# Technical Appendix 5.3:

# Best Practicable Environmental Option Assessment

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# Falmouth Docks Development

## Best Practicable Environmental Option (BPEO) Assessment

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# Falmouth Docks Development

## Best Practicable Environmental Option (BPEO) Assessment

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# Contents

# 1. Introduction

## 1.1 Background

Falmouth Docks and Engineering Company (FDEC) is seeking permission for the redevelopment and modernisation ("the proposed development") of the existing facilities at Falmouth Docks, Cornwall ("the site"), shown on Figure 1. Ramboll UK Limited (Ramboll) has been appointed by FDEC to prepare a Best Practicable Environmental Option (BPEO) assessment for the management and disposal of dredge arisings associated with the proposed development.

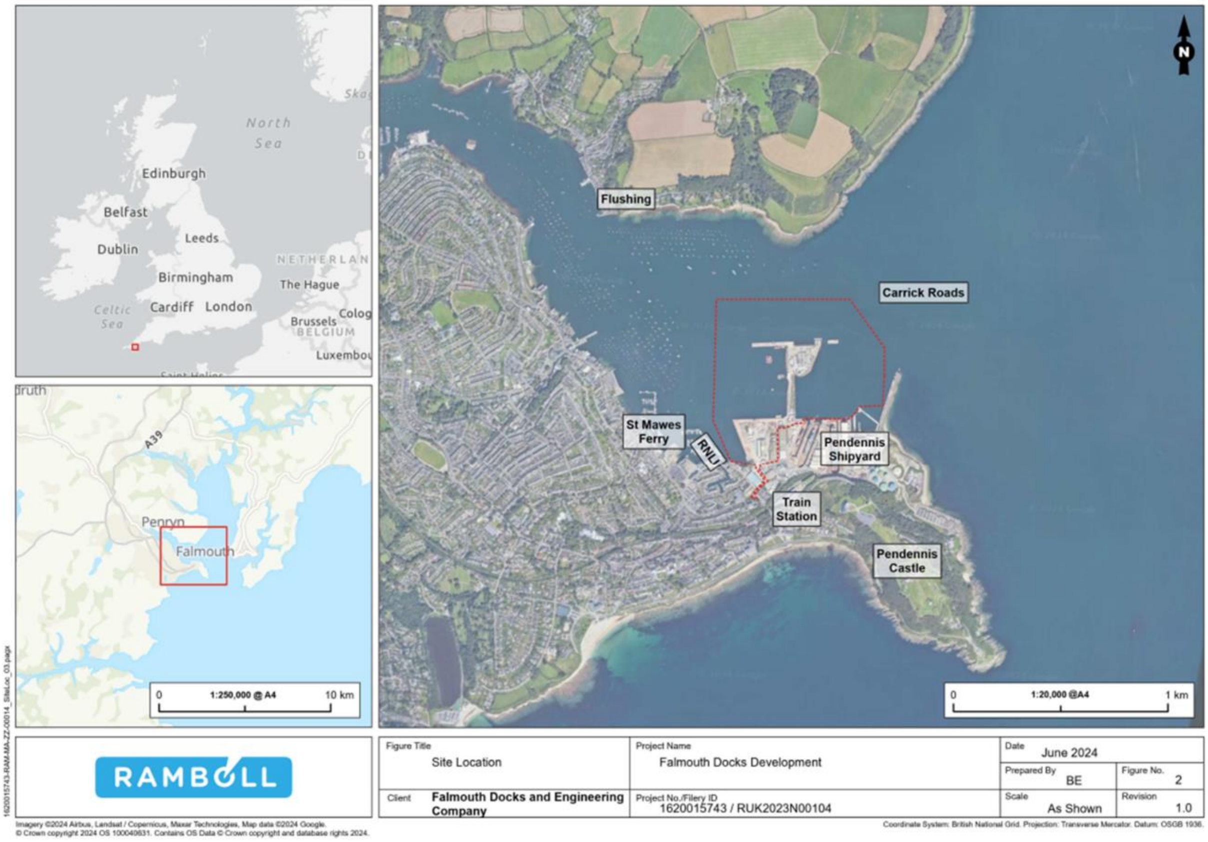



**Figure 1: Site Location and Site Boundary**

Parts of the site and numerous sections of its infrastructure are considered to be in poor condition, unsafe for operational use or reaching the end of their design life. The objectives of the proposed development are to repair and update the currently poor condition dock infrastructure in order to maintain existing business and future proof the docks with respect to cruise capacity, cargo capacity and renewable floating offshore wind (FLOW) (supporting the offshore wind market).

The proposed development would reinstate full alongside berth capability and increase berth capacity at Falmouth Docks, and as such involves capital dredging so that larger cruise vessels (up to Excellence Class) and FLOW devices can be accommodated at the site.

## 1.2 Proposed Development

The following activities are required to facilitate the proposed development:

- Pocket dredge of berth areas to achieve required underkeel clearance for larger cruise vessels (up to Excellence class) and the FLOW renewable energy device underkeel requirements (considered to be -10.5 m Chart Datum (CD));
- Removal of foul ground within areas of the former Kings and Empire Wharves;
- Surface skim of seabed on the eastern side of the site to maintain -5.5 mCD;
- Demolition of the remaining existing Western Wharf timber piles and above surface infrastructure;
- Construction of a new Western Wharf suspended deck structure;
- Demolition of the Northern Arm concrete structure and substructure to below seabed level and removal of the gang walkway and old timber piles that are located west of this structure;
- Construction of a suspended deck structure (Northern Wharf) in the existing 90 m gap between Queen’s Wharf and the Northern Arm to create a longer functional wharf length;
- Upgrades to the existing Queen’s Wharf structure;
- Extension of the Queen’s Wharf suspended deck structure 50 m westward;
- Installation of a 290 m deck (the ‘FLOW Deck’) to facilitate a FLOW device;
- Upgrades to the existing Duchy Wharf structure to facilitate a FLOW device; and
- Demolition of on-site buildings and re-configuration of Falmouth Dock activities.

The dredging requirements for the proposed development are detailed in Section 2 of this report.

## 1.3 Licensing Requirements and Legislative Context

Under Section 66 of the Marine and Coastal Access Act 2009[1], a marine licence is required to undertake the proposed works, including dredging activities. With regards to disposal of dredged material at sea, it is a licensable marine activity to deposit any substance or object within the UK marine licensing area, either in the sea or on or under the sea bed, from any vehicle, vessel, aircraft or marine structure, any container floating in the sea, or any structure on land constructed or adapted wholly or mainly for the purpose of depositing solids in the sea[1].

The disposal of most wastes or other matter at sea is prohibited by the OSPAR Convention. However, the following types of waste may be disposed of at sea, based on a detailed assessment of risks and a marine licence from the Marine Management Organisation (MMO)[2]:

- Dredged material;
- Inert materials of natural origin; and
- Fish waste, including shellfish and any part of a fish.

OSPAR Guidelines for the Management of Dredged Material at Sea (the most recent iteration of which is Agreement 2014-06[3]) specify best environmental practice for managing dredged material and steps to be considered in determining applications for disposal at sea.

[1] UK Legislation, 2009. Marine and Coastal Access Act 2009, online. Available at: https://www.legislation.gov.uk/ukpga/2009/23/contents [Accessed 16/09/2024]

[2] Marine Management Organisation (2019). Marine Licences. Deposits. Available at: https://www.gov.uk/guidance/deposits [Accessed 16/09/2024]

[3] OSPAR Guidelines for the Management of Dredged Material at Sea (Agreement 2014-06, Update 2024). Available at: https://www.ospar.org/documents?v=33037 [Accessed 16/09/2024]

The Waste (England and Wales) Regulations (2011)[4] transpose the EU revised Waste Framework Directive[5] into national law in England and Wales. The Waste Framework Directive provides the legislative context for the collection, transport, recovery and disposal of waste and includes the common definition of waste as "any substance or object which the holder discards or intends or is required to discard" (Article 3). It also lays down measures to protect the environment and human health, by preventing or reducing the generation of waste and the adverse impacts of the generation and management of waste[5].

