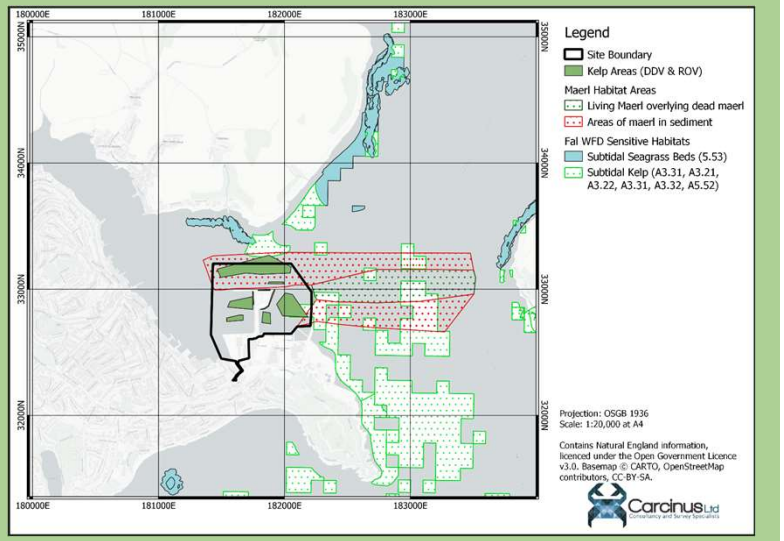
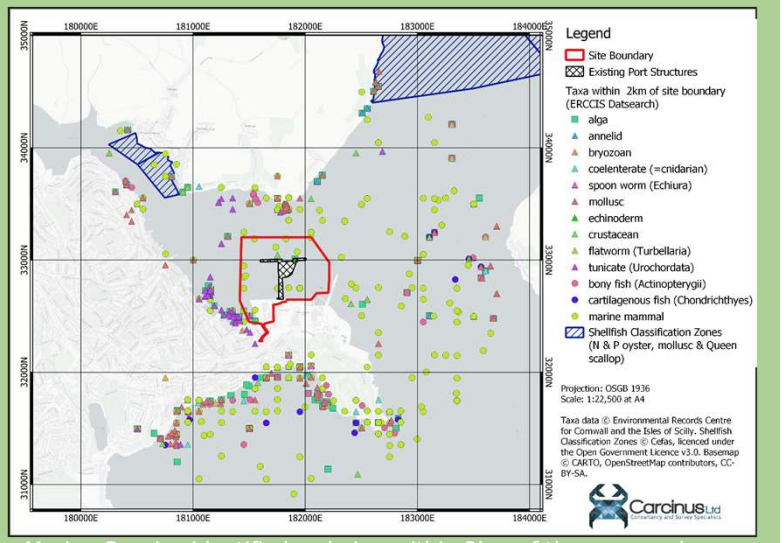
9. Marine Ecology



Relevant sensitive habitats within vicinity of the proposed development



Marine Species identified as being within 2km of the proposed development

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

Existing Conditions

To characterise the marine ecology baseline, including designated sites, communities and supporting habitats, and species of conservation or commercial value in the study area, a desk-based review of available data and existing field studies was undertaken with the use of the following sources:

- Biosys Marine Benthic Surveys;
- Marine Life Information Network;
- MAGIC Map;
- Reporting by Natural England and others into the benthic habitats within the Fal and Helford Special Special Area of Conservation (SAC);
- Data from the Environment Agency National Fish Populations Database for Freshwater and Transitional and Coastal Waters;
- Reporting published by Cornwall Inshore Fisheries and Conservation Authority;
- Reporting published by the Sea Mammal Research Unit; and
- Environmental Records Centre for Cornwall and the Isles of Scilly data.

The field study involved subtidal benthic habitat surveys undertaken at the site as part of a multidisciplinary ecological survey, the scope of which was agreed with statutory bodies.

