- the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely.
- the populations of each of the qualifying species; and
- the distribution of qualifying species within the site.

Qualifying features and location
The qualifying features of Plymouth Sound and Estuaries SAC and associated sub-features has been set out in **Table 5.1**.

Table 5.1 Qualifying features and sub-features of Plymouth Sound and Estuaries SAC and their locations (NE, 2021b)

Qualifying feature	Sub-features		Locations
Allis shad	• Subtidal coarse sediment • Subtidal mixed sediments	• Subtidal sand • Water column	The species is known to migrate into the estuary in late spring, between March and June, to spawn in freshwater upstream.
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	N/A		Found in tidal mudbanks in the Tamar, Tavy, in St. John's Lake and particularly on the Lynher Estuary.
Estuaries	• Atlantic salt meadows • Circalittoral rock • Infralittoral rock • Intertidal mixed sediments • Intertidal mud	• Subtidal mixed sediments • Subtidal mud • Subtidal sand • Subtidal seagrass beds	The rivers Tamar, Tavy, Lynher and Yealm all have major estuaries within the site.

Qualifying feature	Sub-features		Locations
	• Intertidal rock • Intertidal seagrass beds		
Large shallow inlets and bays	• Circalittoral rock • Infralittoral rock • Intertidal rock • Subtidal coarse sediment	• Subtidal mixed sediments • Subtidal mud • Subtidal sand • Subtidal seagrass beds	Found in the outer part of the site, including Plymouth Sound and Wembury Bay, extending up to the Tamar, Plym and Yealm estuaries.
Mudflats and sandflats not covered by seawater at low tide	• Intertidal coarse sediment • Intertidal mixed sediments • Intertidal mud	• Intertidal sand and muddy sand • Intertidal seagrass beds	The main intertidal mudflat areas are found above the Hamoaze in the Tamar-Tavy Estuaries, in the Lynher Estuary, and the Yealm Estuary. Areas of sand and muddy sand are also present within the estuaries, particularly St. John's Lake, the northern Lynher Estuary and the Tamar-Tavy Estuary. Areas of sand and coarse sediments are found on beaches within the Sound.
Reefs	• Circalittoral rock • Infralittoral rock	• Intertidal rock	Reefs are widespread across the site.
Sandbanks which are slightly covered by seawater all the time	• Subtidal coarse sediment • Subtidal mixed sediments • Subtidal mud	• Subtidal sand • Subtidal seagrass beds	Predominantly found in the outer, higher energy areas of the site such as around the mouth of the Yealm Estuary, in Cawsand Bay and in parts of Plymouth Sound
Shore dock (*Rumex rupestris*)	N/A		Shore dock is a terrestrial species and occurs on shingle beaches at Rame and Wembury.

5.2.2 Feature Condition

NE's Marine Condition Assessment methodology is currently only applied to 'marine habitat features'. Other features (marine species, coastal habitats) are assessed using different methodologies (e.g. SSSI assessments), or in some cases by the Joint Nature Conservation Committee (JNCC) (e.g. marine mammals). However, in the 2016 Plymouth Sound and Estuaries SAC Condition Assessment Allis shad was found to be in unfavourable condition due to the presence of Gunnislake Weir which acts as a barrier to migration (NE, 2016).

The most recent assessments for the Plymouth Sound and Estuaries SAC were undertaken in October 2017, June 2018 and July 2021 (NE, 2021c). The overview of the results of the assessment are presented in **Table 5.2** below. For those sub-features assessed as Unfavourable or Unfavourable declining **Table 5.3** sets out a summary of the main reason for unfavourable assessment.

Table 5.2 Plymouth Sound and Estuaries SAC Feature Condition Assessment Results (undertaken October 2017, June 2018 and July 2021)

Qualifying Features	Favourable	Unfavourable recovering	Unfavourable no change	Unfavourable declining	Partially destroyed	Destroyed	Not assessed
H1110 Sandbanks which are slightly covered by sea water all the time	1%	-	18%	81%	-	-	
H1140 Mudflats and sandflats not recovered by seawater at low tide	84%	-	5%	11%	-	-	
H1170 Reefs	99%	-	-	1%	-	-	
H1330 Atlantic salt meadows	-	-	-	-	-	-	100%
H1130 Estuaries	56%	-	3%	41%	-	-	-
H1160 Large shallow inlets and bays	39%	-	12%	49%	-	-	-
S1441 Shore dock	-	-	-	-	-	-	100%
S1102 Allis shad	-	-	-	-	-	-	100%

Table 5.3 Sub feature Unfavourable condition assessments for relevant feature designations in Plymouth Sound and Estuaries SAC

Feature	Sub feature	Feature condition	Confidence	Reason for Unfavourable Assessment if available
Allis shad	N/A	Unfavourable	N/A	• The presence of Gunnislake Weir which acts as a barrier to migration
Estuaries	Intertidal mixed sediments	Unfavourable Unknown	Medium	• Species composition • Sediment contaminants
	Intertidal rock	Unfavourable Declining	Medium	• Increased presence of pacific oyster (*Crassostrea gigas*) reefs in the Yealm Estuary and TBT levels in the Yealm • Water contaminants
	Intertidal seagrass beds	Unfavourable Unknown	Low	• Nutrient enrichment • Sediment contaminants
	Subtidal mixed sediments	Unfavourable Declining	Medium	• Nutrient enrichment • Sediment contaminants • Spread of non-natives (slipper limpet *Crepidula fornicate*)
	Subtidal mud	Unfavourable Declining	Medium	• Nutrient enrichment • Sediment contaminants • Spread of non-natives (slipper limpet)

Feature	Sub feature	Feature condition	Confidence	Reason for Unfavourable Assessment if available
	Subtidal seagrass beds	Unfavourable Declining	Medium	• Abrasion of the seabed from recreational anchorages and mooring • Nutrient enrichment • Suspended solids
Large shallow inlets and bays	Intertidal rock	Unfavourable Declining	Medium	• Increased presence of pacific oyster reefs in the Yealm Estuary and TBT levels • Water contaminants
	Subtidal coarse sediment	Unfavourable Unknown	Low	• Species composition of component communities • Sediment contaminants
	Subtidal mud	Unfavourable Declining	Medium	• Spread of non-natives (slipper limpets) • Sediment contaminants
	Subtidal mixed sediments	Unfavourable Declining	Medium	• Spread of non-natives (slipper limpet) • Sediment contaminants
	Subtidal seagrass beds	Unfavourable Declining	Medium	• Abrasion of the seabed from recreational anchorages and mooring • Nutrient enrichment • Suspended solids
Mudflats and sandflats not covered by seawater at low tide	Intertidal coarse sediment	Unfavourable Declining	Medium	• Increased presence of pacific oyster reefs in the Yealm Estuary and TBT levels • Sediment contaminants
	Intertidal mixed sediments	Unfavourable Unknown	Medium	• Species composition and component communities • Sediment contaminants
	Intertidal sand and muddy sand	Unfavourable Declining	Medium	• Increased presence of pacific oyster reefs in the Yealm Estuary and TBT levels • Sediment contaminants • Water contaminants
	Intertidal seagrass beds	Unfavourable Unknown	Low	• Nutrient enrichment • Sediment contaminants
Reefs	Intertidal rock	Unfavourable declining	Medium	• Increased presence of pacific oyster reefs in the Yealm Estuary and TBT levels in the Yealm • Water contaminants
Sandbanks which are slightly covered by sea water all the time	Subtidal coarse sediment	Unfavourable Unknown	Low	• Sediment contaminants • Species composition of component communities
	Subtidal sand	Unfavourable Unknown	Low	• Sediment contaminants • Species composition and component communities
	Subtidal mud	Unfavourable Declining	Medium	• Spread of non-natives (slipper limpets) • Sediment contaminants

Feature	Sub feature	Feature condition	Confidence	Reason for Unfavourable Assessment if available
	Subtidal mixed sediments	Unfavourable Declining	Medium	• Spread of non-natives (slipper limpets) • Sediment contaminants
	Subtidal seagrass beds	Unfavourable Declining	Medium	• Abrasion of the seabed from recreational anchorages and mooring • Nutrient enrichment • Suspended solids

5.2.3 Sensitivity to maintenance dredging

NE's Advice on Operations has been used to inform the potential impacts of maintenance dredging to be considered for this site (NE, 2021d). The 'Maintenance dredging' marine activity was selected.

The following Medium-High Risk pressures have been identified by NE as pressures that are commonly induced by the activity at a level that needs to be considered as part of an assessment:

- Abrasion / disturbance of the substrate on the surface of the seabed.
- Barrier to species movement.
- Changes in suspended solids (water clarity).
- Habitat structure changes - removal of substratum (extraction).
- Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion; and
- Smothering and siltation rate changes (heavy / light).