When deciding whether to grant a disposal licence (as part of a marine licence for the proposed development), the MMO applies the waste hierarchy from the Waste Framework Directive (see Article 4), which specifies the order of preference for how waste should be dealt with[2]:

- Prevention - can include not carrying out an activity;
- Re-use - finding an alternative, beneficial use for waste material;
- Recycling - can include making high grade products from waste material;
- Other recovery - can include treatment to alter the physical nature of the waste material; and
- Disposal (at sea).

Regulations 12(2) and 12(3) of The Waste (England and Wales) Regulations (2011)[4] allow for cases where the waste hierarchy may be departed from "so as to achieve the best overall environmental outcome where this is justified by life-cycle thinking on the overall impacts of the generation and management of the waste", with the following impact considerations:

"a) the general environmental protection principles of precaution and sustainability
b) technical feasibility and economic viability
c) protection of resources
d) the overall environmental, human health, economic and social impacts".

A holistic understanding of the feasibility of and impacts associated with different options for the management and disposal of waste is therefore required.

## 1.4 Purpose of this Report

This report has been prepared to support the marine licence application for the proposed development. It presents the assessment to determine the BPEO for the management and disposal of dredge arisings from the proposed development. This BPEO assessment is adopted with the aim of managing environmental concerns and establishes the option for management of dredge arisings that provides the most environmental benefits or gives rise to the least environmental damage. It therefore presents the available disposal options, short-lists those which are practicable and assesses the performance of short-listed options against a range of criteria, such as environmental impact, technical feasibility and cost.

The report is structured as follows:

i. Proposed Development Dredging Requirements – justification of the requirement for dredging and description of the dredging method, as it is currently understood;
ii. Dredged Material Characteristics – description of the physical and chemical characteristics of the material to be dredged;

[4] The Waste (England and Wales) Regulations 2011. Available at: https://www.legislation.gov.uk/uksi/2011/988/contents [Accessed 16/09/2024]

[5] Directive 2008/98/EC of the European Parliament and of the Council. Available at: https://www.legislation.gov.uk/eudr/2008/98/contents [Accessed 16/09/2024]

iii. Scoping and Assessment of Available Disposal Options – presentation and scoping of available disposal options, followed by further assessment of the short-listed options against criteria; and
iv. Summary and Identification of the BPEO.

# 2. Proposed Development Dredging Requirements

## 2.1 Need for Capital Dredging

As above-described, the proposed development aims to future-proof Falmouth Docks with respect to the increase in cruise ship sizes, the growth of trade volumes and the demand for dock infrastructure for the maintenance and assembly of FLOW devices. The industries supported by Falmouth Docks, and the longevity and diversification of operations at the Dock, are essential to the local and regional economy and employment.

Falmouth Docks is considered to be an optimal location to accommodate larger cruise vessels and support the development of the FLOW industry. The proposed development makes use of Falmouth Docks' location as a terminal with existing cruise demand and as a unique destination for shore excursions in the south-west. Falmouth Docks is also located in a relatively sheltered estuary, within the 72-hour weather forecasting window and with the access and space requirements to support the FLOW industry.

Capital dredging is necessary to facilitate the proposed development. Deeper and larger berth pockets are required to achieve the required underkeel clearances of FLOW devices and Excellence Class cruise ships. The proposed development would allow a greater quantity, size and variety of vessels to use the landing facilities and thus ensure the continued viability and longevity of Falmouth Docks, in addition to minimising conflicts between different uses.

The dredge requirements for the proposed development (see Figure 2) are considered to be the minimum possible extent and volume of dredging, whilst allowing the design objectives and necessary underkeel requirements to be achieved. Dredging is limited to berth pockets only. Dredging has been avoided where possible, and for example is not proposed in the approach channel to Falmouth Docks. Accordingly, large vessels would make best use of the tides to access and egress the dock infrastructure.

## 2.2 Description of Capital Dredging

The dredge plan for the proposed development, which also indicates the proposed new seabed levels, is shown illustrated in Figure 2.

As displayed in Table 1, it is proposed to dredge pockets along the berths at Western Wharf, north and south of Queen's Wharf and in the western basin adjacent to the proposed FLOW Deck and proposed Duchy Wharf. The berth pockets are proposed to be dredged to -10.5 mCD to achieve the required bed depths and underkeel clearances associated with the FLOW devices and the various vessels that would berth at the site (up to Excellence Class).

These dredge depths are to the clear draught of the design vessel with an additional 1 m underkeel clearance at Lowest Astronomical Tide (LAT) and 300 mm siltation allowance. The sides of the dredge pockets would be graded, and rock scour protection would be placed in the berth pockets, if required.

The remaining elements of King's Wharf and Empire Wharf in the Western Basin would be removed and surface-skimming of the eastern side of the causeway to -5.5 mCD would be undertaken.

| **Table 1: Approximate Dredge Quantities** | | |
|---|---|---|
| | **Area ($m^2$)** | **Volume ($m^3$)** |
| Western Wharf, Northern Wharf and north of Queen's Wharf to -10.5 m CD | 55,500 | 230,000 |
| South of Queen's Wharf to -10.5 m CD | 9,800 | 33,000 |
| FLOW Deck, Duchy Wharf and Western Basin to -10.5 m CD | 60,000 | 224,000 |
| Graded sides | 55,000 | 123,000 |
| Surface Skim to Eastern Basin | 46,700 | 27,000 |
| Removal of obstructions (previous King's and Empire Wharves) in Western Basin | 5,500 | 6,000 |
| **Total** | **232,500** | **643,000** |