The following sensitive receptors were identified:

- Designated sites (such as Fal and Helford SAC);
- Benthic ecological communities (including intertidal and subtidal benthic communities, maerl, subtidal seagrass meadows and subtidal kelp beds);
- Fish and shellfish ecological communities; and
- Marine mammals (including common dolphin, bottlenose dolphin, harbour porpoise and grey seal).

Demolition and Construction

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

- Habitat removal and disturbance which would result in not significant adverse effects ranging from negligible to minor in scale for benthic ecological communities and minor in scale for fish and shellfish, marine mammals and designated sites;
- Overshadowing which would result in not significant negligible adverse effects on all benthic ecological communities;
- Elevated suspended sediment concentrations which would result in not significant minor adverse effects on all benthic ecological communities, fish and shellfish and marine mammals;
- Suspended fine sediment deposition which would result in not significant adverse effects ranging from negligible to minor in scale on benthic ecological communities;
- Mobilisation and deposition of contaminated sediment which would result in not significant minor adverse effects on all benthic ecological communities;
- Underwater noise and vibration from impact piling, which would result in minor adverse not significant effects on fish and shellfish and all marine mammal groups with mitigation measures in place (use of soft-starts where appropriate and Marine Mammal Observer(s)); and
- Underwater noise and vibration from demolition with a hydraulic breaker, which would result in minor adverse not significant effects for marine mammal groups with mitigation measures in place (use of soft-starts where appropriate and Marine Mammal Observer(s)).

Operation

During the operational stage the following impacts and effects have been assessed:

- Scour which would result in not significant adverse effects, negligible in scale for all benthic ecological communities and minor in scale for designated sites;
- Overshadowing which would result in a not significant negligible adverse effect on all benthic ecological communities;
- Effects relating to maintenance dredging which would be minor adverse (not significant) for all benthic ecological communities;
- Vessel strike which would result in not significant adverse effects, negligible in scale for fish and shellfish and minor in scale for marine mammal groups; and
- Noise and vibration due to increased vessel movements, which would result in a not significant minor adverse effect on marine mammal groups.

9 Marine Ecology

9.1 Introduction

9.1.1 This chapter reports on the likely marine ecology effects associated with the demolition and construction stage and operational stage of the proposed development.

9.1.2 The potential impacts and likely effects of the proposed development on terrestrial ecology have been scoped out of the EIA and are reported on in Technical Appendix 2.11: Ecological Impact Assessment. Impacts and effects on commercial fisheries and shellfisheries are assessed in ES Chapter 10: Commercial Fisheries and Shellfisheries. Noise effects are also considered for ecological receptors in ES Chapter 7: Underwater Noise. Sediment mobilisation and displacement effects are reported in ES Chapter 6: Coastal Processes and Sediment Regime.

9.1.3 Impacts and effects on commercial fisheries and shellfisheries, including effects on stocks of commercial species and/or fishing effort/activities are reported on in the subsequent chapter, ES Chapter 10: Commercial Fisheries and Shellfisheries. Where this chapter considers commercial fish and shellfish, the baseline and impact assessment sections focus on the fish and shellfish (including both commercial and non-commercial species) individuals and communities themselves. Cross references to ES Chapter 10, and other chapters, are made where relevant throughout this chapter.

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

- Technical Appendix 9.1 – May 2022 Drop-Down Video (DDV) Survey Report for the Port of Falmouth, Cornwall (Document Reference: J0654/22/05/23);
- Technical Appendix 9.2 – Benthic Survey Scope and agreements;
- Technical Appendix 9.3 – May 2023 Benthic Ecology Survey Report (Document Reference: J0710/24/03/04);
- Technical Appendix 9.4 – Data Search Report from the Environmental Records Centre for Cornwall and the Isles of Scilly; and
- Technical Appendix 9.5 – Falmouth Docks Development. Maerl Technical Note (Document Reference: J0710/24/10/07).

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

International Legislation:

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora[1].