However, due to the reasons for unfavourable and declining features outlined in **Table 5.3**, the following additional pressures are considered relevant and will be considered as part of the assessment:

- Hydrocarbon and PAH contamination.
- Introduction or spread of invasive non-indigenous species.
- Nutrient enrichment.
- Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals); and
- Transition elements and organo-metal (e.g. TBT) contamination.

Consultation with NE identified that the following additional pressures should be considered in relation to Allis shad and will be considered as part of the assessment:

- Allis shad and underwater noise.
- Allis shad and vibration.
- Allis shad and collision below water with static or moving objects not naturally found in the marine environment

Additionally, based on the information presented in **Table 5.1**, the following feature of Plymouth Sound and Estuaries SAC is located at a significant distance from the maintenance dredging activities undertaken (see **Section 3.2**) and so has not been considered further within the assessment:

- Shore dock.

5.3 Dartmoor SAC

The Dartmoor SAC is more than 10km from any regularly dredged channels and berths within the Plymouth Sound and estuaries area. It is designated for predominantly terrestrial habitats and species however it is considered within this Baseline Document as one of the features of the SAC is the Atlantic salmon which is known to migrate along the River Plym.

Conservation Objectives
The conservation objectives for the Dartmoor SAC are the same as for the Plymouth Sound and Estuaries SAC (See **Section 5.2.1**)

Qualifying features
The qualifying features of Dartmoor SAC are:

- Northern Atlantic wet heaths with *Erica tetralix*;
- European dry heaths.
- Blanket bog.
- Old sessile oak woods with *Ilex* and *Blechnum* in the UK.
- Southern damselfly, *Coenagrion mercurial*.
- Atlantic salmon; and
- Otter, *Lutra lutra*.

Feature Condition
Salmon spawning stock assessments undertaken in 2016 classified Atlantic salmon within the River Plym as “At Risk” in 2016 and predicted the Plym would remain classified as ‘At Risk’ up to 2021. However, as a result of the 2017 stock assessment a 2022 classification of ‘Probably at Risk – Improvement’ is predicted (EA, 2018).

5.3.1 Sensitivity to maintenance dredging

Advice on Operations for the Dartmoor SAC has not yet been developed by NE and so the Plymouth Sound and Estuaries Advice on Operations for Allis shad has been used to identify pressures from maintenance dredging that are required to be assessed for Atlantic salmon (see **Section 4.3**). This includes the Medium-High Risk pressures identified and the additional Low Risk pressures identified by NE (underwater noise, vibration and collision risk).

Additionally, the following features of Dartmoor SAC are located at significant distance from the maintenance dredging activities undertaken (see **Section 3.2**) and so have not been considered further within the assessment:

- Northern Atlantic wet heaths with *Erica tetralix*.

- European dry heaths.
- Blanket bog.
- Old sessile oak woods with *Ilex* and *Blechnum* in the UK.
- Southern damselfly, *Coenagrion mercurial*; and
- Otter, *Lutra lutra*.

5.4 Tamar Estuaries Complex SPA

The Tamar Estuaries Complex SPA covers 1,955 ha split into three component parts, all of which are estuarine areas. They are the lower reaches of Tamar and Tavy estuaries, the Lynher Estuary and St John's Lake. The Tamar Estuaries Complex SPA supports internationally important numbers of migratory birds.

Conservation Objectives
The conservation objectives for the Tamar Estuaries Complex SPA apply to the site and / or assemblage species for which the site has been designated (the 'Qualifying Features').

The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive [Directive 2009/147/EC], by maintaining or restoring;

- the extent and distribution of the habitats of the qualifying features.
- the structure and function of the habitats of the qualifying features.
- the supporting processes on which the habitats of the qualifying features rely.
- the populations of each of the qualifying features; and
- the distribution of qualifying features within the site.

Qualifying features and locations
The qualifying features of Tamar Estuaries Complex SPA and associated supporting habitats has been set out in **Table 5.4**.

Table 5.4 Qualifying features and supporting habitats of Tamar Estuaries Complex SPA (NE, 2017a)

Qualifying feature	Sub-features		Locations
Avocet (non-breeding)	• Atlantic salt meadows • Freshwater and coastal grazing marsh • Intertidal coarse sediment	• Intertidal mixed sediments • Intertidal mud • Intertidal rock • Intertidal sand and muddy sand • Water column	The areas of the Tamar close to Hole's Hole, Weir Quay and Kingsmill Lake are the most important, but they are also found on the Tavy and Lynher Estuaries and occasionally in St John's Lake. Roosting sites are on the saltmarsh at Hole's Hole and Kingsmill Lake.
Little Egret (non-breeding)	• Atlantic salt meadows • Coastal reedbeds	• Intertidal mud • Intertidal rock • Intertidal sand and muddy sand	Little egret use all areas of the site and are particularly dispersed during feeding and at high tide roost.

Qualifying feature	Sub-features		Locations
	• Freshwater and coastal grazing marsh • Intertidal coarse sediment • Intertidal mixed sediments	• Intertidal seagrass beds • Water column	Important roost sites in the area include Sheviock Wood, Kingsmill Lake and Drake's Island.

Advice on Seasonality

"Advice on Seasonality", produced by NE as part of the site Conservation Advice Package (NE, 2017b), is presented in **Table 5.5**. This provides the months in which significant numbers of each bird species are most likely to be present at the site during a typical calendar year. Highlighted months with significant numbers were defined on the basis of one or both of the following criteria being met in more than 60% of the years within the six-year period 2007-2012:

i) monthly maxima exceed 10% of the highest mean of monthly maxima over the six-year period.
ii) monthly maxima exceed the 2012/2013 national significance threshold.

These criteria were predominantly used for non-breeding bird features (based on Wetland Bird Survey (WeBS data)). Where insufficient count data were available to use these criteria, months with significant numbers were highlighted on the basis of generic information on seasonal patterns of occurrence in published sources.

The months which are not highlighted in green are not ones in which the features are necessarily absent; rather, that features may be present in less significant numbers in typical years, but there may still be the potential for an effect. This period can vary year to year and in any one year considerable numbers of a species may be present (throughout the year or) outside of the months indicated below. Any assessment of potential impacts on the features must be based on up-to-date count data and take account of population trends evident from these data and any other available information.

Table 5.5 NE advice on Seasonality for Tamar Estuaries Complex SPA. Months highlighted in green indicate when significant numbers of bird species are most likely to be present (NE, 2017b)

Feature	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avocet	Non-breeding												
Little egret	Non-breeding												

Little egret are present year round and breed in the area surrounding the site in the summer, however the species is not designated for the breeding season impacts. NE advise that any impacts to the local breeding populations are likely to affect the over-wintering population, many of which are the same individuals, and so should be considered in plans or projects.

Feature Condition

NE's conservation advice for this site states that there is a 'maintain' objective for both species (NE, 2021e).

5.4.1 Sensitivity to maintenance dredging

NE's Advice on Operations has been used to inform the potential impacts of maintenance dredging to be considered for this site (NE, 2021f). The 'Maintenance dredging' marine activity was selected.

The following Medium-High Risk pressures have been identified by NE as pressures that are commonly induced by the activity at a level that needs to be considered as part of an assessment:

- Abrasion / disturbance of the substrate on the surface of the seabed.
- Barrier to species movement.
- Changes in suspended solids (water clarity).
- Habitat structure changes - removal of substratum (extraction).
- Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion; and
- Smothering and siltation rate changes (heavy / light).

Consultation with NE identified that the following additional pressures should be considered as part of the assessment:

- Visual disturbance

5.5 Tamar Estuary Sites MCZ

The Tamar Estuary Sites MCZ provides sheltered habitats which are subject to various salinity levels and tidal exposures. This diverse estuarine environment supports a number of features of ecological importance, including coarse sediments on the shore and biogenic reefs formed by the blue mussel. These living reefs are ecologically important as they provide a home for numerous species including seaweeds and animals such as sponges, barnacles, winkles and crabs. Areas of biogenic reef exposed at low tide provide a feeding ground for birds, whilst submerged areas are used by predators and scavengers like fish and crabs.

The site is particularly important as it is the only MCZ where the migratory fish the European smelt is protected. The MCZ is also home to the native oyster, a species which experienced significant declines during the 20th Century in European waters.

The site is made up of two separate areas, one in the Lynher Estuary and the other encompassing part of the Tamar and Tavy estuaries. Both parts of the MCZ fall within the Plymouth Sound and Estuaries European Marine Site.

Conservation Objectives
The conservation objectives for the Tamar Estuary Sites MCZ apply to the site and the individual species, and / or habitat for which the site has been designated (the "Designated features").

The conservation objective of the zone is that the protected features:

1. Are maintained in favourable condition if they are already in favourable condition, or
2. Are brought into favourable condition if they are not already in favourable condition.

