8. Marine Water and Sediment Quality

The marine water and sediment quality ES chapter reports on the likely effects associated with the demolition and construction stage and operational stage of the proposed development.

Existing Conditions

A combination of a desk-based review of publicly available information, water sampling and sediment sampling was undertaken to understand the quality of marine sediment and water quality within the proposed dredging area.

The site and study area comprises:

- *Surface water bodies:*
  - Water Framework Directive Surface Water: the site is located in the Carrick Roads Outer water body. Downstream of the Carrick Roads Outer water body lies the Fal / Helford coastal waterbody.
  - Bathing Water: the nearest designated bathing water to the site is at Gyllyngvase beach, located approximately 1 km to the south-west of the site, on the far side of Pendennis Point
  - Shellfish Water: the site straddles the boundary between two designated shellfish water protected areas (Penryn and Carrick Roads). The Percuil shellfish water protected areas lies approximately 3.5 km to the east of the site on the far side of the Fal estuary.
  - Potential Disposal Site: the nearest operational marine sediment disposal site is Falmouth Bay located approximately 9.4 km to the south-east of the site, in the English Channel.
- *Surface Water Quality:* According to an independent environmental database, a sewage outfall is present to the east of the site. A total of 11 surface water samples were taken as part of the 2024 ground investigation at the site and tested for a range of determinants. Elevated concentrations of heavy metals were present due to the industrial uses of the surrounding land and the harbour and also may be as a result of naturally high metal concentrations in the local geology and impacts from the historic metal mining in the area.
- *Marine Sediment Quality:* Various contaminants have been encountered in the marine sediment across the site, such as heavy metals, PCBs, Organo-tins, pesticides, PAHs, and BDE. These show clear lateral and vertical patterns across the site: there is a general trend of decreasing contamination at greater sediment depths, and with increasing distance away from the wharfs.
- *Geology, Hydrology and Groundwater:* The site is underlain by a Secondary A Aquifer (permeable foundations with potential to support localised abstractions). The site is not located within a source protection zone and is not within a drinking water safeguard zone.

Demolition and Construction

During the demolition and construction stage the following impacts and effects have been assessed:

- Direct impacts on the marine sediment and water body receptors at the site from dredging activities which would result in not significant effects ranging from negligible to minor in scale;
- Direct impacts on the marine sediment and water body receptors downgradient of the site from the dredging activities which would result in a not-significant effect of minor scale.
- Direct impacts to the marine sediment and water body receptors at the off-shore disposal site which would result in not significant effects that are minor in scale; and
- Impact to marine sediments and waterbodies from piling activities and other in-ground works which would result in not significant effects ranging from negligible-minor in scale.

Operation

Impacts during operation would comprise some small-scale maintenance dredging, which would result in not-significant effects that are minor in scale.

Falmouth Bay Disposal Site

8 Marine Water and Sediment Quality

8.1 Introduction

8.1.1 This chapter reports on the likely marine water and sediment quality effects associated with the demolition and construction stage and operational stage of the proposed development.

8.1.2 This chapter is supported by the following technical appendices within ES Volume 2:

- Technical Appendix 8.1 – Falmouth Docks Development: Factual Ground Investigation Report[1];
- Technical Appendix 8.2 – Falmouth Docks Development. Contaminated Land Desk Study[2];
- Technical Appendix 8.3 – Falmouth Docks Development. Ground Investigation Interpretative Report[3]; and
- Technical Appendix 8.4 – Water Framework Directive Report[4].

8.1.3 The information within this section relates to the marine proposed development works only, which aligns with EIA scoping.

8.1.4 The Contaminated Land Desk Study, included as Appendix 8.2, has been undertaken for the marine and land based development area, and so, only the information relevant to the marine proposed development works has been used for this assessment.

8.1.5 Impacts and effects on commercial fisheries and shellfisheries are assessed in Chapter 10: Commercial Fisheries and Shellfisheries. Impacts and effects on ecological receptors are assessed in Chapter 9: Marine Ecology. Sediment mobilisation and displacement effects are reported on in Chapter 6: Coastal Processes and Sediment Regime and the outputs have been used to inform this chapter. Impacts and effects relating to material resource and waste are assessed in Chapter 17: Material Resource and Waste.

8.1.6 The assessment has been informed by the following legislation, policies and published guidance:

National Legislation and Policy:

- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017[5];
- The Bathing Water Regulations 2013[6];
- National Policy Statement for Ports[7];
- Marine and Coastal Access Act 2009[8]; and
- The Conservation of Habitats and Species Regulations 2017[9].

Regional Policy:

- South West Inshore Marine Plan 2021[10].

Local Policy:

- The Cornwall Local Plan 2016[11], in particular Policy 23: Natural Environment.

National guidance and industry standards:

- Marine Licensing: sediment analysis and sample plans[12]; and
- Land Contamination Risk Management (LCRM): Stage 1 risk assessment[13].

8.2 Consultation

8.2.1 Table 8.1 summarises the key EIA Scoping Opinion responses with respect to the marine water and sediment quality assessment.

Table 8.1 Summary of Consultation

Consultee / Date of Consultation	Summary of Comments	Summary of Action Taken and Where in this Chapter Comments are Addressed
MMO EIA Scoping Response received 25 October 2023	**Coastal Processes** The release, dispersion and fate of material placed at disposal site (at sea) will be scoped out of the assessment for the potential demolition and construction effects. The rationale for this is that the volumes and types of material to be disposed of at sea will be dependent on the levels of contamination present and will be disposed of in accordance with the licence of the disposal site, both in terms of volume and contaminant levels. Whilst the MMO understands your position, it does not account for the potential dispersal of contaminants as the material is being dredged from the wharf area. The MMO suggests this should be accounted for. **Water Quality** Increases in suspended sediment concentrations (SSC) during construction and operation (e.g., future dredging works) have the potential to smother sensitive habitats. The ES should include information on the sediment quality and potential for any effects on water quality through suspension of contaminated sediments. The EIA should also consider whether increased suspended sediment concentrations resulting are likely to impact upon interest features and supporting habitats of the designated sites as listed above.	HR Wallingford has undertaken modelling to inform sediment transportation resulting from the proposed development, which is reported on in ES Chapter 6: Coastal Processes and Sediment Regime; this includes information on the dispersion of contaminants, which has been used to inform this ES chapter. HR Wallingford has modelled the effect of the proposed development on SSC (Chapter 6: Coastal Processes and Sediment Regime). The effect on water quality has been reported on in this chapter, and the effects on habitats and designated sites in Chapter 9: Marine Ecology and associated technical appendices.

[1] Geotechnical Engineering Ltd (GEL), 2024. Falmouth Docks Development. Factual Ground Investigation Report. Report Reference: 37977. Version: 1 of 1 - B. Dated: 20th May 2024.
[2] Ramboll, 2024. Falmouth Docks Development. Contaminated Land Desk Study. Report Reference: 15743-RAM-FD-SW-RP-EV-00020. Version: 1.0. Dated: 09 August 2024.
[3] Ramboll, 2024. Falmouth Docks Development. Ground Investigation Interpretative Report. Report Reference: 15743-RAM-FD-SW-RP-EV-00021.
[4] Ramboll, 2025. Falmouth Docks Development. Water Framework Directive Assessment. Report Reference: 15743-RAM-FD-SW-RP-EV-00022.
[5] The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. Available at: https://www.legislation.gov.uk/uksi/2017/407/contents/made
[6] The Bathing Water Regulations 2013. Available at: https://www.legislation.gov.uk/uksi/2013/1675
[7] Department for Transport, 2012. National Policy Statement for Ports. The Stationery Office, London. Available [online] at: https://assets.publishing.service.gov.uk/media/5a78c20ae5274a277e68f3b1/national-policy-statement-ports.pdf.
[8] Marine and Coastal Access Act 2009 Available at https://www.legislation.gov.uk/ukpga/2009/23/contents
[9] The Conservation of Habitats and Species Regulations 2017. Available at: The Conservation of Habitats and Species Regulations 2017 (legislation.gov.uk)
[10] Department for Environment, Food and Rural Affairs, 2021. South West Inshore and South West Offshore Marine Plan. Available at: https://assets.publishing.service.gov.uk/media/60f6f71ce90e0764cfc22a78/FINAL_South_West_Marine_Plan__1_.pdf
[11] Cornwall Council, 2016. The Cornwall Local Plan 2016 – 2030. Available at: https://www.cornwall.gov.uk/planning-and-building-control/planning-policy/adopted-plans/#localPlan
[12] Marine Licensing: sediment analysis and sample plans, 2023. Available at: Marine Licensing: sediment analysis and sample plans - GOV.UK (www.gov.uk)
[13] Environment Agency (EA), 2023. LCRM: Stage 1 risk assessment. Available at: https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm/lcrm-stage-1-risk-assessment

Table 8.1 Summary of Consultation

Consultee / Date of Consultation	Summary of Comments	Summary of Action Taken and Where in this Chapter Comments are Addressed
Falmouth Harbour Commissioners received 11 September 2023	…suspension of contaminants into the water column may result in transportation to other local sediments outside of the site resulting in increased contamination levels impacting on other organisations ability to dredge to maintain safe navigational channels. Ideally it would be good to obtain additional baseline sampling in key areas of our fundus and marina seabed so we can potentially establish whether the docks works have had an impact on contamination levels.	Baseline sampling has been completed within the site, results are summarised in Section 8.8 Baseline Conditions. HR Wallingford has undertaken modelling to inform sediment transportation resulting from the proposed development, which is reported on in ES Chapter 6: Coastal Processes and Sediment Regime, with resultant effects reported in this chapter.
Environment Agency received 14 September 2023	**Pollution Prevention** This proposal outlines that there could be significant impacts within the estuary local to the development site although the WFD scoping suggests that the proposed activity and mitigation measure would not detrimentally impact the Carrick Roads WFD water body classification. Given the extent of piling, dredging and sediment disturbance likely to occur, there is a risk that estuarine water quality will be impacted unless suitable containment and mitigation measures such as the erection of silt curtains are deployed. Sediments near the docks have been historically contaminated with TBT so it is essential that any contaminated sediments are characterised and contained and where possible removed and not allowed to spread freely within the estuary. We note that matters of Marine Water and Sediment Quality and material resources and waste are scoped in which is supported. **Contaminated Land** Environmental risks associated with land contamination and redevelopment would be primarily controlled through planning conditions on any approved permission where required and consequently are typically excluded from the ES. This approach will be acceptable for the terrestrial portion of the site to identify the most appropriate options for management of land contamination risks. However, in relation to the proposal that incorporates the Northern arm, our records indicate that this area of the site is identified as the "New Site" historic landfill. This is likely to relate to deposit of material used in land reclamation associated with the original construction of the wharfs and management of potential contaminants from this material will require further assessment. Table 6-1 of the Scoping Opinion document Identifies Potential Effects from development of preferential pathways for contamination (line 1) and mobilisation of contamination during demolition and construction (line 2 and 3). Table 6-1 specifically refers to contaminated sediments and we recommend that these	Sediment characterisation is provided in Section 8.8. Discussion of pollution prevention measures, including sediment containment, is included in Section 7.9. As stated in the Contaminated Land Desk Study (Technical Appendix 8.2), the area of reclaimed land south of Northern Wharf (marine) which is classed as 'landfill' by the Environment Agency consists of Made Ground material described as slightly sandy clayey crushed shale and gravel and sandstone cobbles, with rare instances of sandy ash and occasional coal, and occasional concrete, brick, clay pipe, granite and mudstone gravel. Therefore this is not considered to pose a significant risk to the marine sediment and water quality and is not discussed further in this chapter.
Public Protection Contaminated Land Planning Consultations received 4 Sep 2023	'... a Phase I report (preliminary assessment) is required upon which substantive comments can be provided. In accordance with our consultation criteria, this report should be submitted prior to consulting this Service. However, no such report is available suggesting this has not been submitted... ...Please re-consult this Service when the outlined information has been submitted ....'	A desk study and preliminary risk assessment for the site has been prepared alongside this ES (Volume 2: Technical Appendix 8.2).