National Legislation and Policy:

- Wildlife and Countryside Act, 1981 (as amended)[2];
- Countryside and Rights of Way Act, 2000[3];
- Natural Environment and Rural Communities Act, 2006[4];
- The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007[5];
- The UK Marine Policy Statement, 2011[6];
- Biodiversity 2020: A strategy for England's Wildlife and Ecosystem, 2011[7];
- UK Biodiversity Framework, 2024[8] (which supersedes the UK Post-2010- Biodiversity Framework, 2021[9] (formerly the UK Biodiversity Action Plan, 1994[10]));
- The Conservation of Habitats and Species Regulations 2017 (as amended)[11];
- National Planning Policy Framework (NPPF), 2024[12];
- Planning Practice Guidance, 2019[13]; and
- National Policy Statement for Ports, 2012[14].

Regional Policy:

- South West Inshore Marine Plan, 2021[15].

Local Policy:

- The Cornwall Local Plan, 2016[16];
- The Cornwall Maritime Strategy 2012 – 2030[17]; and
- The Fal Fishery Order 2016[18].

National guidance and industry standards:

- Chartered Institute for Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland, 2019[19].

9.2 Consultation

9.2.1 Table 9.1 summarises the key EIA Scoping Opinion responses with respect to the marine ecology assessment as well as additional consultation that has been undertaken with the MMO, CEFAS and Natural England.

[1] The European Parliament and the Council of the European Union, 'Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora', 92/43/EEC § (1992), http://data.europa.eu/eli/dir/1992/43/oj.

[2] Secretary of State, 'Wildlife and Countryside Act 1981 (as Amended)', 1981 Chapter 69 § (1981), https://www.legislation.gov.uk/ukpga/1981/69.

[3] Secretary of State, 'Countryside and Rights of Way Act, 2000', 2000 Chapter 37 § (2000), https://www.legislation.gov.uk/ukpga/2000/37/contents.

[4] Secretary of State, 'Natural Environment and Rural Communities Act, 2006', 2006 Chapter 16 § (2006), https://www.legislation.gov.uk/ukpga/2006/16/contents.

[5] Secretary of State, 'The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007', 2007 No. 1842 § (2007), https://www.legislation.gov.uk/uksi/2007/1842/contents/made.

[6] His Majesty's Stationery Office, 'UK Marine Policy Statement' (UK Government, 2011), https://assets.publishing.service.gov.uk/media/5a795700ed915d042206795b/pb3654-marine-policy-statement-110316.pdf.

[7] Department for Environment, Food and Rural Affairs, 'Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services' (UK Government, 19 August 2011), https://assets.publishing.service.gov.uk/media/5a78c263ed915d04220651ea/pb13583-biodiversity-strategy-2020-111111.pdf.

[8] Joint Nature Conservation Committee, 'UK Biodiversity Framework, 2024', 2024, https://data.jncc.gov.uk/data/19a729f6-440e-4ac6-8894-cc72e84cc3bb/uk-biodiversity-framework.pdf.

[9] Joint Nature Conservation Committee, 'UK Post-2010 Biodiversity Framework', 2012, https://hub.jncc.gov.uk/assets/587024ff-864f-4d1d-a669-f38cb448abdc#UK-Post2010-Biodiversity-Framework-2012.pdf.

[10] Joint Nature Conservation Committee, 'Biodiversity - The UK Action Plan', 1994, https://data.jncc.gov.uk/data/cb0ef1c9-2325-4d17-9f87-a5c84fe400bd/UKBAP-BiodiversityActionPlan-1994.pdf.

[11] Secretary of State, 'The Conservation of Habitats and Species Regulations 2017', 2017 No. 1012 § (2017), https://www.legislation.gov.uk/uksi/2017/1012/contents/made.

[12] His Majesty's Stationery Office, 'National Planning Policy Framework', 2024, https://assets.publishing.service.gov.uk/media/675abd214cbda57cacd3476e/NPPF-December-2024.pdf

[13] His Majesty's Stationery Office.