For each protected habitat feature, favourable condition means that, within the zones both:

1. Its extent is stable or increasing; and
2. Its structure and function, its quality, and the composition of its characteristic biological communities (including diversity and abundance of species forming part of or inhabiting the habitat) are sufficient to ensure that it remains in a condition which is healthy and does not deteriorate.

The second conservation objective of the zone is that, in relation to smelt and the native oyster:

a) The quality and quantity of habitat available to the population and

b) The composition of that population in terms of number, age and sex ratio are such as to ensure that the population is maintained in numbers which enable it to thrive.

Any alteration to a feature brought about entirely by natural processes is to be disregarded when determining whether a protected feature is in favourable condition. Any temporary reduction of numbers of a species is to be disregarded if the population is sufficiently thriving and resilient to enable its recovery.

Designated features and locations

The qualifying features of Tamar Estuary Sites MCZ has been set out in **Table 5.6**.

Table 5.6 Qualifying features and supporting habitats of the Tamar Estuary Sites MCZ (NE, 2021g)

Qualifying feature	Locations
Blue mussel beds	The largest blue mussel bed within the site is located along the intertidal shore of the Tamar, near to Ernesettle. An adjacent smaller subtidal bed is also located up-river close towards Weir Point. On the Lynher the main bed is present on both sides of the lower reaches of the estuary just up-river of Jupiter Point.
Intertidal biogenic reefs	The main intertidal biogenic reef is the blue mussel bed near to Ernesettle in the Tamar. Here the bed extends from low water into the intertidal and is of a considerable size, extending for over 800m along the bottom of the intertidal mudflats. In the Lynher the blue mussel bed, located just up-river of Jupiter Point, is mostly classed as subtidal, however part of it is exposed during extreme low water springs.
Intertidal coarse sediment	Intertidal coarse sediment is located in the upper intertidal zone in the upper reaches of the Tavy and Tamar, toward the tidal limit of the rivers.
Native oyster	Found in a number of locations within the Lynher and north of the Tamar Bridge.
Smelt	The species is known to migrate up the estuary, spawning late February and early March upstream.

5.5.1 Sensitivity to maintenance dredging

NE's Advice on Operations has been used to inform the potential impacts of maintenance dredging to be considered for this site (NE, 2021h). The 'Maintenance dredging' marine activity was selected.

The following Medium-High Risk pressures have been identified by NE as pressures that are commonly induced by the activity at a level that needs to be considered as part of an assessment:

- Abrasion / disturbance of the substrate on the surface of the seabed.
- Barrier to species movement.
- Changes in suspended solids (water clarity).
- Habitat structure changes - removal of substratum (extraction).
- Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion; and
- Smothering and siltation rate changes (heavy and light).

Consultation with NE identified that the following additional pressures should be considered in relation to smelt and will be considered as part of the assessment:

- Smelt and underwater noise.
- Smelt and vibration.
- Smelt and collision below water with static or moving objects not naturally found in the marine environment

Based on the information presented in **Table 5.6**, the following feature of the Tamar Estuary Sites MCZ is located at a significant distance in the upper reaches of the Tavy from the maintenance dredging activities undertaken (approximately 7km upstream) (see **Section 3.2**) and so has not been considered within the assessment:

- Intertidal coarse sediment.

5.6 Sites of Special Scientific Interest

A number of SSSIs underpin the designated sites and MCZs described above. As a result, they share some of the same interest features. For example, both the Tamar Estuaries Complex SPA and the Tamar-Tavy Estuary SSSI are designated for supporting nationally and internationally important numbers of avocet.

SSSIs are divided up into management units so their requirements to reach a favourable status can be unit specific. For each of these units NE has assessed their condition according to a number of criteria and assigned them a condition level which best represents the unit in question. A full list of the relevant SSSIs including details of their features of interest and their condition are presented in **Appendix A5.1.** A summary of the reason for which the sites have been designated has been provided in **Table 5.7**.

Table 5.7 Relevant SSSIs in the Plymouth Sound and estuaries area and their features

SSSI	Summary of designated features
Tamar-Tavy SSSI	The site covers the upper tidal reaches of the Tamar-Tavy estuary and the large intertidal habitats and associated communities. Key features include populations of avocet and other passage or wintering wading birds, otter and Kingfisher (*Alcedo atthis*).

SSSI	Summary of designated features
	Near Calstock, the prawn *Palaemon longirostris* has been recorded, which has only been recorded in two other estuaries in Britain.
Lynher Estuary SSSI	The site covers the upper tidal reaches of the Lynher Estuary and the large intertidal habitats and associated communities. Key features include populations of wintering wildfowl and waders.
St John's Lake SSSI	South of Torpoint, the site covers part of the Tamar-Lynher estuarine system and covers the large intertidal habitats and associated communities. Key features include populations of wintering wildfowl and waders.
Western King SSSI	This site covers an area of exposed complex series of Devonian limestones containing an important fauna of microfossils.
Plymouth Sound Shores and Cliffs SSSI	This site covers larges areas of the shoreline surrounding Plymouth Sound, including several major ecological zones from open and exposed coastlines to sheltered bays.
Kingsand to Sandway Point SSSI	This site covers a rock platform along the Kingsand beach which forms the only exposure in south-west England of an extrusive rhyolite flow of Permian age.
Wembury Point SSSI	This site covers extensive intertidal reefs and associated communities, including passage, wintering and nesting birds. The area also includes a wave-cut platform, head terrace and degraded fossil cliff line.
Yealm Estuary SSSI	The site covers the upper tidal reaches of the Yealm Estuary. A steep sided inlet with a sand bar at the entrance providing shelter, there is a diverse range of biological communities.

5.6.1 Sensitivity to maintenance dredging

The Western King and Kingsand to Sandway Point SSSIs are designated for geological features and/or wholly terrestrial features only (see **Appendix A5.1**) and therefore no potential pathways for impacts have been identified. For this reason these sites have not been included in any further assessment. Additionally, the Yealm Estuary SSSI has not been considered further as no maintenance dredging is undertaken in the Yealm Estuary (see **Section 3.2.5**).

The following remaining SSSI's will be considered as part of the assessment:

- Tamar-Tavy SSSI
- Lynher Estuary SSSI
- St John's Lake SSSI
- Plymouth Sound Shores and Cliffs SSSI
- Wembury Point SSSI

6 INFORMATION FOR ASSESSMENT OF MAINTENANCE DREDGING IMPACTS

This Baseline Document sets out relevant information to enable an assessment of maintenance dredging activity to be undertaken in relation to designated sites. The document has presented details on the Plymouth Sound and estuaries maintenance dredging regime, baseline environment and designated sites.

This section summarises this information to provide an assessment of the potential impacts of maintenance dredging on the condition of the relevant designated sites.

6.1 Summary of Maintenance Dredge Activity

The average quantity of maintenance dredge material generated within the period 2016-2020 (inclusive) has increased since the 2017 Baseline Document was completed, in part due to a large maintenance dredge campaign undertaken in 2018. The data from dredge returns shows that removal of material during the period 2019-2020 is below the annual average removed in the past 15-year period. Dispersive dredging has been used between disposal campaigns to remove high spots from berths.

Since 2010 the five-year rolling average has varied between approximately 24,040 and 67,214 wmt with a maximum recorded annual maintenance disposal of 120,513 wmt (see **Appendix A3.4**).

Maintenance dredging activities are predominantly undertaken by HMNB Devonport, followed by Cattewater Harbour Commissioners. Further irregular maintenance dredging is undertaken across a number of marinas within the Tamar and Plym estuaries. Therefore, the assessment of maintenance dredging is focussed on the Plym and Tamar estuaries.

In the past six years there have been three small scale capital dredges carried out within the area. These capital dredges did not lead to any substantial change in the maintenance dredging regime.

Much of the literature regarding the sediment budget of the Tamar Estuary complex suggests that the sediment regime is in balance, i.e., sediment inputs equal sediment removal through dredging plus natural export to sea (PML, 2004 and Debut, 2007). In comparison to the 2004 PML estimates, the estuary has seen a decrease in the overall average quantities of material being dredged, and therefore when these quantities are included within the sediment budget calculations, **Table 4.2** shows a net increase in sediment within the estuary system.

However, whilst mathematically the sediment budget calculations confirm the accretion of sediment, the overall amount is small enough for the system to be considered to be still in balance.

6.2 Maintenance Dredge Methodology

Section 3.1 sets out the methodology of the maintenance dredge activities within the area. Further best practice measures included within the marine licences for dredging in the Plymouth Sound and estuaries include:

- Oil, fuel and chemical spill pollution prevention and control measures.
- Where applicable, ongoing sediment sampling, analysis, and Cefas advice on whether the materials are suitable for dredging; and

- Where applicable, regular updates to WFD assessments to ensure the activities are compliant with the WFD.