8.3 Assessment Scope

8.3.1 This assessment has been undertaken through the interpretation of baseline data, literature reviews, legislation and professional judgement and experience in accordance with applicable legislation, guidance, and policy as set out in subsequent sections of this chapter.

8.3.2 Standard EIA terms have been used, where appropriate, to provide consistency across the EIA and to accord with the general EIA approach set out in Chapter 2: EIA Process and Methodology.

Technical Scope

8.3.3 The technical scope of the assessment includes characterisation of current sediment and marine water chemical quality based on the Contaminated Land Desk Study (Technical Appendix 8.2) and the intrusive ground investigation completed in 2024 (Technical Appendix 8.1) and an assessment of the potential environmental impacts and likely effects that are, at this stage, anticipated to arise in connection with all stages of the proposed development relating to marine water quality and marine sediment quality.

8.3.4 Potential impacts and effects of the proposed development considered within this chapter, as well as the reasoning for their inclusion are summarised in Table 8.2 below:

Table 8.2 Summary of potential effects

Potential Effect	Comment
Potential Demolition and Construction Effects	
Formation of pathways between contaminated sediments or surface waters and the underlying Secondary A aquifer.	The proposed development design will incorporate piled structures, the construction of these may have the potential to create vertical pathways, allowing the migration of contamination between surface waters or contaminated sediments in continuity with surface waters into the underlying groundwater body.
Mobilisation of sediments during capital dredging and construction works (including demolition / removal of some of the existing marine structures) potentially causing adverse effects on human and ecological receptors in the vicinity, but also removing source of contamination from the site.	The proposed site works (including dredging) have the potential to disturb sediment (including contaminated sediment), potentially resulting in the exposure of construction workers, port operatives who work on the water and aquatic ecosystems to contaminated sediments. The potential effect on the ecological receptors is discussed in Chapter 9: Marine Ecology.

Table 8.2 Summary of potential effects	
	The potential beneficial effects of removal of contaminated sediment are considered. Potential impacts on users of designated bathing waters are scoped out due to the presence of Pendennis Point, which will direct currents (and thus sediment) away from the beaches.
Sediments being mobilised by dredging or construction works (including demolition / removal of some of the existing marine structures) and adversely affecting the water quality in the River Fal in the vicinity of the site.	The proposed site works (including dredging) have the potential to disturb sediment (including contaminated sediment), which may be capable of adversely affecting the chemical quality or turbidity of the River Fal and the wider Carrick Roads Outer water body.
Release, dispersion and fate of material placed at disposal site (at sea).	Sediments deemed suitable for disposal at sea will be disposed of at the marine disposal site (Falmouth Bay, PL075). The volume dredged and level of contamination present will determine the level of risk and thus the mitigation measures that need to be put in place. For example, control on the volumes and types of material to be disposed of at sea based on the levels of contamination present and disposal licence requirements. Beneficial reuse will be considered where practicable. The potential effects are discussed in Chapter 6: Coastal Processes and Sediment Regime, as well as this chapter.
Potential Operational Effects	
Increased suspended sediment concentration in water column during maintenance dredging.	There is some limited maintenance dredging proposed. The potential effects of this are covered within Chapter 9: Marine Ecology and Chapter 6: Coastal Processes and Sediment Regime, as well as this chapter.

Spatial Scope

8.3.5 The study area for the water and sediment quality topic is determined by assessing the distance over which direct and indirect effects of the project have the potential to occur. This takes into account both the range of the potential pathways and the receptors that could be impacted.

8.3.6 The study area comprises the proposed development footprint and a perimeter extending to 3.5 km. This radius includes the Carrick Roads Outer Waterbody, as well as sensitive ecological receptors including the Percuil shellfish water approximately 3.5 km east. The study area also comprises the disposal site, which is located at Falmouth Bay (site code PL075). This lies approximately 9.4 km to the south-east of the site (as the crow flies), in the English Channel.

Temporal Scope and Assessment Scenarios

8.3.7 The assessment has considered impacts arising during the demolition and construction stage which would mostly be temporary and short-term (up to 5 years) in nature, however, would include some potentially permanent effects of sediment re-deposition.

8.3.8 Impacts from the operational stage include only limited maintenance dredging, which is a temporary works scenario with the same temporal scope as the demolition and construction stage works (taking a precautionary approach).

8.4 Baseline Characterisation Method

Desk Study

8.4.1 The identification of baseline conditions in relation to water and sediment quality has been undertaken based on the review of available desk-study information included within the Contaminated Land Desk Study (Technical Appendix 8.2), derived from a number of sources as referenced below:

- Geological Survey of England and Wales, 1:50,000 Geological Map Series Sheet 352: Falmouth[14];
- British geological Survey Onshore GeoIndex[15];
- Environment Agency Catchment Data Explorer[16];
- Bathing Waters: list of designated waters in England[17];
- Landmark Information Group Envirocheck Report[18];
- Special Areas of Conservation (SACs) with marine components[19];
- MAGIC Interactive Mapping Website[20];
- DEFRA Bathing Water Quality[21]; and
- DEFRA Water Quality Archive[22].

Field Study

8.4.2 An intrusive investigation was undertaken by Geotechnical Engineering Limited on 18th to 20th March 2024 in the marine proposed development area to understand the quality of the marine sediment within the proposed dredging area, and to provide baseline chemical data for both the surface water and marine sediment. The sampling plan was approved by the MMO and Cefas in advance of the ground investigation.

8.4.3 Factual investigation data is provided in the Factual Ground Investigation Report (Technical Appendix 8.1). The Factual Ground Investigation Report includes borehole logs and laboratory analytical data that have been reviewed to inform this chapter.

8.4.4 The ground investigation data has been used to carry out a Tier 2: Generic Quantitative Risk Assessment (GQRA) as set out by the Land Contamination Risk Management[23] (LCRM) guidance, reported in full within the Ground Investigation Interpretative Report (Technical Appendix 8.3). Information from the full assessment has been summarised to aid baseline characterisation of sediment and surface water quality.

8.5 Assessment Method

8.5.1 The assessment of impacts within this chapter follows the general methodology set out in Chapter 2: EIA Process and Methodology.

8.5.2 This chapter will detail the baseline marine water and sediment quality at the site, focusing on chemical quality of sediment and water in the area of the site, WFD criteria and classifications.

[14] British Geological Survey (BGS), 2024. Geology of the country around Falmouth. Memoir for 1:50 000 geological sheet 352 (England and Wales), 1990. Available at: https://webapps.bgs.ac.uk/Memoirs/docs/B01739.html
[15] British geological Survey Onshore Geoindex, BGS Reference SW83SW5. Available at: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://api.bgs.ac.uk/sobi-scans/v1/borehole/scans/items/611338
[16] Environment Agency Catchment Data Explorer. Available at: https://environment.data.gov.uk/catchment-planning/WaterBody/GB650806250000
[17] Bathing waters: list of designated waters in England, 2023. Available at: Bathing waters: list of designated waters in England - GOV.UK (www.gov.uk)
[18] Landmark Information Group, 2024. Envirocheck Report. Report Reference: 342801869_1_1. Dated: 15th April 2024.
[19] Special Areas of Conservation (SACs) with marine components (all UK waters), 2021. Available at: Special Areas of Conservation (SACs) with marine components (all UK waters) - data.gov.uk
[20] MAGIC Maps, 2024. Available at: https://magic.defra.gov.uk/MagicMap.aspx
[21] Department for Environment Food & Rural Affairs (DEFRA), 2024. EA Bathing Water Quality. Available at: https://environment.data.gov.uk/bwq/profiles/
[22] DEFRA, 2021. EA. Water Quality Archive. Available at: https://environment.data.gov.uk/water-quality/view/download/new
[23] EA, 2023. Land contamination risk management (LCRM) Guidance. Available at: https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm

8.5.3 The assessment is supported by hydrodynamic modelling, as outlined in Chapter 6: Coastal Processes and Sediment Regime, to aid understanding of sediment mobilisation, transport and deposition during dredging and the area which may be impacted.

8.5.4 The impact assessment uses a source-pathway-receptor approach to identify the likely significance of effects, in particular the potential for mobilisation of sediment during dredging to impact receptors..

8.6 Assessment Criteria

8.6.1 Marine water and sediment quality baseline data from the intrusive investigation has been assessed using relevant published standards:

- The assessment of water chemical quality is based on the standards outlined in the Water Framework Directive, and the Priority Substances Directive. Further details are provided in the Ground Investigation Interpretative Report (Technical Appendix 8.3).
- The assessment of sediment chemical quality is established through the use of recognised guidelines and action levels including:
  - Cefas Action Levels for the disposal of dredged material[14]. Further details are provided in the Ground Investigation Interpretative Report.
  - OSPAR, 2009. Sediment Environmental Assessment Criteria (OSPAR EAC)[24].
  - USEPA, 1996. Marine Sediment Ecotoxicological thresholds[25, 26, 27].
  - Canadian guidelines including the 1999 Interim Marine Sediment Quality Guidelines (Canada SQGs)[28] (as listed on UK Marine Special Areas of Conservation website[18]) and Canadian Federal Environmental Quality Guidelines for PBDEs[29].
  - German Action Levels (ALs)[30] for TBT, PCBs and organochlorine pesticides (OCPs).

8.6.2 The general criteria used to assess if an effect is significant or not is set out in Chapter 2, and further details are provided herein. This is determined by consideration of the sensitivity of the receptor, magnitude of impact and scale of the effect. In assessment of the magnitude of the impact, consideration has been given to the duration of the effect, the geographical extent of the effect and the application of professional judgement.

Receptor Sensitivity / Value Criteria

8.6.3 The sensitivity of receptors has been classified as low, medium, or high in accordance with the criteria set out in Table 8.3.

Table 8.3 Receptor Sensitivity Criteria

Sensitivity	Criteria
Low	The receptor has a high capacity to accommodate change of water quality status due, for example, due to large relative size of the receiving water and capacity for dilution. Or, the receptor has the following designation: • A designated water body with an overall status of "poor" or "bad"; • A designated Bathing Water with a status of "Poor". Sediment is already contaminated with levels above Sediment Quality Guideline (SQG) 1 and may also be above SQG 2 (as defined in Technical Appendix 8.3). Sediment does not provide suitable substrate for sensitive ecological habitats.
Medium	The water quality of the receptor supports high biodiversity and/or has low capacity to accommodate change to water quality status. Or the receptor has the following designation: • A designated water body with an overall status of "Moderate"; • A designated Bathing Water with a status of "Sufficient". Sediment contaminant levels are generally below SQG 1 but some exceedances of SQG 1 may exist. Sediment may provide suitable substrate for sensitive ecological habitats.
High	The water quality of the receptor contributes towards the designation of a nationally or internationally important feature and/or has a very low capacity to accommodate any change to current water quality status. Or the receptor has the following designation: • A designated water body with an overall status of "Good" or "High"; • A designated Bathing Water with a status of "Good" or "Excellent". Sediment is uncontaminated, generally contaminant levels are below SQG 1. Sediment provides suitable substrate for sensitive ecological habitats.

Impact Magnitude Criteria

8.6.4 The magnitude of impact has been classified as low, medium or high, in accordance with the criteria set out in Table 8.4.

Table 8.4 Impact Magnitude Criteria

Magnitude of Impact	Criteria
Low	Noticeable but limited and/or short-term changes to the water quality status of the receptor. Any change would be quickly reversed. Activity is unlikely to alter local status such as the Water Framework Directive (WFD) or the Bathing Water Regulations (BWR) or have a long-term impact on receptor. Limited change to sediment quality.
Medium	Noticeable changes to the receptor. For example, water quality degraded to the extent that baseline conditions may take a considerable time to recover. Sediment quality altered to result in lasting improvement or deterioration of shallow sediments.
High	Major or long-lasting changes to the receptor. For example, water quality status degraded to the extent that a permanent or long-term change occurs; likely inability to meet Environmental Quality Standard (EQS); downgrading of WFD classification; permanent degradation to ecosystem or habitat. Major change to sediment contamination status (either adverse or beneficial).