[14] Department for Transport, 'National Policy Statement for Ports', 2012, https://assets.publishing.service.gov.uk/media/5a78c20ae5274a277e68f3b1/national-policy-statement-ports.pdf.

[15] His Majesty's Stationery Office, 'South West Inshore and South West Offshore Marine Plan' (UK Government, 2021), https://assets.publishing.service.gov.uk/media/60f6f71ce90e0764cfc22a78/FINAL_South_West_Marine_Plan__1_.pdf.

[16] Cornwall Council, 'The Cornwall Local Plan', 2016, https://www.cornwall.gov.uk/planning-and-building-control/planning-policy/adopted-plans/#localPlan.

[17] Cornwall Council. 2018. Cornwall Council Maritime Strategy Refresh 2018-2030. www.cornwall.gov.uk/maritimestrategy.

[18] Secretary of State, 'The Fal Fishery Order 2016', 2016 No. 716 § (2016), https://www.legislation.gov.uk/uksi/2016/716/made.

[19] CIEEM, 'Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine.' (Winchester: Chartered Institute of Ecology and Environmental Management (CIEEM), 2019).

Table 9.1 Summary of consultation

Consultee and Form/ Date of Consultation	Summary of Comments	Where in this Chapter Comments are addressed
Falmouth Harbour Board of Commissioners Scoping Opinion response dated 11 September 2023	**Marine Water and Sediment Quality** Page 33 Table 6-2 we would ask that seagrass is included as a sensitive habitat as well as maerl in relation to increased suspended sediment concentration in water column during maintenance dredging due to the proximity and sensitivity of these habitats.	All protected/sensitive habitats such as seagrass/maerl have been considered within this ES chapter, including assessment of the impact of the capital dredging proposed.
Falmouth Harbour Board of Commissioners Scoping Opinion response dated 11 September 2023	**Marine Ecology** Page 47 9.2.10 Marine mammals are regularly sighted in and around the planned development site throughout the year. In addition certain seasons see significant changes in frequency of sightings, we were therefore surprised that mammal surveys were not planned. The following paragraph describes the current data so further clarification on decision not to survey would be of interest. Is it because sufficient temporal data exists? If so clarification of the reasons behind this decision would be appreciated. Table 9-1 does not consider noise and disturbance from vessel movement, piling and dredging. In addition, are there additional effects to consider associated with the removal of bedrock that would need to be considered. Have the methodologies been assessed at this stage or are they included within the definition of dredging? Further clarification in additional to use of back hoe dredger would be useful to enable full understanding. Table 9-2 vessel strike causing injury to marine mammals. Vessel strike would be an extreme rarity however more likely and cumulatively potentially equally of impact would be ongoing disturbance of marine mammals. This would be good to add and consider in line with the recent DEFRA guidance.	It was considered that a dedicated marine mammal survey would not have provided significantly more information for the baseline of the marine ecology ES chapter than is readily available. The presence of marine mammals in the vicinity is acknowledged and significant extant survey information is available. A precautionary/conservative approach to the estimation of marine mammal abundance in the vicinity of the proposed development has been taken. Table 9-1 of the scoping report states that noise and disturbance from vessel movement, piling and dredging will be assessed in the Marine Ecology ES chapter. Specifics relating to impacts of particular dredging methodologies are included in this ES chapter. The consideration of disturbance to marine mammals is included within this ES chapter. Low-level noise such as that generated by vessels and dredging, and impulsive sound from piling have been assessed in this ES chapter. The project has committed to JNCC 2010 guidance to minimise injury to marine mammals from underwater sound.
Marine Management Organisation (MMO) Scoping Opinion dated 25 October 2023	Marine Ecology 4.3.2 The design of the upcoming benthic survey and how exactly it was influenced by the results of the previous benthic survey are unclear based on the information provided. These points would need to be clarified before the MMO can comment on whether the resulting data will be sufficient	Response to 4.3.2: The MMO/Cefas Benthic Team were consulted on the proposed survey array on 7 September 2022. The general agreement to the survey plan was received on 11 October 2022 (Document reference: ENQ/2022/00146 – 20221011).