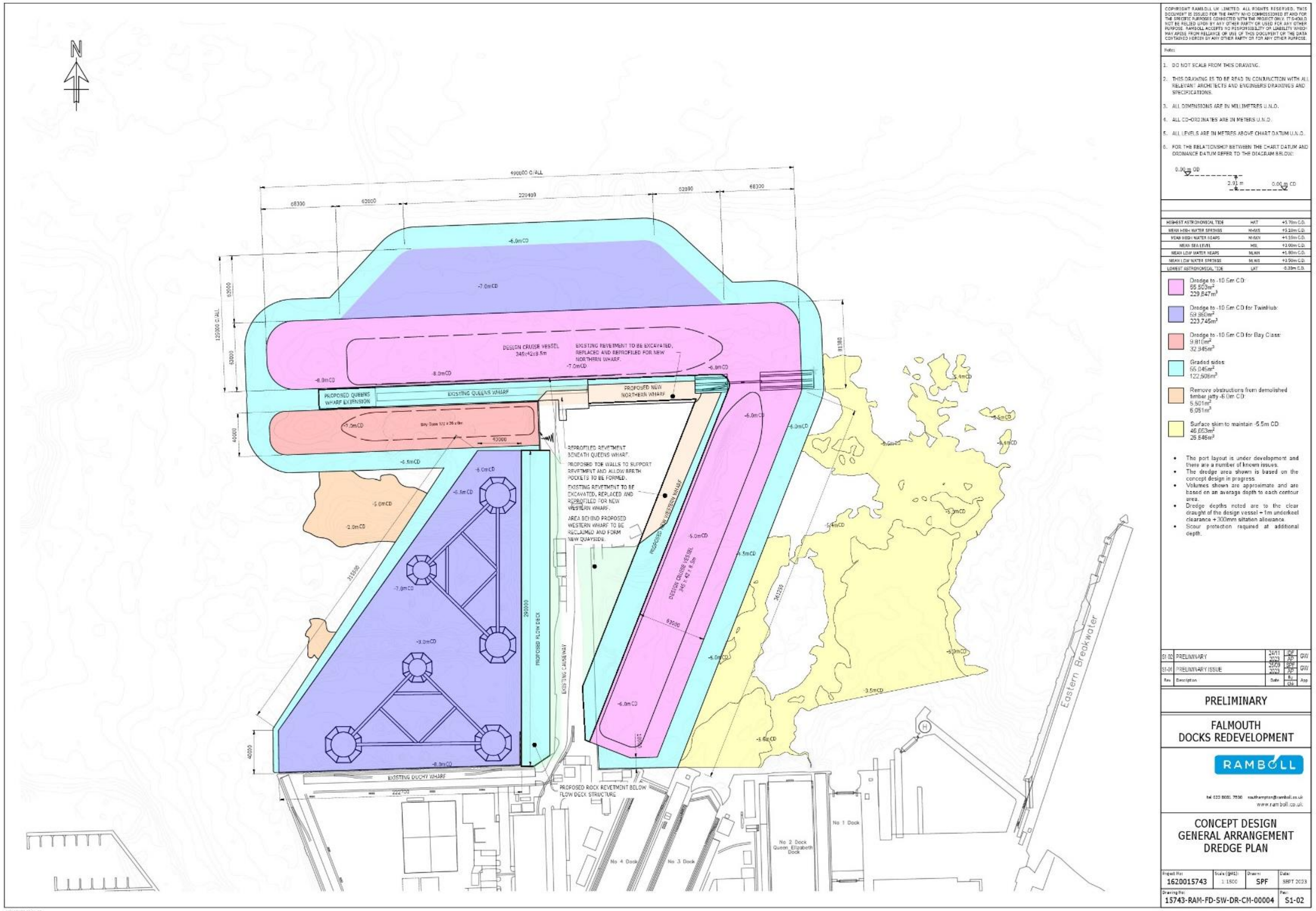



**Figure 2: Proposed Development Dredge Plan**

### 2.3 Dredge Methodology

Stable batter slopes would be formed as part of the dredge process to ensure stability of the existing ground and prevent debris falling into the berth pockets. The sides of the dredge pockets would be graded and, if required, rock scour protection would be placed in the berth pockets. The dredge areas would then be surveyed again, and any missed areas or slipped material from batter slopes would be removed.

The dredge pockets would be formed using a backhoe dredger(s) to minimise sediment mobilisation. In addition, an 'environmental bucket' will be used. This is a lidded bucket which is designed to minimise the release of suspended sediment losses to the water column. The size of the bucket assumed for the EIA is a 10 $m^3$ lidded bucket, which is considered a precautionary approach for modelling purposes. The final choice of plant will be defined by the contractor; however, it will not be larger than the plant simulated.

Dredging will be limited to occur during the flood tide. Following investigation of the sensitivity of released sediment deposition in the area, the timing of the period of dredging was amended to be from 1.75 hours before low water to 1.75 hours before high water, which further minimises fine sediment deposition in the more sensitive areas.

The production rate for the dredger using a 10 $m^3$ bucket will be approximately 11,000 $m^3$ per week. Based on this, dredging could be undertaken over a 58-week period, which is the quickest timeframe that this could realistically be undertaken. This assumes a 10 $m^3$ closed bucket is used for all dredge material and that dredging would only be undertaken on a flood tide (amended to 1.75 hours before low water to 1.75 hours before high water). See ES Chapter 5: Demolition and Construction for further detail.

ES Chapters 6: Coastal Processes and Sediment Regime, 8: Marine Water and Sediment Quality, and 9: Marine Ecology should be referred to for assessment of effects from dredging on receptors in the marine environment.

### 2.4 Maintenance Dredging

At this stage, limited maintenance dredging is anticipated to be required at the site, given the relatively low siltation rates in the Fal Estuary and the 300 mm siltation allowance provided within the berth pockets. The anticipated volume of maintenance dredging is estimated to be up to approximately 8,000 $m^3$ every 5 years (or, up to approximately 16,000 $m^3$ every 10 years), as required within the eastern berth pocket. See ES Chapter 6: Coastal Processes and Sediment Regime and TA 6.2: Sediment Transport Modelling Report for further detail.

## 3. Dredged Material Characteristics

With regards to the capital dredge, the total volume of dredged material would be approximately 643,000 $m^3$, dredged over an area of approximately 232,500 $m^2$. Dredged material would comprise seabed material in addition to rock material that has been identified in the dredge pockets through geophysical surveys.

A Ground Investigation (GI) was conducted at the site in March 2024[6,7]. The GI works comprised a total of 21 environmental vibrocores taken to the maximum depth of 6.0 m below the existing seabed level. The locations of the vibrocore samples are shown in Figure 3. The locations were selected and agreed in consultation with the MMO and Cefas (approved under reference SAM/2023/00055), and the required sediment testing was undertaken in line with relevant requirements[8].

Further geotechnical investigation will be undertaken prior to the proposed works for the purpose of informing the design process and ensuring safe and structurally sound design.

## 3.1 Geology and Superficial Geology

According to British Geological Survey (BGS) 1:50,000 mapping[9] of the area, the site is directly underlain by sedimentary bedrock geology of Portscatho Formation – sandstone and argillaceous rocks, interbedded.

Given the location of the site (docks within marine waters), the BGS mapping has not identified any superficial geology at the site. However, the closest recorded superficial geology comprises marine beach deposits – sand and gravel. A drop-down video (DDV) survey conducted at the site in May 2022[10] recorded seabed conditions at the site consisting predominantly of sublittoral cohesive mud and sandy mud with generally mixed (coarser) sediments occurring further from the existing port structures. A Multidisciplinary Ecological Survey undertaken in May 2023[11], involving DDV transects, ROV inspections and grab samples found that sediments within the western berth pocket were generally sandy mud or muddy sand with a small proportion of gravels within the sediments. Sediments to the north of Queens' Wharf and east of the Docks had a much higher proportion of gravel sediments.

The 2024 GI confirmed that the site conditions comprised of marine sediments (typically described as a soft black silty clay or black clayey silt with occasional anthropogenic material, becoming firm to very stiff orangish brown or greenish grey gravelly clay with fine to coarse siltstone and slate gravel with depth), which ranged in thickness between 0.5 m and 1.0 m. This was underlain by the Portscatho Formation, described as soft laminated grey clay, or very soft greenish grey mottled light bluish grey clay with shell fragments, to firm or stiff orangeish brown mottled greenish grey gravelly clay with slate and siltstone gravel. Below this, the formation was generally recorded as a greenish grey clayey mudstone, slate gravel and clay.

## 3.2 Sediment Characteristics and Testing

The 2024 GI provides information on conditions across the proposed dredging footprint with regards to sediment particle size and contamination concentrations present at the site. A sediment sampling plan was formally agreed with Cefas and the MMO, including the required testing of samples at approved laboratories (locations of the vibrocores are shown in Figure 3).

[6] ES Volume 2, Technical Appendix 8.1. Geotechnical Engineering Limited (2024). Falmouth Docks Development Factual Ground Investigation Report (Ref. 37977).

[7] ES Volume 2, Technical Appendix 8.3. Ramboll UK Ltd (2024). Falmouth Docks Development Ground Investigation Interpretative Report.

[8] Marine Management Organisation (2023). Guidance. Marine Licensing: sediment analysis and sample plans [online]. Available at: [Marine Licensing: sediment analysis and sample plans - GOV.UK (www.gov.uk)] [Accessed 17/09/2024]

[9] BGS Geology Viewer. Available online at: https://www.bgs.ac.uk/map-viewers/bgs-geology-viewer/ [Accessed 14/05/2024]

[10] ES Volume 2, Technical Appendix 9.1. Carcinus Ltd (2022) Drop Down Video (DDV) Survey Report for the Port of Falmouth, Cornwall. A report to Ramboll UK Ltd. on behalf of the Falmouth Docks and Engineering Company by Carcinus Ltd. J0654/22/05/23. Southampton: Carcinus Ltd

[11] ES Volume 2, Technical Appendix 9.3. Carcinus Ltd. (2024) Benthic Ecology Survey Report in support of the Port of Falmouth Development. A report to Ramboll UK Ltd. on behalf of the Falmouth Docks and Engineering Company by Carcinus Ltd. J0710/24/03/04. Southampton: Carcinus Ltd.