24 OSPAR, 2009. Background Document on CEMP Assessment Criteria for QSR 2010 https://www.ospar.org/documents?v=7167. Available at: Microsoft Word - 461_Background Doc CEMP_ Assessment Criteria_Haz_Subs.doc (ospar.org). Accessed: July 2024

25 USEPA, 1996. USEPA Ecotox thresholds. Publication 9345.0-12FSI, 1996. Available at: Ecotox Thresholds (epa.gov). Accessed: July 2024

26 Lynda Webster and Rob Fryer, 2018. Status and trends of polycyclic aromatic hydrocarbons concentrations in sediment. UK Marine Online Assessment Tool, available at: https://moat.cefas.co.uk/pressures-from-human-activities/contaminants/pahs-in-sediment/. Accessed: July 2024

27 Long, E.R. et al, 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management, 19(1), pp.81–97.

28 Canadian Council of Ministers of the Environment (CCME), 1999. Canadian sediment quality guidelines for the protection of aquatic life. Accessed through UK Marine SACs Project website Accessed: July 2024.

29 Government of Canada, 2013. Canadian Environmental Protection Act, 1999. Federal Environmental Quality Guidelines. Polybrominated Diphenyl Ethers (PBDEs). February 2013. Available at: https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/canadian-environmental-protection-act-1999-9.html Accessed: August 2024.

30 OSPAR. Overview of Contracting Parties' National Action Levels for Dredged Material (2008 Update). Available at: https://www.ospar.org/documents?v=7113 Accessed: August 2024.

Scale of Effect Criteria

8.6.5 Impacts have been assessed on the basis of the value/sensitivity of receptors against the magnitude of impact to determine the scale of effect as presented in Table 8.5.

Table 8.5 Scale of Effect Criteria

Sensitivity of Receptor	Magnitude of Change (impact)		
	Low	**Medium**	**High**
Low	Negligible	Minor	Minor
Medium	Minor	Moderate	Moderate
High	Minor	Moderate	Major

8.6.6 Based on professional judgement, moderate and major effects are considered significant in EIA terms.

8.6.7 In determining the significance of reported effects, consideration has been given to the type of effect i.e. direct, indirect or secondary, the geographical extent of the effect and the duration of the effect i.e. temporary which is considered to be either short-term (up to 5 years) or medium-term (5-10 years) or long-term (10 years or more).

Nature of Effect Criteria

8.6.8 The nature of the effect is in accordance with Chapter 2 and has been described as either adverse, neutral or beneficial.

8.7 Assumptions and Limitations

8.7.1 In preparation of the ES chapter, Ramboll has relied upon publicly available information, information provided by the client and information provided by third parties. Accordingly, the conclusions in this report are valid only to the extent that the information provided to Ramboll was accurate, complete and available to Ramboll within the reporting schedule. Namely, the assessment has relied on data provided by Ramboll from a ground investigation carried out by Geotechnical Engineering Limited. It has been assumed that these data sets have been reported correctly.

8.7.2 The ground investigation works were undertaken during a discrete period of time. The findings and conclusions presented in this report are accordingly factually limited by these circumstances and, unless stated otherwise in the report, are preliminary. The field investigations were restricted to a level of detail necessary to meet the stated objectives of the services. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant period of time has elapsed since the sampling took place. The interpretation of the geological and environmental quality conditions is based on extrapolation from point-source data in a heterogeneous environment.

8.8 Baseline Conditions

8.8.1 The site lies along the northern side of the headland which terminates in Pendennis Point, at the point where the Penryn River and Carrick Roads channel meet within the Fal estuary. Water at the site is subject to tidal variation and sediment distribution and movement in this dynamic environment are controlled by multiple factors, including the competing currents within the estuary.

Surface Water Body Designations

Water Quality – Water Framework Directive Surface Water

8.8.2 The surface water body in which the site lies is designated under the Water Framework Directive (WFD) as the Carrick Roads Outer water body, with an overall water body status of 'moderate'. Carrick Roads Outer water body was classified as having a 'good' ecological status in 2022. In 2022, the water body did 'not require assessment' for chemical status, whilst in 2019 the chemical status was classified as 'fail' due to a change in assessment method whereby inclusion of four groups of global pollutants (ubiquitous, persistent, bioaccumulative and toxic substances (uPBTs)) caused all water bodies to fail chemical status. The Carrick Roads Outer water body's chemical status is 'good' when uPBTs are excluded.

8.8.3 The main activities noted as reasons for not achieving good status included:

- Dissolved inorganic nitrogen relating to poor livestock management and poor nutrient management;
- Dissolved inorganic nitrogen relating to sewage discharge (continuous);
- Tributyltin compounds relating to contaminated seabed sediments;
- Polybrominated diphenyl ethers (PBDE); and
- Mercury and its compounds.

8.8.4 Downstream from the Carrick Roads Outer water body lies the Fal / Helford coastal waterbody, which currently has a classification of 'good' ecological quality (2022), and 'fail' chemical quality (2019), with very similar characteristics as the Carrick Roads Outer water body. It is also noted that the water body also fails with respect to mercury compounds and PDBEs.

8.8.5 The Environment Agency monitors water quality within the site, at a sampling point approximately 100 m to the east of the Northern Arm[31]. Results from 2022 to 2024 indicate a typically low turbidity environment, with high levels of dissolved oxygen, and tributyltin being present in most samples.

8.8.6 For further detail refer to Technical Appendix 8.4 Water Framework Directive Assessment.

Water Quality – Bathing Water

8.8.7 The nearest designated bathing water to the site is at Gyllyngvase beach, located approximately 1 km to the south-west of the site, on the far side of Pendennis Point. Swanpool beach lies further along the same stretch of coast, approximately 1.7 km from the site, and also on the far side of Pendennis Point. Both beaches are classified as having excellent water quality[32], the water quality being classified in terms of *Intestinal Enterococci* and *Escherichia coli*.

Water Quality – Shellfish Water

8.8.8 The site straddles the boundary between two designated shellfish water protected areas (Penryn and Carrick Roads), each of which contains multiple individual shellfish beds for varieties of bivalve molluscs. Additionally, the Percuil shellfish water protected areas lies approximately 3.5 km to the east of the site on the far side of the Fal estuary.

8.8.9 The nearest shellfish bed lies approximately 3.2 km to the east of the site and has a classification of long-term class B, meaning that water there is of a quality to support the growth of molluscs that require some form of pre-treatment prior to sale. To the east of this bed lies a further bed, which has a seasonal A/B classification, which indicates water quality good enough to support the growth of molluscs and where the quality varies on a seasonal basis.

[31] DEFRA. Environment Agency, Water Quality Archive, Falmouth Docks Northern Wharf, online. Available at: https://environment.data.gov.uk/water-quality/view/sampling-point/SW-H1910125 Accessed July 2024.

[32] Defra. Environment Agency, Bathing Water Quality, online. Available at: https://environment.data.gov.uk/bwq/profiles/ Accessed: March 2025.

Water Quality – Potential Disposal Site

8.8.10 The nearest operational marine sediment disposal site to the site is PL075, Falmouth Bay (Figure 8.1). This lies approximately 9.4 km to the south-east of the site (as the crow flies), in the English Channel. The sea at that location is not classified under the WFD, due to its location beyond the extent to which WFD designation extends. No datasets are available to quantify water quality at the potential disposal site.

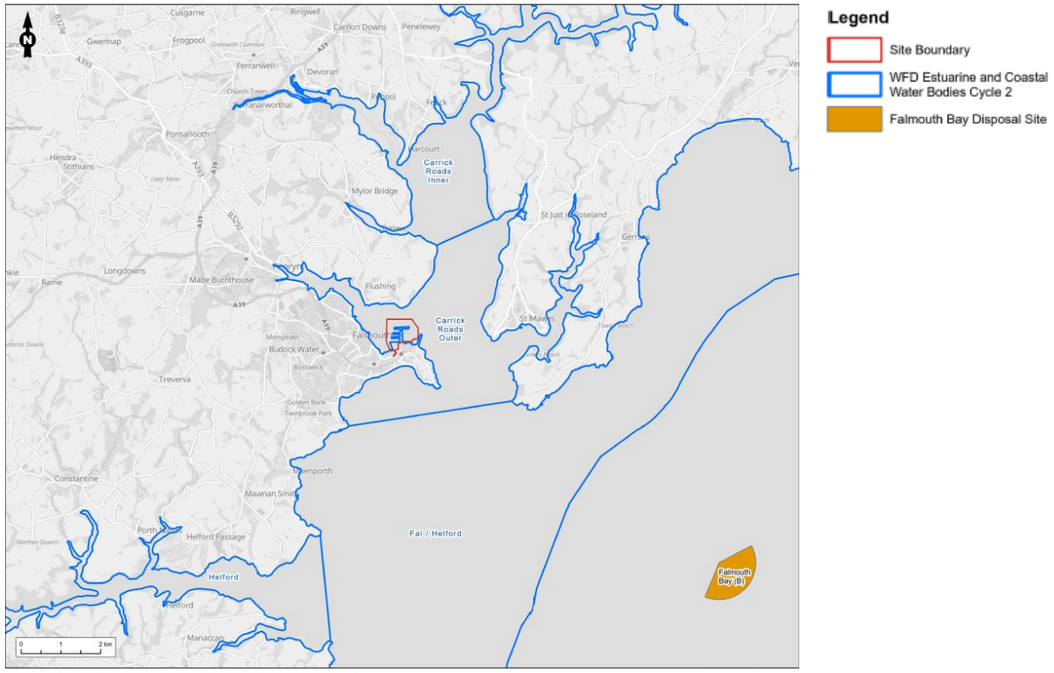

Figure 8.1 Falmouth Bay Disposal Site

Surface Water Quality Survey and Assessment

8.8.11 A total of 11 surface water samples were taken as part of the 2024 ground investigation at the site and tested for a range of determinants. The sampling points (shown in green on Figure 8.2) were located across the site area and taken from approximately 0.20 m below water level.

8.8.12 Samples were tested for a range of potential contaminants and compared to Environmental Quality Standards (EQS) protective of marine receptors; Figure 8.2 provides a summary of impacts above the EQS. Lead and zinc were consistently above the EQS across the site within the surface water, whilst isolated exceedances of mercury, nickel and chromium were recorded within singular locations. Copper was also found to be at concentrations above the EA Environmental Quality Standards (EQS) in two locations. Typically, the highest metal concentrations were recorded in the east of the site (location VC-01). Other exceedances included marginal exceedances of ammoniacal nitrogen in three locations in the eastern half of the site and two total cyanide exceedances in the north of the site.

8.8.13 The elevated concentrations of heavy metals are likely due to the industrial uses of the surrounding land and the harbour and also may be a result of naturally high metal concentrations in the local geology and impacts from the historic metal mining in the area.

8.8.14 Cyanide is considered likely to be associated with historical gas works which were present approximately 360 m west of the site and recorded on the historical mapping until circa 1910. The gas works infrastructure is noted to have been redeveloped between 1960s and 1970s to a car park (albeit the gas works were not in used in between those time periods). As such, the cyanide concentrations are considered to be residual contamination from the gas works land use upstream of the site.

8.8.15 According to an independent environmental database, a sewage outfall is present to the east of the site, this is a potential source of ammoniacal nitrogen within the surface water to the east of the site.

Figure 8.2 Summary of surface water exceedances across the site

Marine Sediment Quality Survey and Assessment

8.8.16 The site is located in an area of seabed consisting of a mix of rocky substrate / reefs, gravel and cobbles, as well as subtidal soft sediments of sand to clay grainsize[33] [34]. A video survey was conducted at the site in May 2022 and recorded seabed conditions at the site consisting predominantly of sublittoral cohesive mud and sandy mud, with generally coarser sediments occurring further from the existing dock structures. The harbour generally supports a low suspended sediment regime.