Conditions relating to these measures, which are currently included on the majority of maintenance dredging licences within the Plymouth Sound and Estuaries, are listed in **Table 6.1** below.

Table 6.1 Typical marine licence conditions and methodologies

Measure	Licence Condition	Reason
Contaminant control and sediment suspension	Tailored conditions, depending on the licence, to ensure regular sediment sampling within maintenance dredge areas, in consultation with Cefas, to only allow dredging in berths where sufficient evidence has shown contaminant levels to be within appropriate action levels for disposal to sea.	To ensure suitability of material for disposal to sea.
	Where consented, the methodology within the marine licence requires that the use of submersible pumps is restricted to areas where no other methods can be used.	N/A – restricted via methodology, not condition.
	Tailored conditions, depending on the licence, to ensure no dredging and/or disposal from areas with known contamination.	To ensure suitability of material for disposal to sea.
Litter prevention measures	All reasonable precautions are taken to prevent the disposal of man-made debris at sea. Any man-made material must be separated from the dredged material and disposed of to land.	To exclude the disposal to sea of man-made material such as shopping trolleys, masonry, paint cans etc.
Pollution prevention measures	Bunding and / or storage facilities must be installed to contain and prevent the release of fuel, oils, and chemicals associated with plant, refuelling and construction equipment, into the marine environment. Secondary containment must be used with a capacity of no less than 110% of the container's storage capacity.	To minimise the amount of man-made materials disposed of at sea.
	Only coatings and treatments can be used that are suitable for use in the marine environment.	To ensure hazardous chemicals that may be toxic, persistent or bioaccumulative are not released into the marine environment.
	The licence holder must report any oil, fuel or chemical spill within the marine environment to the MMO Marine Pollution Response Team within 12 hours.	To ensure that any spills are appropriately recorded and managed to minimise impact to sensitive receptors and the marine environment.
Seasonal restrictions	Tailored conditions, depending on the licence, to ensure dredging activities are not undertaken within areas used for fish migration during sensitive periods (as detailed in **Appendix A4.1**).	To avoid impact to migratory fish.

6.2.1 Invasive Non-Native Species

The Tamar Estuary Marine Biosecurity Plan has been developed in order to help prevent the spread of non-native and invasive non-native species in the area. The plan includes a list of actions and control measures to be undertaken focusing on prevention, control and containment (Wood *et al.*, 2018).

6.2.2 Marine Licence Requirements

All maintenance (as well as capital and non-navigational) dredging undertaken within the marine environment is a marine licensable activity and will therefore require a marine licence unless exempt.

However, as detailed in **Section 3.4.2**, under Section 75 of the MCAA 2009 (as amended), CHC are exempt from needing a marine licence for dredging activities within their jurisdiction.

6.3 Maintenance Dredge Activity and the Habitats Regulations

The designated sites that have the potential to be impacted by maintenance dredging activities are the Plymouth Sound and Estuaries SAC, the Dartmoor SAC and the Tamar Estuaries Complex SPA.

6.3.1 HRA Process

A staged process to undertaking assessment under the Habitats Regulations is practiced, as follows:

- **Screening** (Stage 1). The process of identifying potentially relevant designated sites, and whether the proposed scheme is likely to have a significant effect on the qualifying interest features of the designated site, either alone or in-combination with other plans and projects. If it is concluded at this stage that there is no potential for Likely Significant Effect (LSE), there is no requirement to carry out subsequent stages of the HRA.
- **Appropriate Assessment** (Stage 2). Where an LSE for a designated site(s) cannot be ruled out, either alone or in-combination with other plans and projects, assessment of the potential effects of the project on the integrity of the site(s), in view of its qualifying interest features and associated conservation objectives, is required. Where it is concluded that there would be an adverse effect on site integrity (or where such an effect cannot be discounted) an assessment of mitigation options is carried out and mitigation measures (where available) are proposed to address the effects. If, having considered mitigation, the potential for adverse effect on integrity remains, the HRA must progress to Stages 3 and 4.
- **Assessment of alternative solutions** (Stage 3). Identifying and examining alternative ways of achieving the objectives of the project to establish whether there are solutions that would avoid, or have a lesser effect, on the site(s).
- **Imperative reasons of overriding public interest** (IROPI) (Stage 4). Where no alternative solution exists, the next stage of the process is to assess whether the project is necessary for IROPI and, if so, the identification of compensatory measures needed to maintain the overall coherence of the National Site Network.

In respect of HRA Screening (Stage 1), a ruling (April 2018) by the Court of Justice of the European Union (CJEU) referred to as *People Over Wind and Sweetman v Coillte Teoranta* (C-323/17) has provided a judgement that *"…it is not appropriate, at the screening stage, to take account of the measures intended to avoid or reduce the harmful effects of the plan or project on that site"*. Therefore, no mitigation measures (out with those that form a fundamental part of the proposed scheme design) have been taken into account when undertaking the LSE screening exercise.

In respect of Stage 2, the integrity of a European site is defined as "*the coherence of the site's ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and / or populations of species for which the site has been designated"* (European Community (EC), 2001). An adverse effect on integrity, therefore, is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of designation.

6.3.2 Screening for Likely Significant Effect

The designated sites and associated features considered relevant for the assessment have been considered in relation to the potential pressures from maintenance dredging activities.

The designated sites and associated features considered relevant for the assessment have been set out in **Section 5**, including a justification where certain features have not been taken forward into the assessment. **Section 5** also includes an assessment of the relevant pressures to be included within the assessment (using NE's Advice on Operations guidance).

Additionally, where NE's Advice on Operations has assessed there to be 'No pathway' between a feature and a pressure the pressure / feature interaction has been screened out of any further assessment.

This assessment has been set out in:

- **Table 6.2** (Plymouth Sound and Estuaries SAC).
- **Table 6.3** (Dartmoor SAC); and,
- **Table 6.4** (Tamar Estuary Complex SPA).

Table 6.2 Likely Significant Effect Test: Maintenance Dredging and Plymouth Sound and Estuaries SAC. Green demonstrates No Likely Significant Effect has been concluded, whilst Orange demonstrates the pressure / feature interaction has been taken through to Appropriate Assessment

Qualifying feature/s	Pressure	Assessment	Likely Significant Effect
All features	Hydrocarbon and PAH contamination. Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals). Transition elements and organo-metal (e.g. TBT) contamination.	These pressures have been included due to the Unfavourable condition assessments of a number of sub-features within this site in relation to sediment contamination. Some of the Unfavourable condition assessments relate to elevated TBT levels in the Yealm. No maintenance dredging is currently undertaken in the Yealm and there is no requirement for future maintenance dredging. Some of the Unfavourable condition assessments relate to widespread heavy metal sediment contamination across the wider site. There is the potential for wide ranging impacts from increased contamination levels within this designated site. The mobilisation of sediment due to vessel movements and dredging has the potential to cause the suspension of contaminated sediments and subsequent spread of contaminated sediment. The summary of historical heavy metals sediment data provided in **Section 4.5** identifies that whilst some areas of contamination about AL2 have been identified, the contamination is not consistent across areas and changes temporally, concluding that heavy metal contamination within the area is transient. The geology and historic mining of the area contributes to these elevations. Sediment sampling must be undertaken prior to maintenance dredging activities and reviewed every three years to ensure contaminant levels of maintenance dredge material to be within appropriate action levels for disturbance and disposal to sea.	No LSE
All features	Nutrient enrichment	This pressure has been included due to the Unfavourable condition assessments of a number of sub-features within this site in relation to nutrient enrichment.	No LSE

Qualifying feature/s	Pressure	Assessment	Likely Significant Effect
		Plymouth estuaries are known to have high nutrient levels but these are primarily attributed to agricultural runoff and sewage discharges (NE, 2021b) and not associated with dredging of berths and channels. The mobilisation of sediment due to vessel movements and dredging has the potential to cause the suspension of sediments increasing the levels of organic matter and nutrients in the water column. However, monitoring has shown that elevated nutrient and organic matter levels following most dredging campaigns are localised, temporal and is within natural variability (see **Appendix A3.1**).	
All features	Introduction or spread of invasive non-indigenous species	This pressure has been included due to the Unfavourable condition assessments of a number of sub-features within this site in relation to the increased presence of pacific oyster reefs in the Yealm and the wider spread of the slipper limpets within the site. No maintenance dredging is currently undertaken in the Yealm and there is no requirement for future maintenance dredging. Aquatic organisms may be transferred to new locations as biofouling and can be harmful and invasive in locations where they do not naturally occur. However, commercial dredging vessels will use best practice to avoid transfer of non-indigenous species from operation sites. The International Convention for the Control and Management of Ships Ballast Water and Sediments was adopted in 2004 and entered into force on 08/09/17. This introduces global regulations to control the transfer of potentially invasive species. With the treaty now in force ships need to manage their ballast water. Dredging operations are required to adhere to the convention.	No LSE
Allis shad	Barrier to species movement.	Maintenance dredging may cause temporary sediment plumes, as well as disturbance impacts through noise and vibration, that may cause a barrier to species movement that could temporarily impede the migration of Allis shad through the Tamar Estuary.	LSE