Marine sediment samples were taken at surface level, and at every 1.0 m interval until the required depth (the proposed dredge depth shown on Figure 2) or bedrock was reached.

The results of the GI are summarised below. The Factual Ground Investigation Report[6] and Ground Investigation Interpretative Report (GIIR)[7] should be referred to for further detail.

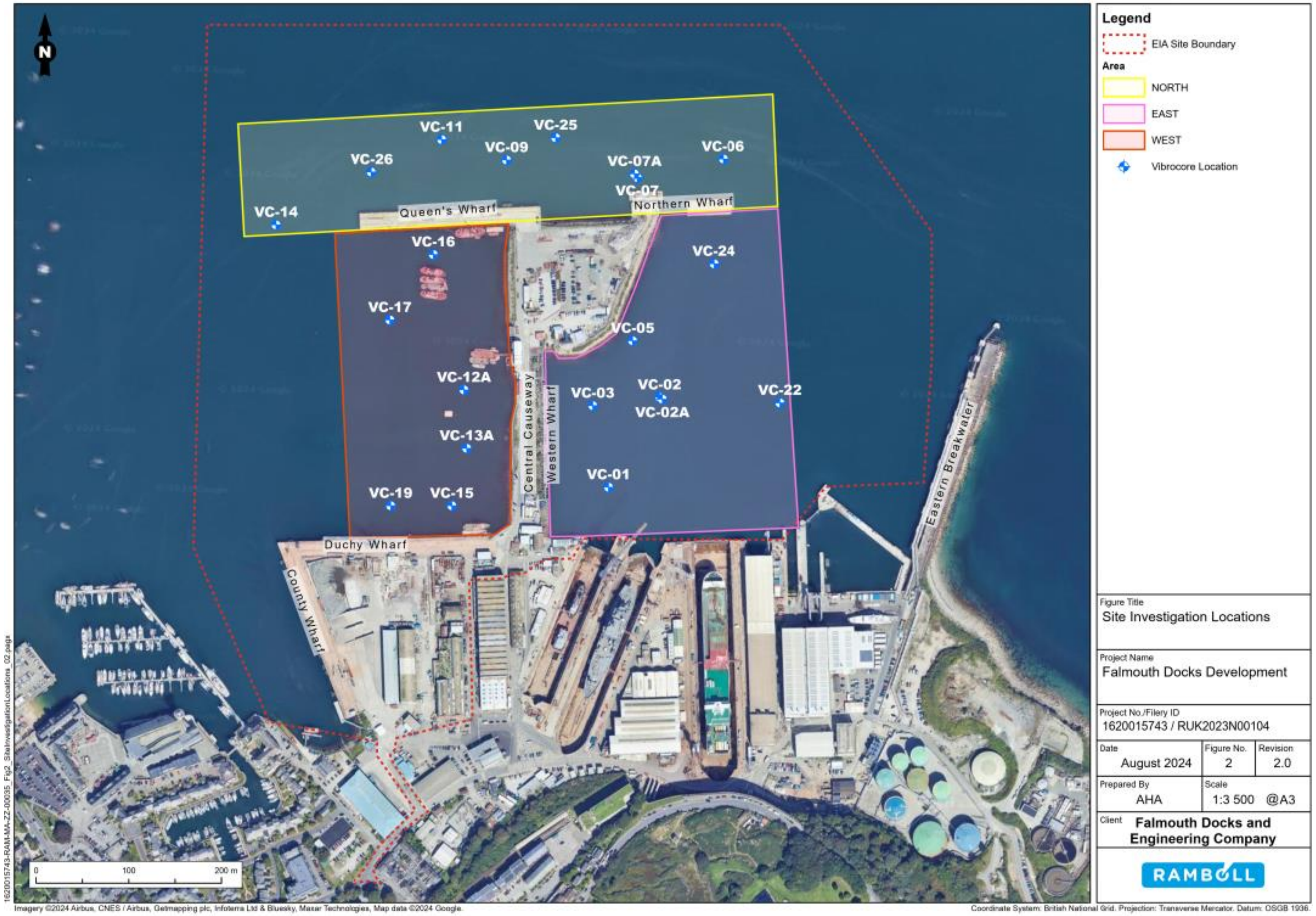



**Figure 3: March 2024 Ground Investigation Vibrocore Locations**

### 3.2.1 Total Organic Carbon Content

The total organic carbon of each sample taken during the 2024 GI was determined, the results of which are presented in Appendix 1. The total organic carbon content of the samples ranged from 0.11 – 6.85%, with a mean of 1.63%.

### 3.2.2 Particle Size Analysis (PSA)

Particle size data for each sample taken during the 2024 GI was also obtained. The percentage of <63 µm of each sample was determined for the purpose of modelling the sediment mobilisation due to dredging operations, and this data is presented in Appendix 1. The percentage of <63 µm of the samples ranged from 14.60 - 98.25%, with a mean of 66.96%. Further GI will be required, prior to construction, specifically for design purposes and to confirm properties for re-use of material.

### 3.2.3 Chemical Analysis

Chemical analysis of the 2024 GI samples was undertaken with regard to the agreed MMO and Cefas requirements and as detailed within the GIIR[7]. The objective of the assessment within the GIIR was to determine the volume of dredge material suitable for disposal at sea.

Marine sediment samples from the 2024 GI were tested for a suite of determinants as per the agreed MMO and Cefas requirements. These determinants are associated with industrial uses and were chosen to target potential contamination that could exist in the sediment on-site. This included heavy metals, total hydrocarbon content, organo-tins (Tributylin (TBT) and Dibutylin (DBT)), pesticides, polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and polybrominated diphenyl ethers (PBDE).

The data was compared against published Cefas Action Levels[12] and various additional risk-based assessment criteria (see the GIIR[7] for detailed description of methodology and criteria employed in line with consultation with Cefas and the MMO). Following initial screening, the next stage of the risk assessment was to review all site data to understand lateral and vertical extent of contamination. This was completed using all exploratory hole logs and visual/olfactory evidence of contamination to determine the thickness of the stratum which each sample could be considered to represent. This provides a robust and evidence-based approach for estimating likely thickness of sediment considered unsuitable for disposal to sea.

The chemical analysis and assessment determined that disposal at sea is not a viable option for a proportion of the dredge arisings (see GIIR[7]). The conclusion of the assessment has resulted in the estimated thickness of shallow sediments unsuitable for disposal to sea[7]. As described within the GIIR, two scenarios have been developed (Scenario 1 (least conservative) and Scenario 2 (more conservative)), which differ in their definitions of depths and areas of impacted sediment. Figures 1a and 1b (Appendix 2) illustrate the estimated thickness of shallow sediments across the site considered unsuitable for disposal to sea, in Scenarios 1 and 2 respectively. The remaining, deeper, sediments are considered to be suitable for disposal at sea.

The sediment chemical analysis was used to complete a waste classification of the dredge material as hazardous or non-hazardous in accordance with the procedure provided in the WM3

[12] Marine Management Organisation, 2023. Marine Licensing: sediment analysis and sample plans. https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans Accessed: May 2024.

guidance[13]. In a similar manner to that described above for the risk assessment, the site data was used to determine the thickness and extent of the stratum which each sample could be considered to represent. This provides a robust and evidence-based approach for estimating likely thickness of sediment considered hazardous. Figure 1 within Appendix 3 illustrates the estimated thickness of shallow sediments considered to be hazardous.

# 4. Assessment of Available Disposal Options

## 4.1 Application of Waste Hierarchy

This BPEO assessment has sought to manage environmental concerns and follow the waste hierarchy[14] as far as reasonably possible to minimise adverse environmental impacts. The first step in the waste hierarchy ('prevention') has been the priority consideration.