8.8.17 The site has a long history of use as a working dock and is also located within a geologically mineral-rich area, and as such, any sediment located within the site is highly likely to have elevated concentrations of chemical contaminants. According to an Environmental Impact Assessment (EIA) completed in 2009 for a previous scheme at the site[35], sediment samples were obtained from both within the boundary of the docks and in its vicinity. The analysis undertaken as part of those works confirmed the presence of elevated concentrations of a range of contaminants including tributyltin and

[33] MAGiC, 2022. MAGiC Interactive Mapping, online. Available at: https://magic.defra.gov.uk/magicmap.aspx Accessed: July 2024.
[34] EMODnet, 2022. Seabed Habitats Map Viewer, online. Available at: https://www.emodnet-seabedhabitats.eu/access-data/launch-map-viewer/ Accessed: July 2024.

[35] Royal Haskoning, 2009. Falmouth Cruise Project Environmental Statement. Report Reference: 50-R011-01.

dibutyltin; metals such as arsenic, nickel, copper, mercury, lead and zinc; as well as polyaromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs).

8.8.18 The 2024 marine sediment investigation and Ground Investigation Interpretative Report provides up to date information and characterisation of the marine sediment. The below information summarises pertinent information; details can be found in the Ground Investigation Interpretative Report (Technical Appendix 8.3).

8.8.19 The marine sediment was sampled and tested in line with the MMO requirements, and the results were screened against relevant action levels to assess the suitability of the dredged material for disposal at sea (as opposed to disposal to land i.e., to a landfill site). For this, and as per the Dredging Guidance outlined by the MMO[36], Ramboll screened the marine sediment data against Sediment Quality Guidelines (SQGs) developed based on the below to provide a risk-based assessment:

- The Cefas (Centre for Environment, Fisheries and Aquaculture Science) Action Levels 1 and 2;
- OSPAR, 2009. Sediment Environmental Assessment Criteria (OSPAR EAC)[37];
- USEPA, 1996. Marine Sediment Ecotoxicological thresholds [38, 39, 40];
- Canadian guidelines including the 1999 Interim Marine Sediment Quality Guidelines (Canada SQG)[41] (as listed on UK Marine Special Areas of Conservation website[18]) and Canadian Federal Environmental Quality Guidelines for PBDEs[42]; and
- German Action Levels (ALs)[43] for TBT, PCBs and organochlorine pesticides (OCPs).

8.8.20 The marine development area has been divided into north, east and south, to discuss the contaminant concentrations across the development area and the depths impacted by contamination. Figure 8.3 illustrates these three areas.

Figure 8.3 The marine development area divided into the North (yellow), East (pink) and West (brown) areas.

8.8.21 The sediment quality criteria used in different countries were combined to define the SQGs, as shown in Table 8.6 below. More information on this derivation can be found in the Ground Investigation Interpretative Report (Technical Appendix 8.3).

Table 8.6 Proposed SQG assessment methodology

Risk Level	Description	Assessment Criteria
SQG1 Low Risk	Those concentrations which are measured below SQG1 are suitable for disposal to sea. Those concentrations which are measured above SQG1 represent a low risk, and are considered potentially suitable for disposal to sea. Further consideration in relation to SQG2 and SQG3 and the CSM are required for proportionate decision making in the UK context.	• Cefas AL1, as these values have been shown to be typically restrictive (low concentrations) compared to other OSPAR state guidelines; • USEPA effects range low (ERL), as these values are risk-based and reflect a low probability of effects on marine life; • German Action Level 1 has been used for compounds which are not currently included in the Cefas or USEPA lists; and • Canadian Federal Standards have been used for BDEs, in absence of Cefas criteria.

36 Marine Management Organisation, 2023. Marine Licensing: sediment analysis and sample plans. Available at: https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans#:~:text=MMO%20licenses%20disposing%20of%20dredged,the%20material%20to%20be%20considered. Accessed: July 2024.
37 OSPAR, 2009. Background Document on CEMP Assessment Criteria for QSR 2010https://www.ospar.org/documents?v=7167. Available at: Microsoft Word - 461_Background Doc CEMP_ Assessment Criteria_Haz_Subs.doc (ospar.org). Accessed: July 2024
38 USEPA, 1996. USEPA Ecotox thresholds. Publication 9345.0-12FSI, 1996. Available at: Ecotox Thresholds (epa.gov). Accessed: July 2024
39 Lynda Webster and Rob Fryer, 2018. Status and trends of polycyclic aromatic hydrocarbons concentrations in sediment. UK Marine Online Assessment Tool, available at: https://moat.cefas.co.uk/pressures-from-human-activities/contaminants/pahs-in-sediment/. Accessed: July 2024
40 Long, E.R. et al, 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management, 19(1), pp.81–97.
41 Canadian Council of Ministers of the Environment (CCME), 1999. Canadian sediment quality guidelines for the protection of aquatic life. Accessed through UK Marine SACs Project website Accessed: July 2024.
42 Government of Canada, 2013. Canadian Environmental Protection Act, 1999. Federal Environmental Quality Guidelines. Polybrominated Diphenyl Ethers (PBDEs). February 2013. Available at: https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/canadian-environmental-protection-act-1999-9.html Accessed: August 2024.
43 OSPAR. Overview of Contracting Parties' National Action Levels for Dredged Material (2008 Update). Available at: https://www.ospar.org/documents?v=7113 Accessed: August 2024.

Table 8.6 Proposed SQG assessment methodology		
SQG2 Moderate Risk	This has been defined using risk-based median or probable effects concentrations, where possible. Those concentrations which are measured above SQG2 are unlikely to be suitable for disposal to sea. Further consideration of the CSM should be used for proportionate decision making in the UK context.	• USEPA effects range median (ERM); • German Action Level 2; and • Cefas Action Level 2 (AL2), in the absence of other values.
SQG3 High Risk	Those concentrations which are measured above SQG3 cannot be disposed to sea.	High risk has been defined using the Cefas AL2 as these have been shown to be typically less restrictive than other OSPAR state guidelines, and there is a concern that these may not be sufficiently restrictive to prevent harm to the environment. High risk levels are only defined for compounds with Cefas Action Levels or sufficient variation in screening values from other countries to warrant adding a category.

8.8.22 The sediment analytical results laboratory certificates are provided in full within Appendix C of the Factual Ground Investigation Report (Technical Appendix 8.1), and the results are screened against SQG1, SQG2 and SQG3 in Appendix 6 of the Ground Investigation Interpretative Report (Technical Appendix 8.3). A discussion of contaminant presence and distribution is provided in Table 8.7 below.

Table 8.7 Contaminant distribution assessment	
Contaminant	**Distribution Comment**
Arsenic (As)	Concentrations of arsenic that exceed SQG1 were recorded across the site, mostly in the west and east. The highest recorded concentration, recorded >SQG2, was detected in VC-16 (0.0-0.10 m) in the west of the site. It is likely this reflects the naturally metal rich geology in the area.
Cadmium (Cd)	Concentrations of cadmium that exceeded SQG1 were focussed in the west of the site and in locations in close proximity to the wharves and structures to the east of the site. Maximum cadmium concentration was recorded in VC-19 (0.0-0.10 m; west of the site). Cadmium was present at a range of depths.
Chromium (Cr)	Concentrations of chromium that exceeded SQG1 were largely focussed in the west of the site and in locations in close proximity to the wharves and structures, generally in the top 1.0 mbgl. No exceedances were recorded in the north. Maximum concentration was recorded in VC-19 (0.0-0.10 m).
Copper (Cu)	Concentrations of copper that exceeded the SQG1 were spread across the whole site. The seven exceedances of SQG3 were all located in the west of the site, and in close proximity to the wharves and structures to the east of the site. There were no SQG3 exceedances in the north of the site. The majority of the SQG exceedances were located in the top 1.0 mbgl, however there are some exceedances at depth across the site. Maximum concentration was recorded in VC-19 (0.0-0.10 m).
Mercury (Hg)	Concentrations of mercury in exceedance of SQG3 were located across the site, largely concentrated around the west and the east in close proximity to the wharves and structures, however not exclusively. Maximum concentration was recorded in VC-03 (2.0-2.1 m) in the west of the site. Concentrations above SQG1 were present in majority of locations, mostly in the top 1.0 m; however, it was also noted at depth in VC-03 and VC-17.
Nickel (Ni)	Concentrations of nickel that exceeded SQG1 were present across the site, with elevated concentrations found through the full vertical profile of sediments analysed. It is likely this reflects the naturally metal rich geology in the area.
Lead (Pb)	Concentrations of lead that exceeded the SQGs were present across the site in the top 0 – 0.1 mbgl. The highest concentration was encountered in VC-16 (0.0-0.1 m), located in the west of the site.

Table 8.7 Contaminant distribution assessment	
	Concentrations at lower depths were located to the west and to the east in close proximity to the wharves and structures. Majority of the SQG3 exceedances were encountered in the western area of the site, with one exceedance (VC-14, 0.0-0.10 m) recorded in the north.
Zinc (pb)	Concentrations of zinc that exceeded the SQGs were present across the site in the top 0.0–0.1 mbgl. Concentrations at lower depths were located to the west and to the east in close proximity to the wharves and structures. All exceedances of SQG3 were encountered in the western area of the site, with the maximum concentration recorded in VC-19 (0.0-0.10 m).
Organotins	Organotins were encountered across the site in the top 0.0–0.10 mbgl. It was encountered at a lower depth in close proximity to the wharves and structures in the east of the site. No exceedances of SQG3 were encountered below 0.8 mbgl. Maximum DBT and TBT concentrations were recorded in VC-03 (in the east).
PAHs	PAH exceedances were generally present across the site in the top 0.10 mbgl. Concentrations above the SQG2 were identified in the east and west of the site, to the maximum depth of 2.10 mbgl (VC-03). The highest concentration was of phenanthrene, encountered in VC-13A in the west of the site (0.0–0.8 m).
PCBs	PCBs were encountered across the site, generally within the top 0.0–0.10 m. They were encountered at a lower depth in the west and in areas in close proximity to the wharves and structures in the east of the site. Exceedances of SQG2 were encountered in the west and east of the site, with the maximum concentrations for total of 25 congeners recorded in VC-15 (0.0-0.10 m) in the west.
Dieldrin	No dieldrin exceedances have been recorded against the available Cefas Action Level.
Pesticides	PPDDT was generally encountered across the site in the top 0.0–0.10 mbgl. It was encountered at a lower depth to the west, north-west, and areas in close proximity to the wharves and structures in the east of the site. Maximum concentration was recorded in VC-03 (0.0-0.10 m) in the east of the site.
BDE	BDE209 is found across the site in sediment from all depths, with highest concentrations in the surface sediments. Concentrations were generally below the SQG1 (although five samples were within one order of magnitude above the SQG1), and therefore, although ubiquitous at low concentrations, are not considered to pose a significant risk to the marine environment.

8.8.23 From this, a risk-based approach was developed to assess the potential risks to the marine environment for sediments if the sediment were to be disposed to sea. Risk assessment in this context is inherently subjective, relying on the level of risk deemed acceptable and the confidence in both site-specific data and the data used to derive the risk based quality criteria.

8.8.24 In order to estimate volumes of sediment considered unsuitable for disposal to sea using different risk levels, three scenarios are considered which are described in Table 8.8. These scenarios define the lateral and vertical extent of sediment considered unsuitable for disposal to sea using all site data, considering overall context of the magnitude of impact (comparison to the SQGs), number of compounds present in the sample above the SQGs, material types, and vertical and lateral distribution of contaminants. A buffer on vertical and lateral extent of impact is included to provide a best estimate of materials which may pose a significant risk to the marine environment. The difference between Scenarios 1 and 2 is in the interpretation of potential risk using the SQGs and also in the provision of the buffer on vertical and lateral extent of impact.

Table 8.8 Scenarios considered to classify the suitability of marine sediment for disposal at sea		
Scenario	**Description**	**Discussion**
Scenario 1	Risk-based approach which is less conservative	Allows for limited moderate impacts to be disposed to sea, which in the overall context of the magnitude of impact, number of compounds present in the sample, material types, and vertical and lateral distribution of contaminants could be considered to pose a low risk.