Qualifying feature/s	Pressure	Assessment	Likely Significant Effect
	Changes in suspended solids (water clarity).		
Allis shad	Habitat structure changes - removal of substratum (extraction)	Allis shad spawn on the substrate in the upper reaches of the Tamar Estuary. The removal of substrate could impact on Allis shad spawning. However, the maintenance dredging activities do not overlap with potential Allis shad spawning areas and so there is no risk for the removal of spawning habitat.	No LSE
Allis shad	Underwater noise Vibration Collision below water with static or moving objects not naturally found in the marine environment	The busy dockyard, commercial port and high levels of recreational use within the Plymouth Sound and Estuaries area mean that there are continuous movements of large vessels in and out of the Estuary. Maintenance dredging operations are temporary, short term and intermittent and predominantly located within areas of other high-density vessel activities. Given the volume of vessel traffic within the areas that the dredgers will be working in it is not considered that there will be an impact of the presence of dredging vessels on Allis shad.	No LSE
Allis shad supporting habitat features	Abrasion / disturbance of the substrate on the surface of the seabed. Habitat structure changes – removal of substratum (extraction). Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion.	Allis shad spawn on the substrate in the upper reaches of the Tamar Estuary. However, the maintenance dredging activities do not overlap with potential Allis shad spawning areas and so there is no risk for impact to spawning habitat. Allis shad migrate through the Tamar Estuary to Gunnislake Weir. Areas of the estuary are subject to maintenance dredging. However, maintenance dredging only occurs in the navigation channels and berths. Subtidal sediments are disturbed through dredging activity however the maintenance dredging occurs in areas of siltation, whereby a certain amount of silt is removed but leaves a silt layer behind. This does not alter the sediment composition of the estuary.	No LSE

Qualifying feature/s	Pressure	Assessment	Likely Significant Effect
Allis shad supporting habitat features Atlantic salt meadows	Barrier to species movement	NE has assessed these features to be 'Sensitive' to this pressure (NE, 2021d). However, it is considered there is no pathway for maintenance dredging to cause a barrier to species movement of supporting habitat features.	No LSE
Allis shad supporting habitat features Atlantic salt meadows Estuaries Large shallow inlets and bays Mudflats and sandflats not covered by seawater at low tide Reefs Sandbanks which are slightly covered by seawater all the time	Changes in suspended solids (water clarity). Smothering and siltation rate changes (heavy / light).	The temporary, short term plume arising from the maintenance dredging activity is minimal and is limited to within the vicinity of the area that is being dredged. The plume, therefore, does not significantly affect levels of siltation in the wider estuary and would not affect the intertidal habitats (see **Appendix A3.1**).	No LSE
Atlantic salt meadows Mudflats and sandflats not covered by seawater at low tide	Abrasion / disturbance of the substrate on the surface of the seabed. Habitat structure changes - removal of substratum (extraction). Penetration and / or disturbance of the	Maintenance dredging only occurs in the subtidal navigation channels and berths within the area and therefore there will be no direct impact to intertidal habitats.	No LSE

Qualifying feature/s	Pressure	Assessment	Likely Significant Effect
	substratum below the surface of the seabed, including abrasion.		
Estuaries	Abrasion / disturbance of the substrate on the surface of the seabed. Habitat structure changes - removal of substratum (extraction). Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion.	Maintenance dredging only occurs in the subtidal navigation channels and berths within the area and therefore there will be no direct impact to intertidal habitats. Maintenance dredging activities undertaken within this complex feature are undertaken within the Tamar, Lynher and Plym estuaries. Maintenance dredging only occurs in the navigation channels and berths. Subtidal sediments are disturbed through dredging activity however the maintenance dredging occurs in areas of siltation, whereby a certain amount of silt is removed but leaves a silt layer behind. This does not alter the sediment composition of the estuary. A sub-feature of this feature, subtidal seagrass beds, is classed as Unfavourable due to the abrasion of the seabed from recreational anchorages and mooring and the Unfavourable condition is therefore not related to maintenance dredging activities. However, based on habitat mapping for this site subtidal seagrass beds are only present within the Yealm Estuary. Therefore, areas of subtidal seagrass beds do not overlap with areas of maintenance dredging activities. No pathway for direct impact to subtidal seagrass beds has been identified.	No LSE
Large shallow inlets and bays Sandbanks which are slightly covered by seawater all the time	Abrasion / disturbance of the substrate on the surface of the seabed. Habitat structure changes - removal of substratum (extraction).	Maintenance dredging only occurs in the subtidal navigation channels and berths within the area and therefore there will be no direct impact to intertidal habitats. Maintenance dredging activities undertaken within these complex features are undertaken within the HMNB Devonport Plymouth Sound Anchorages. Subtidal sediments are disturbed through dredging activity, however maintenance dredging occurs in areas of accumulating sandy material and sediment removal would not alter the sediment composition of the Sound.	No LSE

Qualifying feature/s	Pressure	Assessment	Likely Significant Effect
	Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion.	A sub-feature of these features, subtidal seagrass beds, is classed as Unfavourable due to the abrasion of the seabed from recreational anchorages and mooring. However, based on habitat mapping for this site subtidal seagrass beds are only present and at the edges of Plymouth Sound. NE's condition assessment (NE, 2021c) for this feature noted particular concerns at Cawsand Bay. Therefore, areas of subtidal seagrass beds do not overlap with areas of maintenance dredging activities. No pathway for direct impact to subtidal seagrass beds has been identified.	

Table 6.3 Likely Significant Effect Test: Maintenance Dredging and Plymouth Dartmoor SAC Green demonstrates No Likely Significant Effect has been concluded, whilst Orange demonstrates the pressure / feature interaction has been taken through to Appropriate Assessment

Qualifying feature/s	**Pressure** (Proxy pressures from Allis shad, Plymouth Sound and Estuaries)	**Assessment**	**Likely Significant Effect**
Atlantic salmon	Abrasion / disturbance of the substrate on the surface of the seabed. Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion. Smothering and siltation rate changes (heavy / light). Nutrient enrichment.	NE assessed there to be 'No pathway' between Allis shad and these pressures (NE, 2021d), which for the purposes of this assessment has been used as a proxy for Atlantic salmon. It is considered that, in relation to these specific pressures, there is no significant differences between these two species that would alter this assessment.	No LSE
Atlantic salmon	Barrier to species movement. Changes in suspended solids (water clarity).	Maintenance dredging may cause temporary, short term sediment plumes, as well as disturbance impacts through noise and vibration, that may cause a barrier to species movement that could temporarily halt the migration of Atlantic salmon through the Tamar and Plym estuaries.	LSE
Atlantic salmon	Habitat structure changes - removal of substratum (extraction)	Atlantic salmon migrate to the upper reaches of the Tamar Estuary and to the Dartmoor SAC to spawn. However, the maintenance dredging activities do not overlap with potential Atlantic salmon spawning areas and so there is no risk for impact to spawning habitat. Areas of the Tamar and Plym Estuary areas used for migration are subject to maintenance dredging. However, maintenance dredging only occurs in the navigation channels and berths. Subtidal sediments are disturbed through dredging activity however the maintenance dredging occurs in areas of siltation, whereby a certain amount of silt is removed but leaves a silt layer behind. This does not alter the sediment composition of the estuary.	No LSE

Qualifying feature/s	**Pressure** (Proxy pressures from Allis shad, Plymouth Sound and Estuaries)	Assessment	Likely Significant Effect
Atlantic salmon	Underwater noise Vibration Collision below water with static or moving objects not naturally found in the marine environment	The busy dockyard, commercial port and high levels of recreational use within the Plymouth Sound and Estuaries area mean that there are continuous movements of large vessels in and out of the Estuary. Maintenance dredging operations are temporary, short term and intermittent and predominantly located within areas of other high-density vessel activities. Given the volume of vessel traffic within the areas that the dredgers will be working in it is not considered that there will be an impact of the presence of dredging vessels on Atlantic salmon.	