### 4.1.1 Prevention

A key design parameter for the proposed development has been the minimisation of dredging as far as possible to reduce the volume of material generated by dredging in the first instance. The proposed dredging (illustrated on Figure 2) is considered to be the minimum possible extent and volume, whilst allowing the design objectives and underkeel requirements of Excellence Class cruise ships and FLOW devices to be achieved, and to allow for safe navigation and berthing of these at the docks. Dredging is limited to berth pockets only and avoids dredging of the approach channel to Falmouth Docks. Large vessels would therefore make best use of the tides to access and egress the dock infrastructure.

## 4.2 Consideration of Potential Management and Disposal Options

### 4.2.1 Assessment Methodology

Application of the waste hierarchy has underpinned the assessment of potential disposal options below. The following potential management and disposal options have been identified:

- Incineration
- Spreading on Agricultural Land
- Construction Fill/Material
- Aggregate Production
- Beach Nourishment
- Recycling Centre
- Disposal at Sea
- Landfill

In Section 4.3 (Scoping), each of the identified management and disposal options are briefly described in turn, and it is determined whether each option is evidently either reasonably feasible or not. Where an option is not considered feasible, the reason for this is provided and the option is not progressed for further assessment. Conversely, where an option is considered reasonably feasible, the option is short-listed and progressed to Section 4.4 (Further Assessment), for further assessment of the relative advantages and disadvantages it presents in terms of:

- Operational/technical practicalities;

[13] Environment Agency, 2018. Guidance on the classification and assessment of waste (1st Edition v1.2.GB). Technical Guidance WM3. Available at: Waste_classification_technical_guidance_WM3.pdf [Accessed 09/09/2024].

[14] Defra (2011). Guidance on applying the Waste Hierarchy. Available at: Waste hierarchy guidance (publishing.service.gov.uk) [Accessed 16/09/2024]

- Anticipated environmental implications; and
- Cost implications.

Following this assessment, the BPEO is identified in Section 5.

## 4.3 Scoping

### 4.3.1 Incineration

The viability of incineration relates to the organic matter content (the combustible component) of the dredged material. Due to the low percentage of combustible materials (as described in Section 3.2.1), incineration is not considered practicable and therefore this option is **discounted**.

### 4.3.2 Spreading on Agricultural Land

Spreading on agricultural land would involve the landing, storage, dewatering and onward land-side transport of dredged material to identified agricultural fields. In addition, treatment of the sediments would likely be required to reduce salt concentrations to a level which would not be considered detrimental to the agricultural soils and terrestrial ecology.

The supply of material from the proposed development would need to be matched with a concurrent demand for such material for agricultural fields within a reasonable distance from the site, or appropriate temporary storage agreed.

The significant dewatering and treatment which would be required to ensure that the material is suitable for use makes this option unpracticable, and therefore it is **discounted**.

### 4.3.3 Construction Fill/Material or Land Reclamation

A proportion of the dredged material, specifically rock material, could be suitable for use as construction fill or material. This option would likely require handling, de-watering and re-working to segregate relevant material, with associated cost implications. The supply of material from the proposed development would need to be matched with a concurrent demand for such material within a reasonable distance from the site, or appropriate temporary storage agreed. For construction or reclamation projects off-site, there would be transport implications with material potentially requiring transit by road to the recipient site.

However, as the proposed development requires large inputs of material as part of the construction activities, for example for the proposed area of reclaimed land behind Western Wharf, the re-use of material for construction fill or reclamation is considered to be practicable (particularly in comparison to options that require removal of material from the Falmouth Docks site and transit to a recipient) and this option has been **short-listed**.

### 4.3.4 Aggregate Production

Certain entities within the aggregate production industry have the relevant permissions and infrastructure to undertake activities associated with the supply, sorting and working of dredged material.

Operational and cost implications for this option would be related to the landing, handling, and potential de-watering of dredged material and its onward transport to the identified recipient.

Aggregate production centres able to accept dredged material and with the capacity to receive the dredged material, within reasonable distance of the site, would need to be identified. However, the material generated by the proposed development will have a high proportion of fine/silt material, unlikely to be of interest to the aggregate industry as it would not be suitable for concrete production. As such, aggregate production is not considered to be practicable and therefore this option has been **discounted**.

#### 4.3.5 Beach Nourishment

Beach nourishment would involve the deposition of dredged material either by discharging straight from the dredging vessel onto a beach (likely using pipework) or transit via road to the recipient location and using machinery to place and spread the material. Potential impacts on local sediment dynamics and public access would require careful consideration.

The supply of material from the proposed development would need to be matched with a concurrent demand for such material at a recipient beach of similar physical characteristics (colour, general appearance and composition of material). The dredge material should be free from high levels of contamination and organic content and would need to have drainage qualities and load-bearing capabilities.

As the material generated by the proposed development would require significant treatment and processing and will have a high proportion of fine/silt material that could be easily washed away once deposited on a beach, beach nourishment is not considered to be practicable and therefore this option has been **discounted**.

#### 4.3.6 Recycling Centre

A proportion of the dredge arisings could be recycled by a landside facility with the suitable infrastructure and permissions to undertake activities associated with the treatment, processing, and recycling of dredged material.

Operational and cost implications for this option would be related to the landing, handling, and potential dewatering of dredged material and its onward transport to the identified recipient. Recycling centres able and with capacity to accept, receive and treat the dredged material, within reasonable distance of the site, would need to be identified.

Recycling is considered to be practicable and therefore this option has been **short-listed**.

#### 4.3.7 Disposal at Sea

The disposal of dredge arisings at sea involves the use of barges to transport material to a licensed disposal site at sea and is an established practice for management of dredge arisings. There are a number of open disposal sites in Devon and Cornwall[15], the closest of which is Falmouth Bay (B) Disposal Site (PL075) located approximately 9.4 km south-east of the site, in the English Channel.

Following analysis of the contaminant levels within the 2024 GI sediment samples[7] and subsequent consultation with Cefas to seek agreement on the approach to the management of contaminated material and the volume of material suitable for disposal at sea (as detailed above), it is concluded that a large proportion of the dredge material would be suitable for disposal at sea.

[15] Defra (online). Map Viewer. Available at: Untitled map (arcgis.com) [Accessed 18/09/2024]

Disposal at sea therefore presents a practicable solution and is **short-listed**.

### 4.3.8 Disposal at Landfill

Landfill is the burying and covering of material with soil and is considered to be the burial of material for purposes that cannot be considered as beneficial (i.e. the disposal of waste). Landfill sites able to accept dredged material and with the capacity to receive the dredged material, within reasonable distance of the site, would need to be identified.

ES Chapter 17: Materials and Waste provides information on the available landfill void capacity for hazardous material and inert and non-hazardous material in the south-west of England in 2023. The chapter identifies licensed waste management permitted non-hazardous landfills in the south-west and Cornwall, and hazardous landfills in the south-west, with whom engagement would be required to confirm their suitability to receive the dredged material.

Landfill is therefore considered to be a feasible option for the disposal of dredged material and is **short-listed** for further assessment, however given its low priority within the waste hierarchy, landfill is the last resort option.

## 4.4 Further Assessment of Short-Listed Disposal Options

Following the scoping of potential management and disposal options above, four options are considered to be practicable and therefore have been short-listed:

- Construction Fill/Material;
- Recycling Centre;
- Disposal at Sea; and
- Landfill.

The short-listed management and disposal options are now assessed for their relative advantages and disadvantages in turn within Tables 2-5 below.