Table 8.8 Scenarios considered to classify the suitability of marine sediment for disposal at sea		
Scenario 2	Risk-based approach which is more conservative	Allows limited samples to be disposed to sea if one compound was only marginally above the moderate risk level (SQG2). In particular, marginal impacts of metals which were all below Cefas AL2 and likely to be naturally high in the area due to the local geology and mining history. The assessment results in the deeper samples from VC-01, VC-14 and VC-19 are added to those considered unsuitable for disposal to sea in Scenario 1.
Scenario 3	All material with one or more contaminant above SQG1 is unsuitable for disposal to sea (highly conservative)	Since all but one analysed sample from the site contained one or more compound above SQG1; using this approach, all material to be dredged would be considered unsuitable for disposal to sea. This is overly precautionary and not a suitably considered risk-based approach, which will not be considered further. Further assessment of all samples in relation to SQG2 and SQG3, the number and magnitude of exceedance of SQG1, and distribution of vertical and lateral impacts, has been completed to provide a risk-based proportionate approach to defining potential risks to the marine environment, as described in Scenario 1 and 2 below.

8.8.25 Scenario 3 has been dismissed as overly conservative. Therefore, an assessment of the volume of material that contains contamination levels that cannot be disposed of at sea for Scenarios 1 and 2 was completed.

8.8.26 The vertical and lateral extent of materials assumed unsuitable for disposal to sea are shown for Scenarios 1 and 2 on Figures 8.4 to 8.9.

8.8.27 As can be seen in Figures 8.4 to 8.9, much of the shallow sediment is not suitable for disposal to sea due to the contamination concentration across the site. The most impacted section of the site is the western area, and the least impacted section is the northern area.