Table 9.1 Summary of consultation

	to accurately characterise the benthic ecology baseline. 4.3.3 Given that maerl beds are a protected feature within the Fal and Helford SAC and are present in the vicinity of the proposed development (see section 9.2.7 of the SR), the Applicant should provide reassurance that they will be able to accurately (or conservatively) delineate the extent and distribution of this feature within the development footprint using the data that are/will be collected. 4.3.4 You should consider whether the proposed development would increase risks relating to 1) invasive non-native species (INNS), either due to the activities conducted introducing species or the presence/extension of hard artificial structures providing surfaces for colonisation, or 2) changes to the hydrodynamics of the area caused by the presence of new hard structures. Any effects on sensitive or protected benthic features, such as maerl beds, are particularly important to consider. These potential impacts should be scoped in or out, with justification. 4.3.5 You should clarify whether 'Shading and overshadowing' and 'Noise and disturbance from vessel movement, piling and dredging' will be assessed for benthic ecology receptors. If not, then justification should be provided. 4.3.6 Regarding the potential impact of propellor wash and wake wash following the completion of the development (see Table 9-2 in the SR), it states that it is "unlikely to be significant, but the effects will be considered in the ES". However, the second column of the same table indicates that this impact will not be assessed in the EIA. Please clarify whether this impact will be scoped in or out, with justification. 4.3.7 Proposed mitigation measures include: the use of a 'soft-start' procedure for any/all piling operations; avoidance of important migratory fish periods through seasonal piling; the use of silt curtains during any/all dredging operations to minimise smothering; and the use of vibro-piling (see section 9.5.1 of the SR). Of these measures, the use of silt curtains is the most relevant to benthic ecology receptors. The MMO agrees that this would be an appropriate measure if it is	Response to 4.3.3: Benthic survey information collected to date is considered to be sufficient to allow a conservative delineation of maerl beds within the development footprint. Response to 4.3.4 Consideration has been given to the potential spread of INNS within this ES chapter. It should be that the proposed development site is already an active international dock and so it is highly likely that INNS have already colonised hard structures to a certain degree. During benthic ecology surveys at the site in May 2023, two invasive fauna were identified, the barnacle *Austrominius modestus* and red ripple bryozoan *Watersipora subatra*. More detail is provided in the Survey Report (Technical Appendix 9.3) and Paragraph 9.8.25. Response to 4.3.5 'Shading and overshadowing' and 'noise and disturbance from vessel movement, piling and dredging' has been assessed in this ES chapter for benthic ecological receptors. Response to 4.3.6 Effects of propeller wash and wake wash from the operational development has been assessed in this ES chapter as there is a potential impact pathway. Response to 4.3.7 Mitigation measures, where required and appropriate, and their effectiveness are considered within this ES chapter and in Chapter 6: Coastal Processes and Sediment Regime. Response to 4.3.8 Significance of effects on designated features of the Fal and Helford SAC are assessed in this ES and HRA. Mitigation