**Table 2: Further Assessment of Construction Fill/Material**

| Consideration | Advantages | Disadvantages |
|---|---|---|
| Operational /Technical Practicalities | • Provided dredged material is of the correct grade or engineering specification suitable for the intended construction or reclamation purpose, re-use can be practical and beneficial as it reduces the virgin material requirements of other projects or construction activities. | • Material will require further geotechnical investigation, to ensure its competency for re-use as construction fill/material.<br>• Requires landing, and considerable handling, de-watering and re-working to segregate relevant material.<br>• Supply of material needs to be matched with a concurrent demand within a reasonable distance from the site, or appropriate temporary storage agreed during the time-period between the dredging and construction activities. |
| Anticipated Environmental Implications | • Re-use is preferential on the waste hierarchy (see Section 1.3) in comparison to other options.<br>• This option avoids use of landfill capacity or marine disposal sites. | • Any storage and handling of material on-site needs to be carefully designed and managed to avoid the entrance of sediment material back to the marine environment or effects relating to odour, run-off or dust. |

| Table 2: Further Assessment of Construction Fill/Material | | |
|---|---|---|
| **Consideration** | **Advantages** | **Disadvantages** |
| | • Re-use on-site avoids transport, carbon and noise implications as material does not require transit by road to the recipient site. | • For re-use off-site, there would be transport, carbon and noise implications with material potentially requiring transit by road to the recipient site. |
| Cost Implications | • Re-use of dredge material within construction activities reduces the imported/virgin material requirements of the project, minimising costs associated with purchase, procurement and transport of material to site. | • Requires handling, de-watering and re-working to segregate relevant material, with associated costs of labour and specialist equipment. |

| Table 3: Further Assessment of Recycling | | |
|---|---|---|
| **Consideration** | **Advantages** | **Disadvantages** |
| Operational /Technical Practicalities | • Dredged material is removed and managed off-site, potentially minimising stock-piling and management requirements. | • A facility with the suitable infrastructure, capacity and permissions to undertake activities associated with the treatment, processing, and recycling of the dredged material arisings is required.<br>• Operational logistics include the landing, handling, and potential de-watering of dredged material and its onward transport to the identified recipient. |
| Anticipated Environmental Implications | • Recycling is higher on the waste hierarchy (see Section 1.3) in comparison to disposal. | • Any storage and handling of material on-site needs to be carefully designed and managed to avoid the entrance of sediment material back to the marine environment or effects relating to odour, run-off, or dust.<br>• Transport, noise and carbon implications as material requires transit by road to the recipient recycling centre. |
| Cost Implications | • Use of recycling centres is generally a less expensive option than landfill. | • Costs associated with the landing, handling, and potential dewatering of dredged material and its onward transport to the identified recipient, in addition to potential payment of fee to recipient centre. |

| Table 4: Further Assessment of Disposal at Sea | | |
|---|---|---|
| **Consideration** | **Advantages** | **Disadvantages** |
| Operational /Technical Practicalities | • This option avoids the operational landside logistics associated with landing, handling, potentially de-watering and onward transport of dredged material. | • A barge(s) is required to support the backhoe dredger, so that material suitable for disposal at sea can be loaded directly onto the barge and taken to the disposal site. |

**Table 4: Further Assessment of Disposal at Sea**

| Consideration | Advantages | Disadvantages |
|---|---|---|
| | • This option is common practice and undertaken in line with relevant licence conditions. | |
| Anticipated Environmental Implications | • This option avoids the transport, noise and carbon implications associated with material requiring transit by road (potentially with greater public acceptability).<br>• This option avoids filling landfill capacity with dredge material.<br>• By using a marine disposal site within proximity to the site, this option retains sediment within the same sediment cell. | • Disposal is a last resort within the waste hierarchy.<br>• Vessel movements required between the application site and disposal site need to be minimised to reduce vessel emissions and any potential impacts on ongoing maritime activities.<br>• The disposal of material at sea generates sediment plumes and temporary increases in suspended sediment concentrations prior to settlement of material on the seabed. |
| Cost Implications | • Landing, treatment, de-watering, processing, and transport of material via Heavy Goods Vehicle (HGV) is not required, eliminating a number of costs. | • Costs associated with sea disposal are related to the mobilisation of barges, including fuel costs during transit (however, this would likely be lower than those for other options). |

**Table 5: Further Assessment of Landfill**

| Consideration | Advantages | Disadvantages |
|---|---|---|
| Operational /Technical Practicalities | • Dredged material is removed and managed off-site, potentially minimising stock-piling and management requirements. | • Landfill sites permitted to and with the capacity to receive dredged material of the relevant waste classification, within reasonable distance of the site, would need to be identified. |
| Anticipated Environmental Implications | • Landfills are typically sites with limited natural resource value, so impacts from an environmental perspective at the landfill site are limited. | • Disposal is a last resort in the waste hierarchy.<br>• Impact on landfill capacity in addition to transport, noise and carbon implications associated with material requiring transit by road.<br>• Any storage and handling of material on-site needs to be carefully designed and managed to avoid the entrance of sediment material back to the marine environment or effects relating to odour, run-off or dust. |
| Cost Implications | N/A | • Likely high costs associated with the landing, handling, potential de-watering of dredged material and its onward transport to the identified landfill site, in addition to payment of landfill use fee or similar to the landfill operator. |

# 5. Identification of the BPEO

### 5.1.1 Capital Dredge

The dredge material arising from the proposed development is not homogenous in its physical or chemical characteristics. As such, according to the dredged sediments' competency, levels of contamination, and classification as either hazardous or non-hazardous, a different management and disposal option is considered to be the BPEO. Following the assessment of relative advantages and disadvantages in Section 4.4, it is therefore considered that the BPEO is as follows:

1. For dredge material that is suitable for such re-use, the option to re-use dredge material as construction fill/material on-site is considered to be the BPEO. This option is preferential within the waste hierarchy and would reduce the imported/virgin material requirements associated with the proposed development, for example within the area of reclamation behind Western Wharf.
2. For the remaining proportion of dredge material that is suitable for disposal at sea, disposal at an approved marine disposal site is considered to be the BPEO due to the proximity of Falmouth Bay (B) Disposal Site and because disposal at sea eliminates a number of environmental, logistical and cost constraints presented by land-based disposal options (including storage and handling requirements, and the carbon, transport and noise impacts associated with removal of material from the site by HGV).
3. Land-based management/disposal options (the use of recycling centres and landfill sites) will be necessary for the remaining proportion of dredge material that is not suitable for disposal at sea. These options have cost implications and environmental impacts associated with landing, handling and onward transport of material by HGV and therefore, the volume of dredge material requiring land-based management/disposal will need to be minimised as far as reasonably practicable (i.e. by maximising on-site re-use and disposal at sea). Where recycling is possible, this option will be prioritised as far as reasonably practicable over landfill (with recognition of potential constraints posed by the availability, capacity and proximity of recycling centres, the current waste classification of the dredge material and technical challenges associated with segregation and treatment of material that can be recycled).

The current estimates of the volumes of material that can be appropriately managed and disposed of using each short-listed option is provided in Table 6.

**Table 6: Anticipated Management and Disposal of Dredged Arisings (Capital Dredge)**

| Management and Disposal Option | Approximate Volume of Material ($m^3$), estimated at time of writing | Notes |
|---|---|---|
| 1. Potential re-use on site as construction fill/material | 65,000 – 135,000 | Estimated based on historic GI and bedrock contour plans. Volume depends on weathered bedrock's ability to become competent quickly, considered likely. Potential volume of material to be re-used to be confirmed via further GI for the purpose of informing the design process and ensuring safe and structurally sound design; further GI considered unlikely to change estimate. |
| 2. Disposal at sea at approved disposal site | 357,000 (Scenario 2) – 394,000 (Scenario 1) | Calculated following the chemical analysis of sediment samples taken during the 2024 GI (described within Section 3.2.3 and GIIR[7]). |

| Table 6: Anticipated Management and Disposal of Dredged Arisings (Capital Dredge) | | |
|---|---|---|
| **Management and Disposal Option** | **Approximate Volume of Material ($m^3$), estimated at time of writing** | **Notes** |
| 3. Disposal on land, either recycling (better-case) or landfill (worst-case) | 184,000 (Scenario 1) – 221,000 (Scenario 2), of which 99,950 estimated to be hazardous | Distribution and depth of material considered unsuitable to be disposed of at sea is presented in Appendix 2, distribution and depth of hazardous material is presented in Appendix 3. Scenario 1 considered to be the BPEO in comparison to Scenario 2, to be agreed via consultation with MMO and Cefas. |
| **TOTAL** | **643,000** | |

The relevant technical assessments within ES Volumes 1 and 2 should be referred to for detailed assessment of environmental effects (mentioned in Tables 2-5) associated with the management and disposal options.