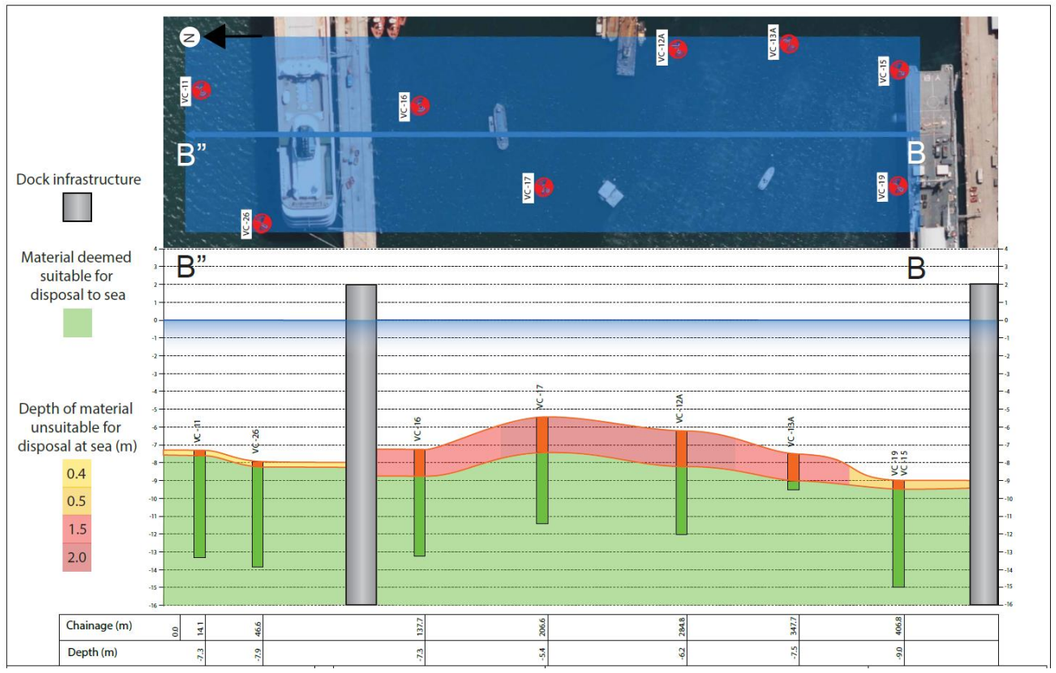

Figure 8.4 Scenario 1: Western Area

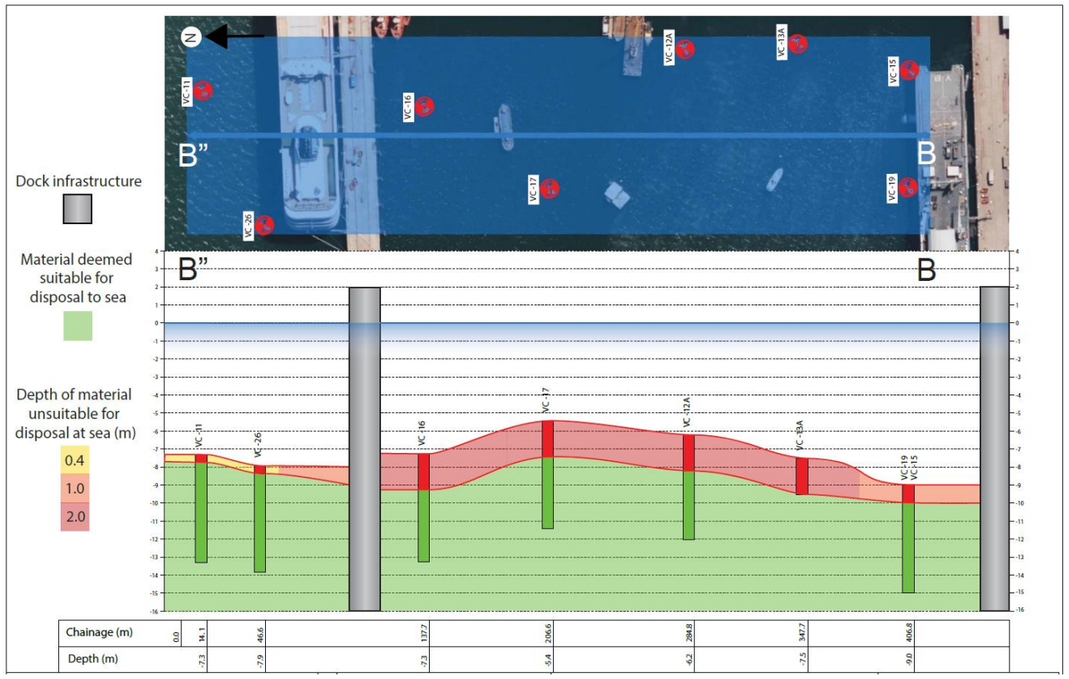

Figure 8.5 Scenario 2: Western Area

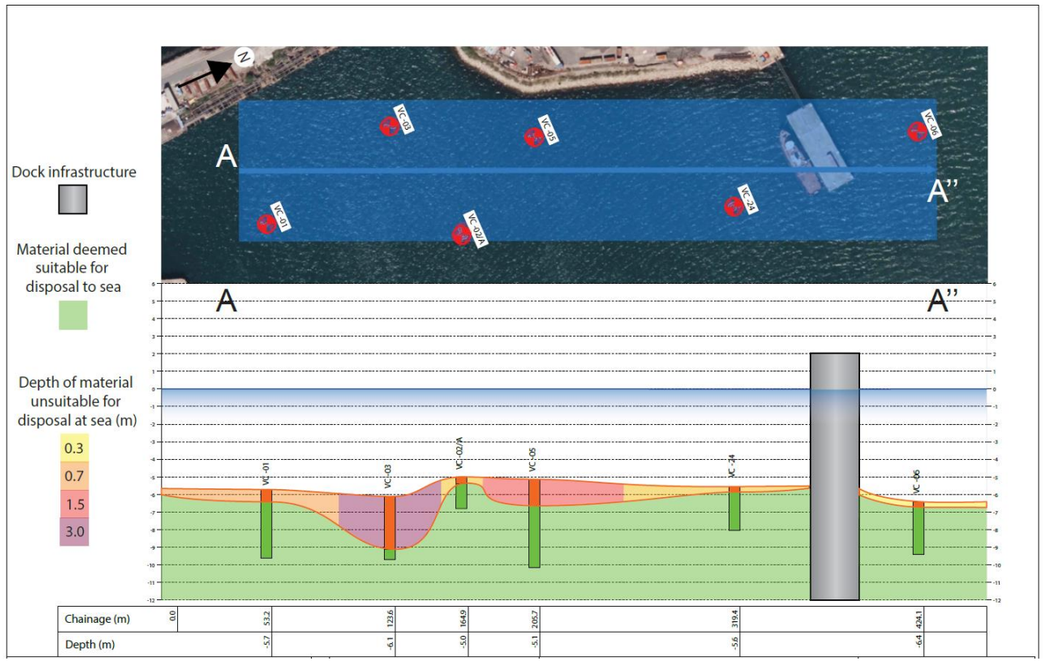

Figure 8.6 Scenario 1: Eastern Area

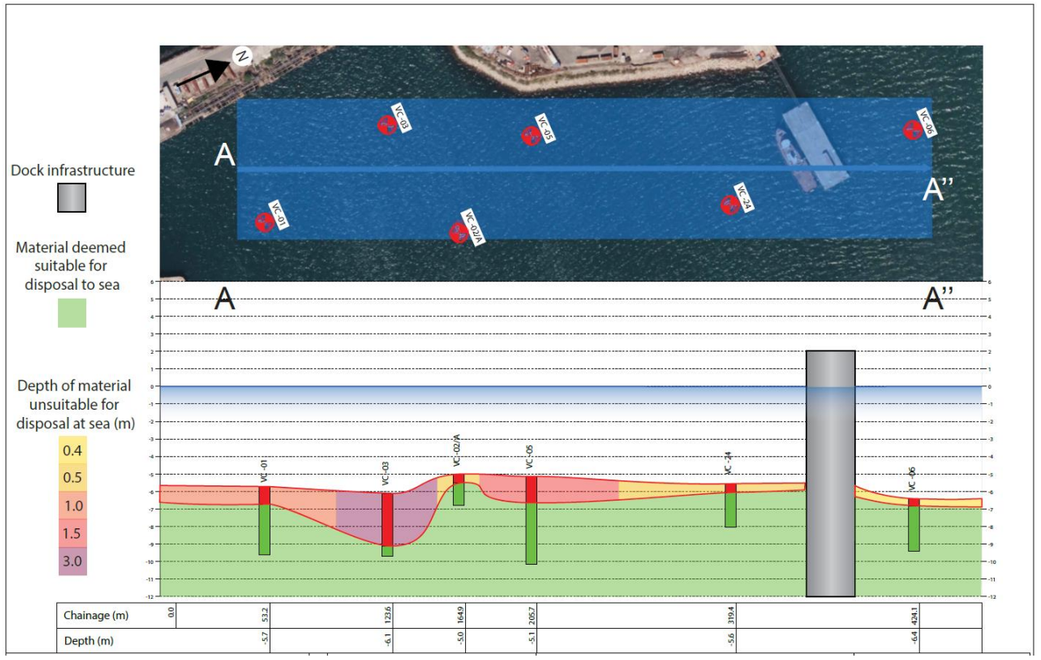

Figure 8.7 Scenario 2: Eastern Area

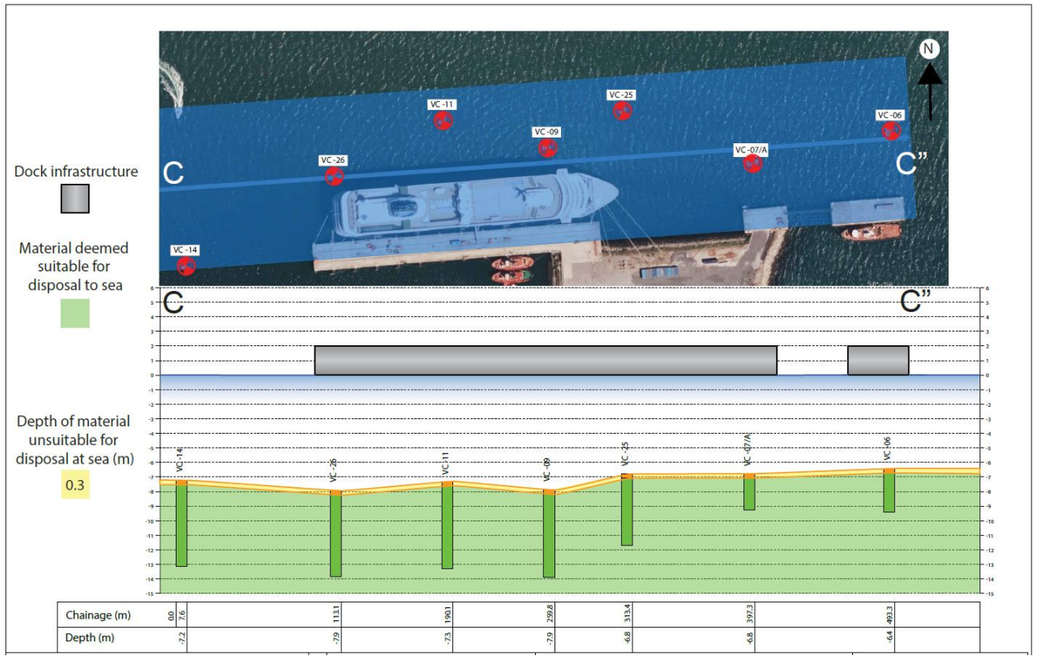

Figure 8.8 Scenario 1: Northern Area

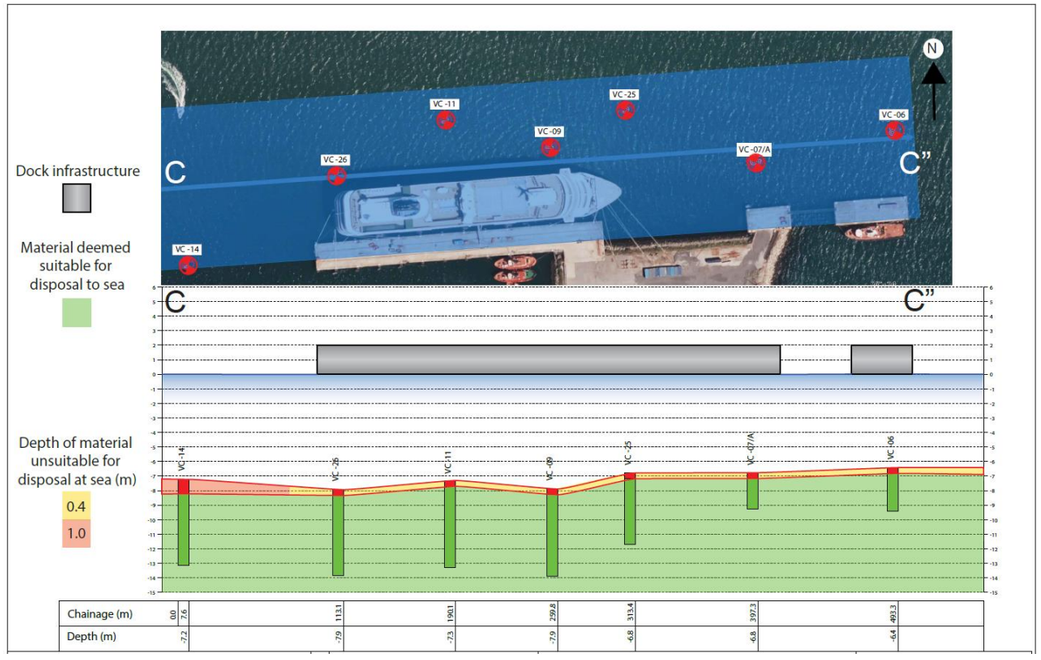

Figure 8.9 Scenario 2: Northern Area

8.8.28 Scenario 1 allows the disposal of a higher volume of material to sea than Scenario 2 across the site. Tables 8.9 and 8.10 below show the volumes of material proposed as suitable to be disposed of to sea with the different scenarios and total dredging volumes.

Table 8.9 Anticipated Management and Disposal of Dredged Arisings - Scenario 1

Disposal	Anticipated Type of Material	Approximate Volume of Material (m^3)	Approximate Mass of Material (tonnes)
Potential re-use on site	Rock	65,000	-
Suitable for disposal at sea at approved disposal site	Seabed material (and rock)	394,000	591,000
Disposal at land (worst-case: landfill)	Seabed material	184,000	276,000
TOTAL	**-**	**643,000**	**-**

Table 8.10 Anticipated Management and Disposal of Dredged Arisings - Scenario 2

Disposal	Anticipated Type of Material	Approximate Volume of Material (m3)	Approximate Mass of Material (tonnes)
Potential re-use on site	Rock	65,000	-
Suitable for disposal at sea at approved disposal site	Seabed material (and rock)	357,000	535,500
Disposal at land (worst-case: landfill)	Seabed material	221,000	331,500
TOTAL	**-**	**643,000**	**-**

8.8.29 Scenario 1 is considered a reasonable scenario as a disposal option to be agreed with CEFAS, however, for the purposes of the EIA, Scenario 2 has been assessed, which is a more conservative approach.

Summary

8.8.30 Various contaminants have been encountered in the marine sediment across the site, such as heavy metals, PCBs, Organo-tins, pesticides, PAHs, and BDE. These show clear lateral and vertical patterns across the site: there is a general trend of decreasing contamination at greater depths, and with increasing distance away from the wharfs.

8.8.31 The assessment using multiple guideline values showed the subjectivity of contamination assessments at the site, and allowed a risk-based approach to be developed to determine the lateral and vertical levels of contamination across the site.

8.8.32 Two viable scenarios were developed to classify the volume of marine sediment; using this risk-based scenario approach, the volumes of material deemed too contaminated to be disposed of to the disposal site at sea have been calculated. This also shows the volume of sediment that poses a risk to receptors during the construction works, such as capital dredging and piling.

Sediment Management

8.8.33 Sedimentation rates at the site are low, therefore the requirement for maintenance dredging is anticipated to be minimal and infrequent. A suitable approach to maintenance dredging has been determined based on sediment transport modelling results (refer to Technical Appendix 6.2 Sediment Transport Modelling) and proposes a maintenance regime of dredging up to approximately 8,000 m^3 every 5 years (or depending on operational requirements, up to approximately 16,000 m^3 every 10 years), as required, mostly within the eastern berth pocket. Further detail is provided in Chapter 6: Coastal Processes and Sediment Regime.

Geology, Hydrogeology and Groundwater

Water Quality – Water Framework Directive Groundwater

8.8.34 The site is underlain by the Portscatho Formation, which comprises interbedded sandstone and slaty mudstone and is classified as a Secondary A aquifer (permeable formations with potential to support localised abstractions). This formation underlies the estuary, cropping out on land to both the north and south of the site. The site is not underlain by a superficial aquifer; it is not located within a Source Protection Zone (SPZ), and it is not within a Drinking Water Safeguard Zone for groundwater.

8.8.35 Under the WFD, the aquifer within the Portscatho Formation is designated as being part of the South Cornwall Water Body and is classified as being of 'poor' overall quality ('poor' chemical and 'good' quantitative quality; 2019). The main activities noted as contributing to the classification elements in this waterbody include an abandoned mine, poor pesticide management, poor nutrient management, and poor livestock management. These activities are classified as diffuse sources. For further detail refer to Technical Appendix 8.4 Water Framework Directive Assessment.

8.8.36 The site is within a high-risk area for groundwater vulnerability. This risk refers to the vulnerability of the groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within a single square kilometre.

Sensitive Receptors

8.8.37 The receptors identified as sensitive to the proposed development, and which have been 'scoped-in' to the assessment are summarised in Table 8.11.

Table 8.11 Summary of Sensitive Receptors

Sensitivity	Receptor	Rationale
High	Carrick Roads Outer water body	The water body has been classified as having a 'good' ecological status in 2022. The water body is present on-site and covers the area up to 2.6 km south-east and 2 km south of the Falmouth Docks.
Low	Marine sediments within the dredge footprint	The majority of marine shallow sediments within the dredge footprint contain contaminants.
High	Marine sediment outside of the dredge footprint - upon which the sediment mobilised from the dredge settles	The marine sediment quality improves away from the wharfs and dock structures, with the lowest concentrations of contaminants recorded to the north of the docks. Therefore, it is envisaged that there will be fewer Cefas Action Level 1 exceedances outside of the dredge footprint and further from the docks where there are fewer vessels and dock processes in general.
Medium	Marine sediment at the disposal site (Falmouth Bay PL075)	The materials are proposed to be disposed of at the Falmouth Bay disposal site (PL075) in the English Channel, which is an approved disposal site[44].
Medium	Water body (English Channel) at the disposal site	The sea at the disposal site (the English Channel) is not classified under the WFD, due to its location beyond the area to which WFD designation extends. Therefore, the sensitivity of the site has been assumed to be medium as a disposal site is unlikely to have high sensitivity receptors, however as there are standards associated

[44] Catchment Based Approach Data (2024) Potential Beneficial Use (Mud): Potential Material Sources - maintenance dredge disposal sites (MMO). Available at: Potential Beneficial Use (Mud): Potential Material Sources - maintenance dredge disposal sites (MMO) | Catchment Based Approach Data Hub (Accessed October 2024)

Table 8.11 Summary of Sensitive Receptors		
Sensitivity	**Receptor**	**Rationale**
		with the disposal material permitted for the site, it is unlikely to be low sensitivity.

8.8.38 Based on the baseline characterisation, the following receptors have been scoped out of the subsequent assessment:

- Human Health: construction and demolition workers;
- Human Health: Port operators and amenity users; and
- Controlled Waters: groundwater as a potable water supply.

8.8.39 These receptors have been scoped out based on the outcome of the qualitative assessments undertaken within the Ground Investigation Interpretative Report, as detailed below.

Human Health

8.8.40 Human health (namely port operators, amenity site users and construction / demolition workers) was considered as a potential receptor from the marine sediment at the site, which would mobilise contaminants during the dredging works. In terms of amenity or bathing water users, it is considered that there is unlikely to be a risk associated with bathing waters within the site itself as the site is a working dock with vessels and associated activities. The closest designated bathing water area is approximately 1 km south-west of the site (as the crow flies), and therefore, the works are unlikely to pose a risk to the bathing water areas. Pendennis Point is intervening between the site and designated bathing waters, and its presence will direct currents (and thus sediment) away from the beaches, therefore no effect to the designated bathing water areas is anticipated. There is the potential for incidental contact of people via water sports and other activities where there is the possibility for site users to come into contact with the water, however this will be infrequent and typically for a short-duration, and therefore is considered to be a low risk. Port operators are also unlikely to come into contact with the water for any significant length of time during or after the works, therefore this is considered to be a low risk.

8.8.41 In terms of the construction and demolition workers, the risk to these receptors is also anticipated to be low with the use of appropriate working procedures and personal protective equipment (PPE) in line with the Management of Health and Safety at Work Regulations[45], Construction (Design and Management) Regulations[46] (for some sites) and the Control of Substances Hazardous to Health Regulations[47].

Groundwater

8.8.42 Piling is proposed and there is a potential risk of creating pathways for contaminant migration. The proposed development design and construction methods will need to ensure that such pathways are not created where potential contaminants are present, or appropriate mitigation is put in place.

8.8.43 However, as discussed within the Ground Investigation Interpretative Report, the proposed marine development works involve dredging and removal of much of the top layers of marine sediment at the site. The uppermost marine sediments in the marine area are the most contaminated, and therefore the dredging process would lead to the removal of the most impacted sediment, with the remaining material being significantly less impacted. The risk to the groundwater aquifer beneath the site is therefore reduced as the source of the majority of the contamination will be removed before the piling works begin. It is also expected that soft sediments would rapidly form a seal around driven square or circular piles, reducing the risk to the groundwater aquifer during the piling works further.