Table 6.4 Likely Significant Effect Test: Maintenance Dredging and Plymouth Tamar Estuaries Complex SPA Green demonstrates No Likely Significant Effect has been concluded

Qualifying feature/s	Pressure	Assessment	Likely Significant Effect
Non-breeding birds	Barrier to species movement Visual disturbance	The noise arising from dredging operations may pose a barrier to species movement when occurring on or in proximity to specific migratory routes. The Plymouth estuaries are an important site for overwintering waders and wildfowl. Noise disturbance can affect the condition of birds if it is at levels where their feeding is interrupted or there is a displacement from feeding habitats. The busy dockyard and commercial port and high levels of recreational use within the Plymouth Sound and Estuaries area mean that there are continuous movements of large vessels in and out of the Estuary. Maintenance dredging operations are temporary, short term and intermittent and predominantly located within areas of other high-density vessel activities. It is likely that birds have become habituated to the regular movements of vessels and will be tolerant to the presence of dredgers. Given the volume of vessel traffic within the areas that the dredgers will be working in it is not considered that there will be a visual impact of the dredging vessels on birds. Waders in a port or estuarine environment tend to habituate to the presence of moving vessels and dredgers will be operating in readily used areas (berths and navigation channels). Dredging vessels will be lit during the night-time operations however lighting levels from these vessels will be of a low level compared with larger vessels that operate or are in transit through the estuary. Given the areas that the dredgers operate in it is not considered that light levels from the vessels will have an impact on birds within the estuary.	No LSE
Supporting habitat features	Abrasion / disturbance of the substrate on the surface of the seabed.	Maintenance dredging only occurs in the subtidal navigation channels and berths within the area and therefore there will be no direct impact to supporting habitat resource used by non-breeding birds.	No LSE

Qualifying feature/s	Pressure	Assessment	Likely Significant Effect
	Habitat structure changes - removal of substratum (extraction). Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion.		
Supporting habitat features	Changes in suspended solids (water clarity). Smothering and siltation rate changes (heavy / light).	The temporary short-term sediment plume arising from the maintenance dredging activity is minimal and is limited to within the vicinity of the area that is being dredged. The plume, therefore, does not affect levels of siltation in the wider estuary and would not affect the intertidal habitats (see **Appendix A3.1**).	No LSE

6.3.3 Appropriate Assessment

Based on the outcomes of the screening for Likely Significant Effect (**Section 6.3.2**) some pressure / feature interactions have been screened into requiring an Appropriate Assessment.

Consideration of the most relevant attributes, as set out in the Supplementary Advice on Conservation Objectives for the site (NE, 2019; NE, 2021b), identified for the qualifying features has been undertaken for those pressures screened into Appropriate Assessment. The most relevant attributes have been identified as only those attributes that will most efficiently and directly help to define condition and are clearly capable of identifying a change in condition.

This assessment has been set out in:

- **Table 6.5** (Allis shad; Plymouth Sound and Estuaries SAC); and,
- **Table 6.6** (Atlantic salmon; Dartmoor SAC).

Table 6.5 Appropriate Assessment: Maintenance Dredging and Allis shad (Plymouth Sound and Estuaries SAC)

Feature	Pressure	Relevant Attribute	Attribute Target	Adverse effect of proposal alone on attribute and/or feature	Mitigation	Adverse affect on site integrity?
Allis shad (upstream migration)	Barrier to species movement	Population: population size	Restore the population as a viable component of its natural habitats within the site.	Shad usually migrate through estuaries to the spawning grounds in April and May (Maitland and Hatton-Ellis, 2003). Maintenance dredging activities generate minor sediment plumes that have the potential to temporarily disturb Allis shad and potentially create a temporary barrier to migration. However, the sediment plume arising from the maintenance dredging activity is minimal and is limited to within the vicinity of the area that is being dredged. The plume, therefore, does not significantly affect levels of siltation or suspended sediment levels in the wider estuary (see **Appendix A3.1**). However, within some more sensitive areas of the channel it is considered there may be some disturbance to migration for a number of migratory fish species, including Allis shad, should maintenance dredging activities be undertaken.	Where dredging overlaps with the more sensitive areas of the channel, there are a number of existing seasonal restrictions included within the current marine licences to avoid significant impact on fish migration. The existing seasonal restrictions are outlined in **Appendix A4.1**. The main spawning location is on the Tamar just south of Gunnislake Weir. The targets for the relevant attributes of this feature have been set at 'restore' due to the potential impact of Gunnislake Weir on population size (NE, 2021b). It is therefore considered that the restore target does not relate to maintenance dredging activities.	No
		Presence and spatial distribution of the species	Restore the presence and spatial distribution of the species and their ability to undertake key life cycle stages and behaviours.			No
		Structure and function: biological connectivity	Restore connectivity of estuarine features to surrounding rivers, freshwater, marine and coastal habitats, to ensure larval dispersal and recruitment, maintain nursery grounds for mobile species, and to allow movement of migratory species.			No
	Changes in suspended solids (water clarity)	Supporting processes: water quality - turbidity (species)	Maintain natural levels of turbidity (eg suspended concentrations of sediment, plankton and other material) in areas where this species is or could be present.		Where dredging overlaps with the more sensitive areas of the channel, there are a number of existing seasonal restrictions included within the current marine licences to avoid significant impact on fish migration. The existing seasonal restrictions are outlined in **Appendix A4.1**.	No

Feature	Pressure	Relevant Attribute	Attribute Target	Adverse effect of proposal alone on attribute and/or feature	Mitigation	Adverse affect on site integrity?
Allis shad (downstream migration)	Barrier to species movement	Population: population size	Restore the population as a viable component of its natural habitats within the site.	Downstream migration of juveniles to estuarine areas is understood to be undertaken during summer before movement into coastal waters in spring (Aprahamian *et al.,* 1998). During their time in the estuary juveniles tend to be found at the surface and close inshore. A proportion of the juvenile population may remain in the river or estuary for a second year (Aprahamian *et al.,* 2003). Maintenance dredging activities may overlap with downstream migratory periods, and some dredge areas within the upper estuary areas may overlap with suitable low energy inshore environments where juvenile shad may be present. It is considered that the extended period of downstream migration means there is no higher period of sensitivity where maintenance dredging activities would significantly disturb migration. The majority of maintenance dredging activities are undertaken outside of the low energy inshore waters.	The main spawning location is on the Tamar just south of Gunnislake Weir. The targets for the relevant attributes of this feature have been set at 'restore' due to the potential impact of Gunnislake Weir on population size (NE, 2021b). It is therefore considered that the restore target does not relate to maintenance dredging activities.	No
		Presence and spatial distribution of the species	Restore the presence and spatial distribution of the species and their ability to undertake key life cycle stages and behaviours.			No
		Structure and function: biological connectivity	Restore connectivity of estuarine features to surrounding rivers, freshwater, marine and coastal habitats, to ensure larval dispersal and recruitment, maintain nursery grounds for mobile species, and to allow movement of migratory species.			No
	Changes in suspended solids (water clarity)	Supporting processes: water quality - turbidity (species)	Maintain natural levels of turbidity (eg suspended concentrations of sediment, plankton and other material) in areas where this species is or could be present.		Not required.	No

Table 6.6 Appropriate Assessment: Maintenance Dredging and Atlantic salmon (Dartmoor SAC)

Feature	Pressure	Relevant Attribute	Attribute Target	Adverse effect of proposal alone on attribute and/or feature	Mitigation	Adverse affect on site integrity?
Atlantic salmon (Tamar)	Barrier to species movement Changes in suspended solids (water clarity)	Population (of the feature). Adult run size.	Restore the Atlantic Salmon population to that expected under un-impacted conditions, allowing for natural fluctuations.	Atlantic salmon migrate through the Tamar Estuary and up to Gunnislake Weir. Atlantic salmon are known to migrate upstream between April and December, with peak numbers between June and July. Downstream migration is undertaken between April to June. Whilst there is limited information available about the movement of salmon through the estuary, it is expected that by the end of their migratory period (November to December) there will be no presence of this species within the estuarine environments. Maintenance dredging activities generate minor sediment plumes that have the potential to temporarily disturb Atlantic salmon and potentially create a temporary barrier to migration. However, the sediment plume arising from the maintenance dredging activity is minimal and is limited to within the vicinity of the area that is being dredged. The sediment plume, therefore, does not significantly affect levels of siltation and suspended sediment in the wider estuary (see **Appendix A3.1**). However, within some more sensitive areas of the channel it is considered there may be some disturbance to migration for a number of migratory fish species, including Atlantic	Where dredging overlaps with the more sensitive areas of the channel, there are a number of existing seasonal restrictions included within the current marine licences to avoid significant impact on fish migration. The existing seasonal restrictions are outlined in **Appendix A4.1**. The connectivity of the Dartmoor SAC through the Tamar Estuary is prevented by Gunnislake Weir. It is therefore considered that the restore / ensure targets do not relate to maintenance dredging activities.	No
		Supporting habitat: structure / function. Biological connectivity.	Ensure the natural movement of Atlantic Salmon through the SAC is not artificially constrained.			No
		Supporting habitat: structure / function. Sediment regime.	Maintain, and in places, restore the natural supply of coarse and fine sediment to the river.		Not required.	No
	Changes in suspended solids (water clarity)	Supporting processes: water quality - turbidity (species)	Maintain natural levels of turbidity (eg suspended concentrations of sediment, plankton and other material) in areas		Where dredging overlaps with the more sensitive areas of the channel, there are a number of existing seasonal restrictions included within the current marine licences to avoid significant impact	No