### 5.1.2 Maintenance Dredges

The scoping and further assessment of potential management and disposal options within this report is also considered to apply to any maintenance dredging required at the site during the operational stage of the proposed development. As described above, limited volumes of maintenance dredging are anticipated to be required infrequently.

Material arising from maintenance dredge campaigns is expected to be suitable for disposal at sea (as contaminants will have been removed from the site during the capital dredge, reducing the contaminant loading within the site). Given the low volumes and anticipated infrequent, ad-hoc nature of future maintenance dredging, it is considered that the BPEO for maintenance dredge arisings is disposal at sea. This is concluded due to the proximity of the nearest marine disposal site and because disposal at sea eliminates a number of environmental, logistical and cost constraints presented by land-based disposal options.

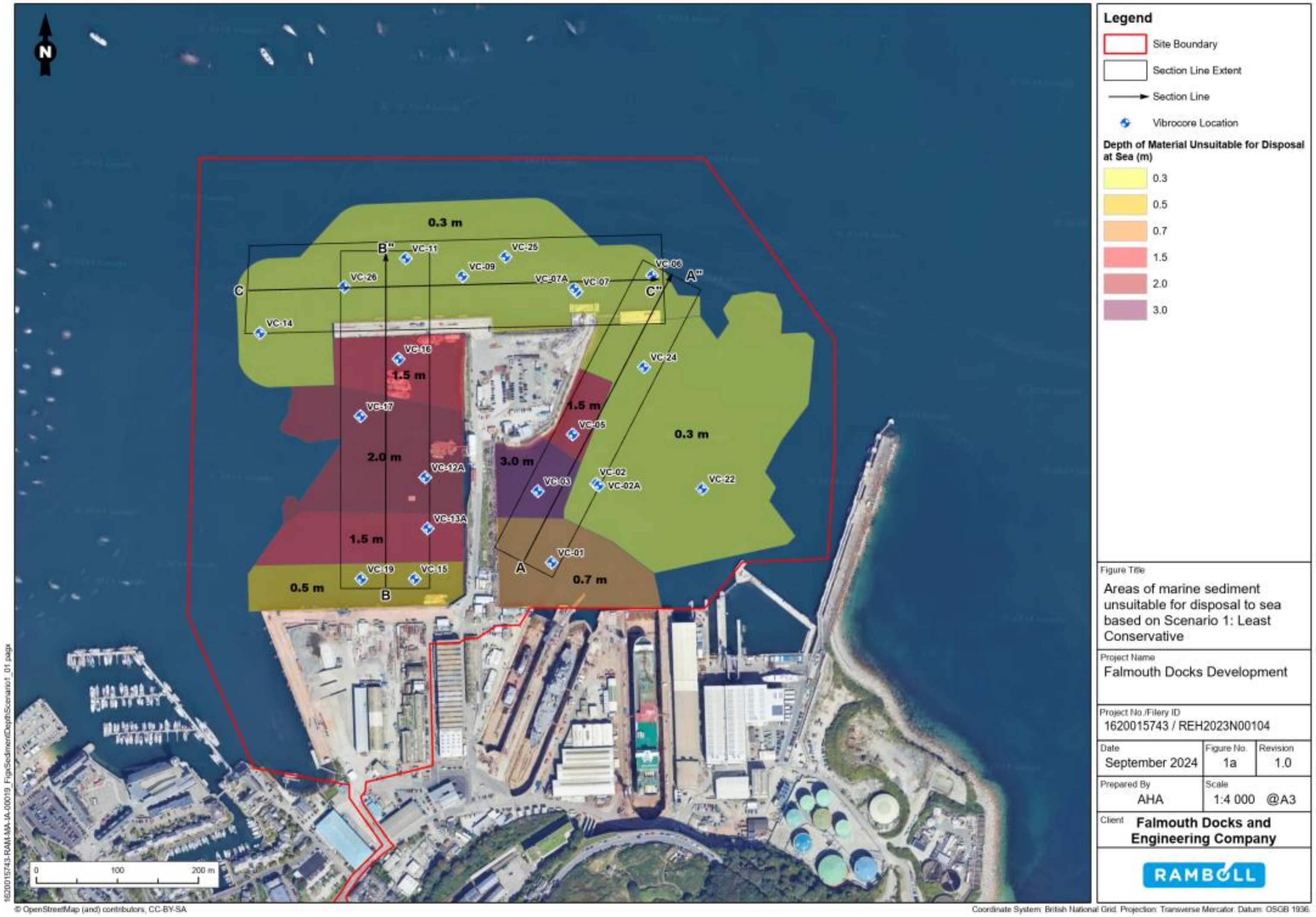
# Appendix 1
## Total Organic Carbon and Particle Size Data