8.8.44 Therefore, the risk to the groundwater aquifer during piling is minimal as the source is to be removed, and the piling methodology and soft sediments present at the site would further reduce the risk. For this reason, a quantitative assessment of the risks to the groundwater body has not been undertaken.

8.9 Assessment of Effects

8.9.1 The following potential impacts have been assessed for the demolition and construction stage of the proposed development:

- Impacts on the marine sediment within the dredge footprint from dredging activities;
- Impacts on the marine sediment outside of the dredge footprint from the dredging activities;
- Impacts to the Carrick Roads Outer water body from dredging activities;
- Impacts to the marine sediment and water body at the offshore disposal site; and
- Impacts to marine sediment and water bodies from piling activities and other in-ground works.

8.9.2 The following potential impacts have been assessed for the operational stage of the proposed development:

- Impacts on receptors from maintenance dredging activities.

Demolition and Construction Effects: Dredging

8.9.3 Embedded mitigation in the form of dredging plant and methodology (dredging using a backhoe dredger(s) with a 10 m^3 (or smaller) lidded bucket and dredging from 1.75 hours before low water to 1.75 hours before high water only, non-continuously over 58 weeks (the quickest timeframe that this could realistically be undertaken)) would minimise the potential for adverse effects on water quality (in terms of EQS exceedances), clarity (in terms of SSC) and sediment deposition. Use of a 10 m^3 (or smaller) lidded backhoe dredger allows for increased accuracy in areas of contamination, reduced production rate and reduced sediment disturbance and release rate in comparison to dredging using other plant. Dredging solely on specific tides leads to an elongated dredge programme (the quickest possible duration being a total of 58 weeks), thereby reducing the rate of sediment suspension and resultant SSC elevation and rate of deposition. The timing of the dredging (on an adjusted flood tide) would reduce the dispersion distance of sediment and aqueous contaminant plumes and allow for periods of down-time during which no dredging would occur and suspended sediment and dissolved contaminants would be dispersed (particularly given the dynamic tidal environment).

8.9.4 Example outputs of the modelling in terms of peak and mean predicted SSC concentrations, total predicted sediment deposition, and dissolved contaminants are shown in Figures 8.10-8.13.

[45] UK Statutory Instruments (1999) The Management of Health and Safety at Work Regulation No. 3242
[46] UK Statutory Instruments (2015) Construction (Design and Management) Regulations No. 51
[47] UK Statutory Instruments (2002) Control of Substances Hazardous to Health Regulations No. 2677

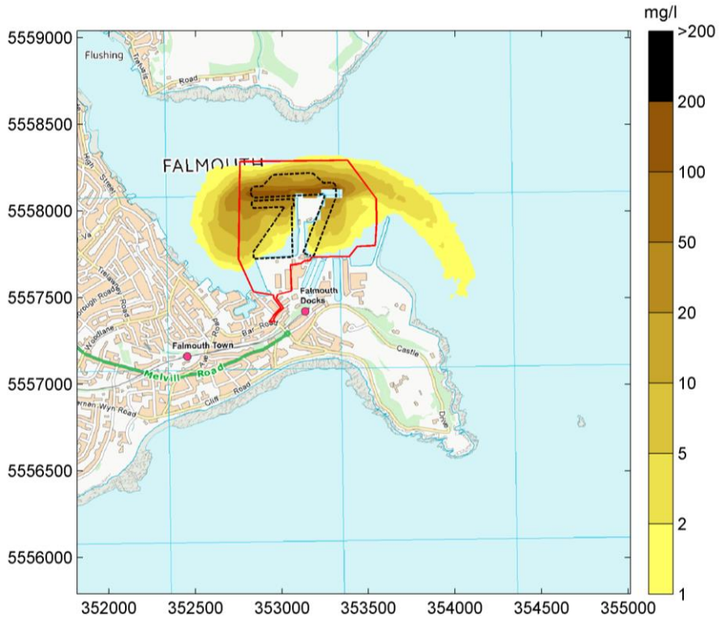

Figure 8.10 Peak predicted increase in suspended sediment concentration, dredging in the north area (Queens Wharf). Source: HR Wallingford (2025)

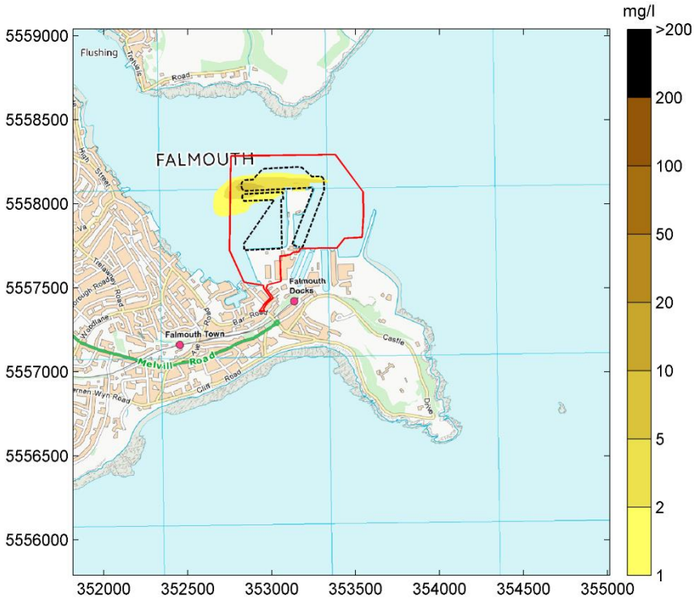

Figure 8.11 Mean predicted increase in suspended sediment concentration, dredging in the north area (Queens Wharf). Source: HR Wallingford (2025)

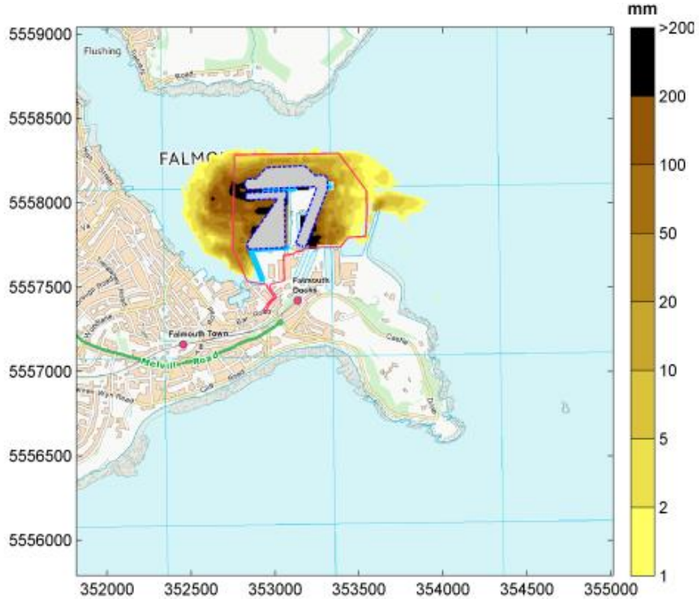

Figure 8.12 Total predicted fine sediment deposition resulting from entire capital dredge campaign (dredging in all areas) (dredge pockets are shown in grey). Source: HR Wallingford (2025)

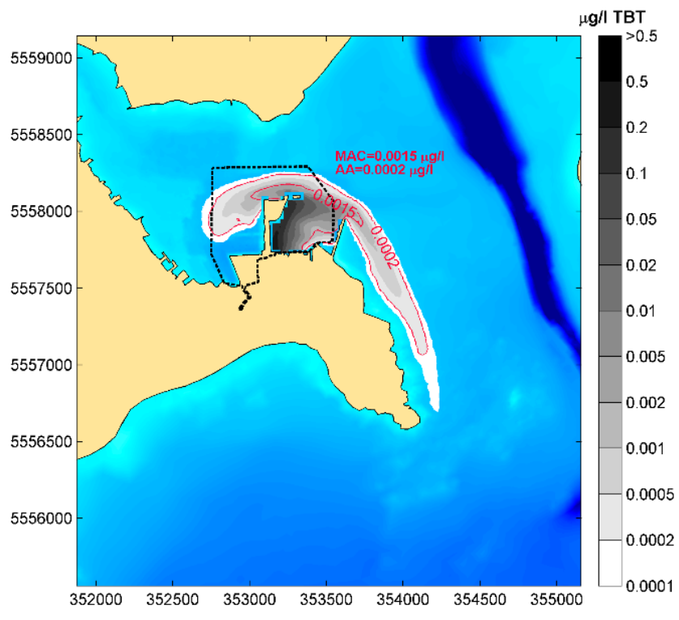

Figure 8.13 Dissolved TBT from dredging in the east of the site (Western Wharf). Source: HR Wallingford (2024)

8.9.5 For all model outputs, refer to ES Chapter 6: Coastal Processes and Sediment Regime and Technical Appendix 6.3: Sediment Plume Modelling Report, which include the following:

- Sediment plumes - the modelled maximum and mean increases of suspended sediment concentration during the capital dredge (over a 15-day simulation to include all tide ranges), for dredging in the north, east and west areas of the site respectively, with the embedded mitigation measures in place. Figures 8.10 and 8.11 show peak and mean predicted increases in SSC for dredging in the north area, which produces the largest plume extent relative to dredging in the east and west;
- Sediment deposition footprint – the modelled predicted total fine sediment deposition at the end of the capital dredge, for dredging in the north, east and west areas of the site and dredging in all areas of the site, with the embedded mitigation measures in place. Figure 8.12 shows the total predicted fine sediment deposition resulting from the entire capital dredge (north, east and west); and
- Aqueous (dissolved phase) plumes - the modelled time-averaged dissolved concentrations for various contaminants of concern after 15 days of dredging in the north, east and west areas of the site respectively, and predicted EQS threshold exceedances in the water column. This was modelled for a scenario where dredging using a backhoe dredger occurs continuously (24 hours a day, 7 days a week) over 17 weeks (a worst-case scenario, without embedded measures in place), using a 10 m^3 lidded bucket for contaminated sediment unsuitable for disposal at sea and a 13-14 m^3 open bucket for the remaining sediment. As described previously, in practice, a backhoe dredger with a 10 m^3 (or smaller) closed bucket would work on an adjusted flood tide over a 58-week programme. Figure 8.13 shows the dissolved TBT extent resulting from dredging in the east. Dredging on an adjusted flood tide, rather than 24 hours per day (as shown in the scenario for which the aqueous plume contaminant modelling was undertaken) means that the quantity of contaminants released (on each tide) and average concentrations of contaminants within the water column will be approximately half of that shown in the modelled time-averaged dissolved concentrations within Technical Appendix 6.3: Sediment Plume Modelling Report and Figure 8.13. Some exceedances of EQS would nonetheless still be expected outside of the site boundary for TBT, although with a reduced spatial extent.

Impacts of dredging on marine sediment within the dredge footprint

8.9.6 Capital dredging operations at the site will remove shallow sediments found to be impacted with elevated concentrations of contaminants within the dredge footprint, thus removing a large contaminant mass from the marine environment and leaving the new seabed level a higher quality and less of a risk to the marine environment. The extent of resettlement of impacted sediment within the dredge footprint will be limited due to the requirement for dredging to a specific depth (i.e. any sediment re-deposited within the dredged areas would be re-dredged until the required depth is achieved).

8.9.7 Removal of impacted sediment will be a permanent, high magnitude beneficial impact to the marine sediment within the dredge footprint (low sensitivity) and therefore is considered to be a permanent, **Minor Beneficial** effect. This is **not significant** in EIA terms.

Impacts of dredging on marine sediment outside of the dredge footprint

8.9.8 During the capital dredging operations at the site, the suspension of marine sediments into the water column; mobilisation and transportation of the sediments with the current; and resettlement of the mobilised marine sediments onto a different part of the seabed will affect marine sediments outside of the dredge footprint. Losses of fine sediments during dredging works and bucket overspill will also contribute to the creation of sediment plumes that will migrate outside of the dredge footprint.