Feature	Pressure	Relevant Attribute	Attribute Target	Adverse effect of proposal alone on attribute and/or feature	Mitigation	Adverse affect on site integrity?
			where this species is or could be present.	salmon, should maintenance dredging activities be undertaken.	on fish migration. The existing seasonal restrictions are outlined in **Appendix A4.1**.	
Atlantic salmon (Plym)	Barrier to species movement Changes in suspended solids (water clarity)	Population (of the feature). Adult run size.	Restore the Atlantic Salmon population to that expected under un-impacted conditions, allowing for natural fluctuations.	Atlantic salmon migrate through the Plym Estuary and up to Dartmoor SAC. Atlantic salmon on the Plym are understood to have a later migratory run than the Tamar salmon population and, based on historical consultation responses from regulators as part of marine licence applications, are known to migrate upstream between June and January, with peak numbers between September and January. Downstream migration is undertaken between March and May with peak smolt numbers in April and May. Evidence suggests that smolt are more likely to use the river by night. There is limited information available regarding the movement of salmon through the Plym Estuary and when salmon may be present within the estuarine areas where dredging is undertaken.	This lack of information has resulted in variable seasonal restrictions enforced across the different marine licences and maintenance dredging works within the Plym Estuary. The existing seasonal restrictions are outlined in **Appendix A4.1**. The connectivity of the Dartmoor SAC through the Tamar Estuary is prevented by Gunnislake Weir. It is therefore considered that the restore / ensure targets do not relate to maintenance dredging activities.	No
		Supporting habitat: structure / function. Biological connectivity.	Ensure the natural movement of Atlantic Salmon through the SAC is not artificially constrained.			No
		Supporting habitat: structure / function. Sediment regime.	Maintain, and in places, restore the natural supply of coarse and fine sediment to the river.		Not required.	No
	Changes in suspended solids (water clarity)	Supporting processes: water quality - turbidity (species)	Maintain natural levels of turbidity (eg suspended concentrations of sediment, plankton and other material) in areas where this species is or could be present.		This lack of information has resulted in variable seasonal restrictions enforced across the different marine licences and maintenance dredging works within the Plym Estuary. The existing seasonal restrictions are outlined in **Appendix A4.1**.	No

6.4 Maintenance Dredge Activity and the Marine and Coastal Access Act

The designated site that has the potential to be impacted by maintenance dredging activities is the Tamar Estuary Sites MCZ.

6.4.1 MCZ Assessment Process

An MCZ assessment under the Marine and Coastal Access Act (2009) is undertaken, as a staged process as follows:

- **Screening. The screening stage determines if** the activity is taking place within or near an MCZ or an area being put forward as an MCZ and whether the activity is capable of affecting (other than insignificantly) either (i) the protected features of an MCZ; or (ii) any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependant.
- **Stage 1 Assessment**. The Stage 1 assessment should determine whether there is no significant risk of the activity hindering the achievement of the conservation objectives stated for the MCZ. If there is a risk, the Stage 1 assessment then considers whether there is no other means of proceeding which would create a substantially lower risk of hindering the achievement of the conservation objectives stated for the MCZ. This should include proceeding with the activity (a) in another manner, or (b) at another location.
  If mitigation to reduce identified impacts cannot be secured, and there are no other alternative locations, then the project will proceed to be considered under Stage 2 of the assessment process.
- **Stage 2 Assessment**. The Stage 2 assessment considers the socio-economic impact of the plan or project together with the risk of environmental damage. There are two elements to the Stage 2 assessment process, firstly, consideration of whether the public benefit in proceeding with the project clearly outweighs the risk of damage to the environment that will be created by proceeding with it. If so, can measures of equivalent environmental benefit for the damage the project will have on the MCZ features be secured.

6.4.2 MCZ Screening

The designated sites and associated features considered relevant for the assessment have been considered in relation to the potential pressures from maintenance dredging activities.

The designated sites and associated features considered relevant for the assessment have been set out in **Section 5**, including a justification where certain features have not been taken forward into the assessment. **Section 5** also includes an assessment of the relevant pressures to be included within the assessment (using NE's Advice on Operations guidance).

Where NE's Advice on Operations assessed there to be 'No pathway' between a feature and a pressure the pressure / feature interaction has been screened out of any further assessment.

This assessment has been set out in **Table 6.7**.

Table 6.7 MCZ Assessment Screening: Maintenance Dredging and Tamar Estuary Sites MCZ. Green demonstrates that the pressure / feature interactions have been screened out of further assessment, whilst Orange demonstrates that the pressure / feature interaction has been taken through to Stage 1 Assessment

Qualifying feature/s	Pressure	Assessment	Screened into further assessment?
Blue mussel beds Intertidal biogenic reefs Native Oyster	Abrasion / disturbance of the substrate on the surface of the seabed Habitat structure changes - removal of substratum (extraction) Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion	The main areas of intertidal biogenic reefs and blue mussel beds (intertidal and subtidal) are in the Lynher (upstream of Jupiter Point) and in the Tamar (upstream of Ernesettle). Native oyster records are not currently published for this site however records from the Finding Sanctuary Final Report document (Lieberknecht *et al*, 2011) show point records for native oyster in both the upper reaches of the Tamar and Lynher estuaries. Maintenance dredging activities are undertaken within HMNB Devonport berths adjacent to these areas (at Jupiter Point and at Ernesettle Jetty). However, the extent of the maintenance dredging areas do not overlap with these features and therefore there will be no direct impacts on these features.	No
Blue mussel beds Intertidal biogenic reefs	Barrier to species movement	NE has assessed these features to be 'Sensitive' to this pressure (NE, 2021h). However, it is considered there is no pathway for maintenance dredging to cause a barrier to species movement of these habitat features.	No
Blue mussel beds Intertidal biogenic reefs Native oyster	Smothering and siltation rate changes	Whilst the maintenance dredging activities undertaken within HMNB Devonport berths are adjacent to these areas (at Jupiter Point and at Ernesettle Jetty), the sediment plume arising from maintenance dredging activity is minimal and is limited to within the vicinity of the area that is being dredged. The plume, therefore, does not significantly affect levels of siltation or suspended sediment in the wider estuary and would not affect these features (see **Appendix A3.1**).	No
Native oyster	Changes in suspended solids (water clarity)	Whilst the maintenance dredging activities undertaken within HMNB Devonport berths are adjacent to these areas (at Jupiter Point and at Ernesettle Jetty), the sediment plume arising from maintenance dredging activity is minimal and is limited to within the vicinity of the area that is being dredged. The plume, therefore, does not significantly affect levels of siltation or	No

Qualifying feature/s	Pressure	Assessment	Screened into further assessment?
		suspended sediment in the wider estuary and would not affect these features (see **Appendix A3.1**).	
Smelt	Abrasion / disturbance of the substrate on the surface of the seabed Habitat structure changes - removal of substratum (extraction)	Smelt migrate to the upper reaches of the Tamar Estuary to spawn. However, the maintenance dredging activities do not overlap with potential smelt spawning areas and so there is no risk regarding impact to spawning habitat. Areas of the Tamar Estuary used for migration are subject to maintenance dredging. However, maintenance dredging only occurs in the navigation channels and berths. Subtidal sediments are disturbed through dredging activity however the maintenance dredging occurs in areas of siltation, whereby a certain amount of silt is removed but leaves a silt layer behind. This does not alter the sediment composition of the estuary.	No
Smelt	Barrier to species movement Changes in suspended solids (water clarity)	Maintenance dredging may cause temporary, short term sediment plumes, as well as disturbance impacts through noise and vibration, that may cause a barrier to species movement that may temporarily impede the migration of smelt through the Tamar Estuary.	Yes
Smelt	Smothering and siltation rate changes	This pressure relates to increased sedimentation of smelt spawning habitat (NE, 2021h). Smelt spawning habitat is within the upper reaches of the tidal limit of the Tamar. The sediment plume arising from maintenance dredging activity is minimal and is limited to within the vicinity of the area that is being dredged. The plume, therefore, does not significantly affect levels of siltation in the wider estuary and would not affect the smelt spawning habitats which are approximately 23 km upstream from the nearest maintenance dredging area (see **Appendix A3.1**).	No
Smelt	Underwater noise Vibration Collision below water with static or moving objects not naturally found in the marine environment	The busy dockyard, commercial port and high levels of recreational use within the Plymouth Sound and Estuaries area mean that there are continuous movements of large vessels in and out of the Estuary. Maintenance dredging operations are temporary, short term and intermittent and predominantly located within areas of other high-density vessel activities. Given the volume of vessel traffic within the areas that the dredgers will be working in it is not considered that there will be an impact of the presence of dredging vessels on smelt.	No

6.4.3 MCZ Stage 1

Based on the outcomes of the MCZ screening (**Section 6.4.2**) some pressure / feature interactions have been screened into requiring an MCZ Stage 1 Assessment.