**Appendix 1, Table 1: Total Organic Carbon (%) and Particle Size Data (% <63 µm) of 2024 Ground Investigation Samples**

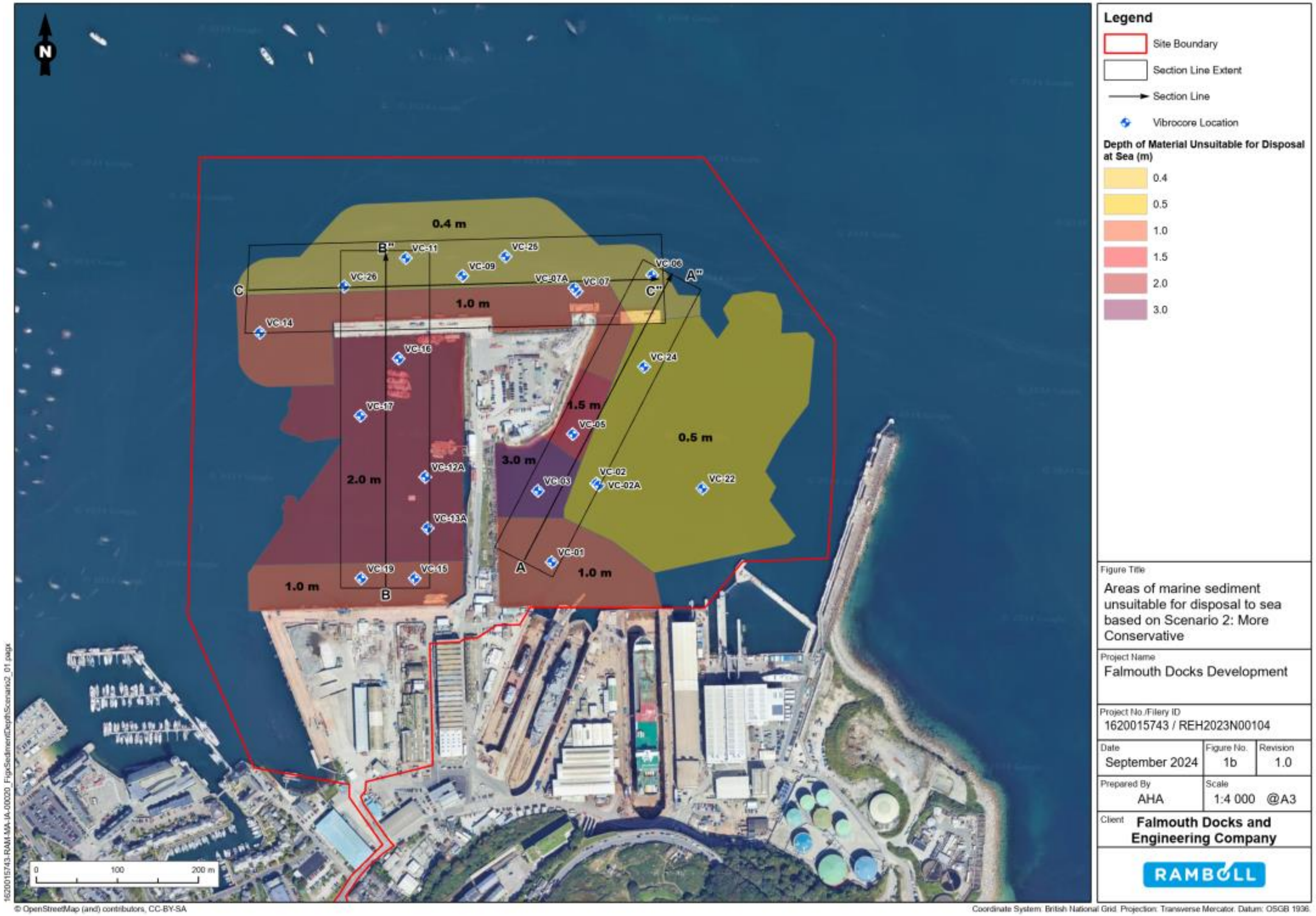
| Sample Reference and Depth | Location within site (Figure 3) | Total Organic Carbon (%m/m) | Particle Size (% <63 µm) |
|---|---|---|---|
| VC-01 0.00-0.10m | East | 2.47 | 73.12 |
| VC-01 1.00-1.10m | | 1.23 | 94.73 |
| VC-01 2.00-2.10m | | 1.32 | 91.81 |
| VC-01 3.00-3.10m | | 1.23 | 94.45 |
| VC-01 3.55-3.65m | | 0.43 | 42.92 |
| VC-02 0.05-0.15 | East | 0.23 | 87.24 |
| VC-02 0.90-1.00 | | 0.16 | 42.33 |
| VC-02A 0.00-0.10m | East | 1.39 | 36.17 |
| VC02A 1.00-1.10m | | 0.13 | 22.43 |
| VC-02A 1.40-1.50m | | 0.13 | 28.27 |
| VC-03 0.00-0.10 | East | 2.53 | 78.02 |
| VC-03 1.00-1.10 | | 3.35 | 71.42 |
| VC-03 2.00-2.10 | | 4.01 | 72.08 |
| VC-03 3.00-3.10 | | 0.32 | 19.31 |
| VC-05 0.00-0.10m | East | 2.56 | 63.33 |
| VC-05 1.00-1.10m | | 1.23 | 51.44 |
| VC-05 2.00-2.10m | | 0.30 | 98.25 |
| VC-05 3.00-3.10m | | 0.41 | 97.03 |
| VC-05 3.90-4.00m | | 0.20 | 64.41 |
| VC-06 0.00-0.05 | North | 0.90 | 58.41 |
| VC-06 1.00-1.10 | | 0.19 | 54.51 |
| VC-06 2.00-2.10 | | 0.11 | 19.76 |
| VC-06 2.55-2.65 | | 0.12 | 14.60 |
| VC-07 0.00-0.10 | North | 1.68 | 58.19 |
| VC-07 1.00-1.10 | | 0.22 | 20.74 |
| VC-07 1.20-1.30 | | 0.18 | 25.49 |
| VC-07A 0.00-0.10m | North | 2.92 | 54.59 |
| VC-07A 1.00-1.10m | | 0.20 | 38.46 |
| VC-07A 2.00-2.10m | | 0.12 | 45.99 |
| VC-09 0.00-0.10 | North | 2.26 | 42.24 |
| VC-09 1.00-1.10 | | 1.64 | 91.86 |
| VC-09 2.00-2.10 | | 1.80 | 90.77 |
| VC-09 3.00-3.10 | | 1.83 | 86.73 |
| VC-09 4.00-4.10 | | 1.38 | 89.33 |
| VC-09 5.00-5.10 | | 2.13 | 19.43 |
| VC-11 0.00-0.10 | North | 0.21 | 63.61 |
| VC-11 1.00-1.10 | | 1.61 | 73.95 |
| VC-11 2.00-2.10 | | 0.80 | 75.34 |
| VC-11 3.00-3.10 | | 1.81 | 85.48 |
| VC-11 4.00-4.10 | | 1.89 | 88.04 |
| VC-11 5.00-5.10 | | 2.52 | 89.61 |
| VC-11 5.30-5.37 | | 1.81 | 81.87 |

| | | | |
|---|---|---|---|
| VC-12A 0.00-0.10m | West | 2.71 | 87.11 |
| VC-12A 1.00-1.10m | | 4.56 | 86.54 |
| VC-12A 2.00-2.10m | | 1.28 | 92.09 |
| VC-12A 3.00-3.10 | | 1.54 | 92.86 |
| VC-12A 4.00-4.10m | | 1.93 | 85.69 |
| VC-12A 5.00-5.10m | | 2.44 | 68.64 |
| VC-13A 0.00-0.80m | West | 6.85 | 37.88 |
| VC-14 0.00-0.10m | North | 3.43 | 39.21 |
| VC-14 1.00-1.10m | | 1.79 | 92.10 |
| VC-14 2.00-2.10m | | 2.03 | 90.87 |
| VC-14 3.00-3.10m | | 2.17 | 88.68 |
| VC-15 0.00-0.10m | West | 2.14 | 45.70 |
| VC-15 1.00-1.10m | | 0.18 | 21.73 |
| VC-16 0.00-0.10m | West | 2.29 | 89.86 |
| VC-16 1.00-1.10m | | 4.27 | 68.17 |
| VC-16 2.00-2.10m | | 1.56 | 88.60 |
| VC-17 0.00-.0.10m | West | 2.33 | 72.44 |
| VC-17 1.00-1.10m | | 4.14 | 71.84 |
| VC-17 2.00-2.10m | | 1.66 | 60.59 |
| VC-17 3.00-3.10m | | 2.09 | 86.70 |
| VC-17 4.00-4.10m | | 1.74 | 81.82 |
| VC-17 5.10-5.20m | | 1.59 | 78.83 |
| VC-19 0.00-0.10m | West | 2.39 | 69.68 |
| VC-19 1.00-1.10m | | 2.21 | 86.38 |
| VC-19 2.00-2.10m | | 2.33 | 90.76 |
| VC-19 3.00-3.10m | | 2.46 | 84.05 |
| VC-22 0.00-0.10 | East | 1.54 | 47.80 |
| VC-22 1.00-1.10 | | 0.16 | 42.88 |
| VC-24 0.00-0.10 | East | 0.86 | 30.01 |
| VC-24 1.00-1.10 | | 0.26 | 93.79 |
| VC-24 1.90-2.00 | | 0.25 | 56.51 |
| VC-25 0.00-0.10 | North | 1.74 | 44.61 |
| VC-25 1.00-1.10 | | 2.45 | 86.39 |
| VC-25 2.00-2.10 | | 1.76 | 90.18 |
| VC-25 3.00-3.10 | | 1.99 | 84.40 |
| VC-25 3.90-4.00 | | 0.16 | 19.16 |
| VC-26 0.00-0.10m | North | 2.18 | 74.39 |
| VC-26 1.00-1.10m | | 1.26 | 85.68 |
| VC-26 2.00-2.10m | | 1.32 | 89.16 |
| VC-26 3.00-3.10m | | 1.60 | 89.40 |

# Appendix 2
## Estimated Thickness of Shallow Sediments Considered Chemically Unsuitable for Disposal at Sea




**Appendix 2, Figure 1a: Estimated Thickness of Shallow Sediments (Depth from Seabed Surface) Considered Chemically Unsuitable for Disposal at Sea, Scenario 1**




**Appendix 2, Figure 1b: Estimated Thickness of Shallow Sediments (Depth from Seabed Surface) Considered Chemically Unsuitable for Disposal at Sea, Scenario 2**

# Appendix 3
## Estimated Thickness of Shallow Sediments Considered to be Hazardous


**Appendix 3, Figure 1: Estimated Thickness of Shallow Sediments (Depth from Seabed Surface) Considered to be Hazardous**