8.9.9 Figure 8.12 shows the predicted total deposition of fine sediments following dredging in all areas of the site. Up to 200 mm of deposition is predicted up to 150 m west of the site boundary, and up to 50 mm of deposition is predicted in a localised area at the end of the eastern breakwater. Outside of these areas the predicted deposition is up to 5 mm, declining to less than 1 mm at distances of 370 m to the west of the site and 300 m to the east of the site.

8.9.10 The marine sediment quality outside of the dredge footprint will be affected by the deposition of the suspended marine sediment mobilised by the dredging works. It is not possible to know the exact type and level of sediment-bound contaminants that would be deposited following the capital dredge, however the concentrations of contaminants within deposited sediments would likely be lower than within the pre-dredged sediment due to some contaminants partitioning from the sediment-bound phase to the aqueous phase. In addition, the extent of deposition is contained to within 370 m of the site boundary. This impact is a permanent, low magnitude impact to the marine sediment outside of the dredge footprint (high sensitivity) and therefore is considered to be a permanent, **Minor Adverse** effect. This is **not significant** in EIA terms.

Impacts of dredging on the Carrick Roads Outer Waterbody

8.9.11 Dredging associated with the proposed development has the potential to affect water quality and clarity due to the mobilisation of sediment (including contaminated sediment), with the following impact pathways identified:

- Removal and mobilisation of (contaminated) sediment, leading to elevated suspended sediment concentrations at the site and surrounds; and
- Mobilisation of contaminated sediment, potentially leading to dissolved aqueous contaminant plumes with water quality effects at the site and surrounds, as sediment-bound contaminants desorb from the disturbed sediment and become dissolved in the water column.

8.9.12 The water quality of Carrick Roads Outer water body (high sensitivity receptor) will be affected by increased turbidity from increased suspended sediment concentrations within the water column during dredging. These effects will be continuous for the duration of dredging between 1.75 hours before low water to 1.75 hours before high water, but would comprise temporary, short-term changes to the water quality status of the receptor (being quickly reversed upon completion of the dredging, during the tidal window within which the dredging operations would stop).

8.9.13 Worst-case (dredging in the north of the site) sediment plume model outputs are provided in Figures 8.10 and 8.11. Increases in SSC are, on average, largely confined to the area within the site boundary (red line) and the peak increases (in the order of 100s mg/l above background) are largely predicted to be within the site boundary and within the water column in the immediate vicinity of the dredged berth pocket areas (black dashed lines).

8.9.14 This impact is considered to be low magnitude on a high sensitivity receptor, leading to a temporary, **Minor Adverse** effect. This is **not significant** in EIA terms.

8.9.15 Technical Appendix 6.3: Sediment Plume Modelling shows modelled EQS threshold exceedances (either the Maximum Allowed Concentration (MAC) or Annual Average (AA) threshold) in the water column. EQS exceedances for the various contaminants modelled are largely limited to within or immediately adjacent to the site boundary with the exception of exceedances of AA thresholds for TBT which are predicted to extend from the site to the east and south-east (Figure 8.13). Dredging from 1.75 hours before low water to 1.75 hours before high water only means that the quantity of contaminants released (on each tide) and average concentrations of contaminants within the water column is approximately halved in comparison to dredging 24 hours per day (results of which are shown in the modelling outputs for EQS exceedances). Some exceedances of EQS would nonetheless still be expected outside of the site boundary for TBT. Such dissolved contamination levels are not expected to give rise to any large-scale or prolonged water quality effects.

8.9.16 These impacts are therefore considered low magnitude on a high sensitivity receptor and considered to be temporary, **Minor Adverse** effects. This is **not significant** in EIA terms.

8.9.17 Overall, it is considered that water quality and turbidity effects during the capital dredge operations would be of limited spatial extent in comparison to the overall scale of the Carrick Roads Outer Water

Body. Effects would also be temporary, non-continuous and of short-duration due to the natural downtime between the tides during which dredging would stop. Increases in SSC are predicted to be short-lived, returning to baseline levels shortly after the completion of dredging operations. These effects are **Minor Adverse** and **not significant.**

Impacts of disposal of dredge arisings at the disposal site

8.9.18 In addition to dredging operations within the development area, the disposal at sea of the dredged material will generate a sediment plume at the disposal site. The fine sediments in the plumes will be dispersed over a wide area by the action of waves and currents until they settle onto the seabed.

8.9.19 The disposal would create short-term suspension within the English Channel, increasing turbidity locally until the sediment is deposited. Disposal would be undertaken in line with any marine licence conditions to ensure no significant adverse environmental effects. Various standards have been combined to ensure that the dredged material is suitable to be disposed of at sea, as discussed in Section 8.8, reducing the risk to the disposal site and surroundings.

8.9.20 Therefore, the effect on the English Channel water quality (medium sensitivity) at the disposal site from the disposal of the dredged material is short-term and of low magnitude, thus the effect is considered to be **Minor Adverse**. This is **not significant** in EIA terms.

8.9.21 The effect on the marine sediment at the disposal site (medium sensitivity) from the disposal of the dredged material is of low magnitude, thus the effect is considered to be **Minor Adverse**. This is **not significant** in EIA terms.

Demolition and Construction effects: Impacts from piling activities and in-ground works

8.9.22 Piling and inground works are proposed across the site for strengthening and enabling works, demolition of structures, and construction. Chapter 5 provides detail regarding the demolition and construction works on site.

8.9.23 Piling and other inground works across the site have the potential to cause the mobilisation of sediment at the site, potentially mobilising contaminants into the water column, increasing turbidity, and settling elsewhere on the site, impacting the marine sediment at the site and the Carrick Roads Outer Waterbody. Sediment dispersion from piling and inground works are not anticipated to extend beyond the site. Enabling works will occur prior to dredging and construction phase works will be after dredging. The site data has identified that the uppermost sediments in the marine area are the most contaminated. The proposed development works involve dredging and removal of much of the top layers of marine sediment at the site, therefore the dredging process would lead to the removal of the most impacted sediment with the remaining material being significantly less impacted. The effect of the piling works to the site receptors will therefore be significantly reduced post-dredging as the majority of the contamination will have already been removed before the piling works begin. Works prior to dredging are localised and whilst some sediment mobilisation will occur, this will be a temporary low magnitude effect on both sediment and water quality.

8.9.24 The piling works may temporarily increase the turbidity at the site (localised), however relatively high levels of turbidity already occur during storm events at the site, and piling activities are not anticipated to increase turbidity in the waterbody to above this level.

8.9.25 Therefore, the effect on the marine sediment within the site (low sensitivity) from piling works is short-term and of low magnitude, thus the risk is considered to be **Negligible Adverse**. This is **not significant** in EIA terms.

8.9.26 The effect on the Carrick Roads Outer Waterbody at the site (high sensitivity) from piling works is of low magnitude, thus the risk is considered to be **Minor Adverse**. This is **not significant** in EIA terms.

Operational Effects

8.9.27 Infrequent maintenance dredging may be required at intervals of 5 or 10 years. A suitable approach to maintenance dredging has been determined based on sediment transport modelling results (refer to Technical Appendix 6.2 Sediment Transport Modelling) and proposes a maintenance regime of dredging up to approximately 8,000 m^3 every 5 years (or depending on operational requirements, up to approximately 16,000 m^3 every 10 years), as required, mostly within the eastern berth pocket.

8.9.28 The scale of maintenance dredging would be significantly less than the capital dredging occurring as a part of the demolition and construction works. In addition, much of the sediment identified to contain contaminants would have been removed from site during the capital dredge, decreasing the contamination loading present in the marine sediment at the site, which is considered to be a beneficial impact.

8.9.29 Therefore, the impact to any sensitive receptors at or surrounding the site from the operational development are considered to be **Negligible Adverse**. This is **not significant** in EIA terms.

8.10 Additional Mitigation

8.10.1 No significant adverse effects are predicted, and consequently no additional mitigation is required.

8.11 Enhancement Measures

8.11.1 Further refinement of the dredging methods could be undertaken in conjunction with a contractor, once appointed. However, at this stage no enhancement measures are proposed in respect of the Marine Water and Sediment Quality.

8.12 Demolition and Construction Residual Effects

8.12.1 As no additional mitigation measures have been identified at this stage of the process, the demolition and construction residual effects remain as reported in the assessment of effects section.

8.13 Operational Development Residual Effects

8.13.1 As no additional mitigation would be required for the operation of the proposed development, the residual operational effects remain as reported in the assessment of effects section.

8.14 Summary of Significant Effects

8.14.1 Table 8.13 provides a tabulated summary of the outcomes of the marine water and sediment quality assessment of the proposed development. It reports on the likely significant effects with respect to marine water and sediment quality associated with the demolition and construction and operational stages of the proposed development.

Table 8.12: Summary of Marine Water and Sediment Quality Effects

Receptor	Description of Effect	Pre-Additional Mitigation Effect: Scale/ Nature/ Significance*	Additional Mitigation	Post-Additional Mitigation Effect: Scale/ Nature/ Significance*	Details of Residual Effect			
					Direct/ Indirect	Permanent/ Temporary	Reversible/ Irreversible	Short-term/ Medium-term/ Long-term
Demolition and Construction								
Marine sediment within dredge footprint	Dredging: removing marine sediment beneath the site	Minor/Beneficial/Not Significant	No additional mitigation measures required.	Minor/ Beneficial/Not Significant	Direct	Permanent	Irreversible	Long-term
Marine sediment outside of dredge footprint	Dredging: removing marine sediment beneath the site and resultant sediment deposition	Minor/Adverse/Not Significant	No additional mitigation measures required.	Minor/ Adverse/Not Significant	Indirect	Permanent	Reversible	Long-term
Carrick Roads Outer Water Body	Dredging: Elevated SSC	Minor/Adverse/Not Significant	No additional mitigation measures required.	Minor/Adverse/Not Significant	Direct	Temporary	Reversible	Short-term
Carrick Roads Outer Water Body	Dredging: increased aqueous contaminants	Minor/Adverse/Not Significant	No additional mitigation measures required.	Minor/Adverse/Not Significant	Indirect	Temporary	Reversible	Short-term
English Channel – dredging disposal site	Disposal of uncontaminated sediment at sea: dredged marine sediment mobilised during placement onto seabed	Minor/Adverse/Not Significant	No additional mitigation measures required.	Minor/Adverse/Not Significant	Direct	Temporary	Reversible	Short-term
Marine sediment - Seabed at the dredging disposal site (Falmouth Bay PL075)	Disposal of uncontaminated sediment at sea: dredged marine sediment placed onto seabed	Minor/Adverse/Not Significant	No additional mitigation measures required.	Minor/Adverse/Not Significant	Direct	Permanent	Reversible	Long-term
Marine sediment at the site	Piling: settlement of marine sediment mobilised by the piling works onto the seabed at the site	Negligible/Adverse/Not Significant	No additional mitigation measures required.	Negligible/Adverse/Not Significant	Direct	Permanent	Reversible	Long-term
Carrick Roads Outer Water Body	Piling: mobilising contaminants within the marine sediment at the site	Minor/Adverse/ Not Significant	No additional mitigation measures required.	Minor/Adverse/ Not Significant	Direct	Temporary	Reversible	Long-term
Operational Development								
Water and Sediment quality receptors	Maintenance dredging and operational activities	Negligible/ Adverse/Not Significant	No additional mitigation measures required.	Negligible/ Adverse/Not Significant	Direct	Temporary	Reversible	Long-term

Notes (refer to Chapter 2, Section 2.8 for definitions):

* Negligible/Minor/Moderate/Major, Adverse/Beneficial, Significant/Not Significant

8.15 Cumulative Effects

Intra-Project Effects

8.15.1 As explained in Chapter 2: EIA Process and Methodology, intra-project cumulative effects are discussed in Chapter 20: Cumulative Effects.

Inter-Project Effects

8.15.2 No other large-scale dredging is planned in the area therefore there are no cumulative inter-project effects anticipated in regard to marine water and sediment quality.