Consideration of the most relevant attributes, as set out in the Supplementary Advice on Conservation Objectives for the site (NE, 2021i), identified for the qualifying feature has been undertaken for those pressure screened into Stage 1 Assessment. The most relevant attributes have been identified as only those attributes that will most efficiently and directly help to define condition and are clearly capable of identifying a change in condition.

This assessment has been set out in **Table 6.8**.

Table 6.8 MCZ Stage 1 Assessment Scope: Maintenance Dredging and smelt (Tamar Estuary Sites MCZ)

Feature	Pressure	Relevant Attribute	Attribute Target	Capable of effecting protected features of the MCZ?	Mitigation	Will the conservation objective be hindered?
Smelt	Barrier to species movement	Population: population size	Recover the population size within the site.	Smelt are thought to form large shoals in the lower reaches of estuaries in winter before moving upstream to spawn in the spring. According to Cotterell and Hillman (2016) smelt are likely to have passed through the Tamar Estuary by February (see **Section 4.3.3**) as smelt appeared to congregate in the middle estuary (upstream of Cargreen) in spring prior to spawning and they were not recorded within the lower estuary However, there is the potential that smelt will be migrating through the section of the Tamar Estuary subject to maintenance dredging activities during December to February (when maintenance dredge activities in the main channel of the Tamar are undertaken). Maintenance dredging activities generate minor sediment plumes that have the potential to disturb smelt and create a temporary barrier to migration. However, the plume arising from maintenance dredging activity is minimal and is limited to within the vicinity of the area that is being dredged. The plume, therefore, does not significantly affect levels of siltation in the wider estuary (see **Appendix A3.1**).	Currently there is very little information on the smelt population size or health within the Tamar Estuary Sites MCZ, and a 'recover' conservation objective was set nationally for this species (MMO, 2017c), reflecting a significant national decline where the species has been lost from a number of sites (Colclough and Coates, 2013). Professor Paul Dando, a leading smelt expert from the MBA, who recorded the colonisation of the site in 1968 and has collected most of the data since that date, has stated that no significant evidence of a decline in the Tamar smelt population has been found (MMO, 2017c).	No
		Presence and spatial distribution of the species	Recover the presence and spatial distribution of the species and their ability to undertake key life cycle stages and behaviours.			No
		Structure and function: biological connectivity	Recover biological connectivity between the estuary and the spawning and nursery grounds.			No
	Changes in suspended solids (water clarity)	Supporting processes: water quality - turbidity (species)	Maintain natural levels of turbidity (eg suspended concentrations of sediment, plankton and other material) in areas where this species is or could be present.		Not required.	No

6.5 Maintenance Dredge Activity and Sites of Special Scientific Interest

The designated sites that have the potential to be impacted by maintenance dredging activities are as follows:

- Tamar-Tavy SSSI
- Lynher Estuary SSSI
- St John's Lake SSSI
- Plymouth Sound Shores and Cliffs SSSI
- Wembury Point SSSI

Given that these SSSI sites legally underpin Plymouth Sound and Estuaries SAC and some of the sites additionally legally underpin the Tamar Estuaries Complex SPA there are many overlaps between the protected features of these sites. A review of SSSI designated features of these sites considered within the scope of the HRA assessment (**Section 6.3**) has been undertaken and those designated features not included within the HRA assessment identified (**Appendix A6.1**). **Appendix A6.1** also provides an initial screening to identify features that do not require further assessment as they are wholly terrestrial and so no pathway for impact has been identified.

6.5.1 Screening of designated features requiring further assessment

A summary of the SSSI designated features identified as requiring further assessment in **Appendix A6.1** has been identified in **Table 6.9**.

Table 6.9 SSSI designated features requiring further assessment

SSSI Designation	Designated features requiring further assessment
Tamar-Tavy SSSI	Wintering bird assemblage
Lynher Estuary SSSI	Wintering bird assemblage Summer bird assemblage
St John's Lake SSSI	Wintering bird assemblage
Plymouth Sound Shores and Cliffs SSSI	None
Wembury Point SSSI	Wintering bird assemblage Summer bird assemblage

6.5.2 SSSI Assessment

Wintering bird assemblage

The noise arising from dredging operations may pose a barrier to species movement when occurring on or in proximity to specific migratory routes.

The Plymouth Estuaries are an important site for overwintering waders and wildfowl. Noise disturbance can affect the condition of birds if it is at levels where their feeding is interrupted or there is a displacement from feeding habitats. The busy dockyard and commercial port and high levels of recreational use within the Plymouth Sound and Estuaries area mean that there are continuous movements of large vessels in and out of the estuary. Maintenance dredging operations are temporary, short term and intermittent and

predominantly located within areas of other high-density vessel activities. It is likely that birds have become habituated to the regular movements of vessels and will be tolerant to the presence of dredgers.

Given the volume of vessel traffic within the areas that the dredgers will be working in it is not considered that there will be a visual impact of the dredging vessels on birds. Waders in a port or estuarine environment tend to habituate to the presence of moving vessels and dredgers will be operating in areas already in constant use (berths and navigation channels).

Dredging vessels will be lit during the night-time operations however lighting levels from these vessels will be of a low level compared with larger vessels that operate or are in transit through the estuary. Given the areas that the dredgers operate in it is not considered that light levels from the vessels will have an impact on birds within the estuary.

Summer and breeding bird assemblage

The noise arising from dredging operations may cause disturbance to the summer bird assemblage including breeding birds when occurring near to nesting sites. However, the majority of noted breeding bird species are associated with terrestrial low cliffs and scrub habitats.

The busy dockyard, commercial port and high levels of recreational use within the Plymouth Sound and Estuaries area mean that there are continuous movements of large vessels in and out of the estuary. Maintenance dredging operations are temporary, short term and intermittent and predominantly located within areas of other high-density vessel activities. It is likely that birds have become habituated to the regular movements of vessels and will be tolerant to the presence of dredgers.

Given the volume of vessel traffic within the areas that the dredgers will be working in it is not considered that there will be a visual impact of the dredging vessels on birds.

Dredging vessels will be lit during the night-time operations however lighting levels from these vessels will be of a low level compared with larger vessels that operate or are in transit through the estuary. Given the areas that the dredgers operate in it is not considered that light levels from the vessels will have an impact on birds within the estuary.

7 CONCLUSIONS

This Baseline Document represents a tool for the assessment of maintenance dredging undertaken by HMNB Devonport and also the statutory harbour authorities in the Plymouth Sound and estuaries area.

Section 3 has provided a baseline of maintenance and capital dredging undertaken within the Plymouth Sound and Estuaries area, updated with dredging activities undertaken over the 2015 to 2020 period. A summary and review of the most recent available disposal returns has informed the assessments made on the potential impacts of the current maintenance dredging regimes.

Section 4 has presented the environmental baseline conditions including coastal processes and geomorphology, estuarine habitats and ecology, ornithology, sediment and water quality (including baseline information for the WFD). Further environmental baseline information made available since the last Baseline Document update has been incorporated, including updated sediment quality data and migratory fish monitoring data.

Section 5 has provided an overview of the designated sites present within the Plymouth Sound and estuaries study area. There have been no major changes in designations since the last Baseline Document, but updated site information published by NE, including feature conditions, has been incorporated.

Finally, **Section 6** has presented information to inform an assessment of maintenance dredging in relation to designated sites and associated features. Due to a ruling (April 2018) by the Court of Justice of the European Union (CJEU) referred to as People Over Wind and Sweetman v Coillte Teoranta (C-323/17) which provided a judgement that *"…it is not appropriate, at the screening stage, to take account of the measures intended to avoid or reduce the harmful effects of the plan or project on that site*", no mitigation measures (out with those that form a fundamental part of the proposed scheme design) have been taken into account when undertaking the LSE screening exercise. Unlike the previous Baseline Document, where seasonal restrictions were considered within the LSE stage, consideration of the impact of seasonal restrictions has now been undertaken within an Appropriate Assessment.

It is concluded that the present maintenance dredging practices are sustainable and, subject to standard marine licence conditions being implemented as well as mitigation measures to prevent the overlapping of maintenance dredge activities with sensitive periods for migratory fish species, the activities presented in this document will not have an adverse effect on the features of the Plymouth Sound and estuaries designated sites, nor will they hinder the achievement of the conservation objectives stated for the Tamar Estuary Sites MCZ.

A five-year update is recommended to ensure that the information presented in the Baseline Document remains relevant and up to date. Any further legislative and regulatory changes that affect the content of the Baseline Document will be updated accordingly.

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