Table 9.1 Summary of consultation

	determined that sediment suspension and deposition is likely to have significant impacts on benthic ecology receptors. 4.3.8 It is unclear whether the applicant intends to prevent or minimise impacts on the designated features of the Fal and Helford SAC, within which the development site is located. Potential impacts on maerl beds appear to be a particularly high risk, given their proximity to the development footprint. Efforts to mitigate such impacts would be appropriate. If residual impacts are likely, then an impact and recovery monitoring programme should be implemented. It may also be necessary for compensation measures to be carried out (e.g., enhancements or restoration to the impacted feature either at the development site or elsewhere). 4.3.9 The SR scopes in relevant impacts that would result from the proposed development of Falmouth Docks and identifies appropriate data sources to characterise the benthic ecology baseline against which impacts will be assessed. Additional information is needed from the Applicant regarding the possibility of other potential impacts, the details of an upcoming benthic ecology survey plan (though this information may have been provided in a separate consultation), and the approach to mitigating impacts on protected features of the Fal and Helford SAC.	measures are proposed where necessary. Response to 4.3.9 The MMO were consulted on the benthic survey plan (see response to 4.3.2). As per the response to 4.3.8., effects on the Fal and Helford SAC will be included in this ES chapter and the HRA.
Marine Management Organisation (MMO) Scoping Opinion dated 25 October 2023	**Fish Ecology** 4.6.1 After reviewing the Environment Agency (EA) data (https://environment.data.gov.uk/ecology/explorer/), the MMO found evidence of European eel (*Anguilla anguilla*) being present in the Fal River. Both Allis and Twaites Shad (Alosa alosa and Alosa fallax) have also been recorded within the vicinity, and these species should therefore be scoped into the assessment. 4.6.2 Please specify what kind of piling will be proposed in your ES. Underwater noise (UWN) generated during percussive piling operations has the potential to cause physiological harm and affect behaviour in fish. Fish responses to noise are in-part related to the anatomy of their hearing mechanisms. The presence of a swim bladder enhances hearing sensitivity as the bladder acts as a pressure transducer, converting sound pressure to particle velocity. Those species where the swim bladder is near to or connected to the ear have increased hearing sensitivity and thus greater vulnerability to underwater noise impacts. The MMO recommends that the impacts of underwater noise and vibration on fish are scoped into the impact assessment. 4.6.3 Please ensure you consider the following key points when undertaking UWN modelling as part of the UWN impact assessment for fish: i: Fish species with spawning or nursery grounds in the area, and those that are known to migrate through the Fal should be classified into one of the four categories based on the hearing capabilities and presence/absence of a swim bladder. ii. Please also refer to Popper et al. (2014) for sound exposure guidelines on noise thresholds for mortality, potential mortal injury and recoverable injury, temporary threshold shift (TTS) and behavioural responses for fish for impulsive noise (e.g., percussive piling) and continuous noise (e.g., vibro piling). iii. The underwater noise assessment should be presented using appropriate unweighted metrics, supported by underwater noise modelling or by case studies of a similar nature to support conclusions made on the likelihood and significance of impacts to fish from piling. iv. The modelled/predicted impact ranges for underwater noise should be discussed in the context of the width of the Fal Estuary to determine the likelihood of an acoustic 'barrier' to fish movement and migration. v. If concurrent/simultaneous piling activity is proposed, this should also be included in the modelling or considered when sourcing supporting case study information. vi. The timing of piling and dredging works should be provided, together with a description of the number and size of the piles, typical duration of installation (per pile), and the number of piles to be installed per day, so that any overlap in construction and dredging activities with	Response to 4.6.1 EA data explorer is listed as a data source and has informed the fish ecology baseline of this ES chapter. All protected species /species of conservation importance identified as being present within the Fal River are included in this ES chapter. Response to 4.6.2 Details of piling methodology has been summarised briefly within this ES chapter. Full details of construction methodologies are provided in Chapter 5: Demolition and Construction. Impacts of underwater noise and vibration are listed in Table 9-1 of the Scoping Report as being topics scoped-in to the assessment. Response to 4.6.3 (i) This has been presented within this ES chapter. Response to 4.6.3 (ii) Guidelines and other information presented within Popper *et al.* (2014) are presented where necessary in this ES chapter. Response to 4.6.3 (iii) Underwater noise modelling is presented within Chapter 7 of the ES. The results of this modelling have been used where necessary to support the noise and vibration assessment in this ES chapter. Response to 4.6.3 (iv) This has been included in the ES chapter. Response to 4.6.3 (v) No concurrent/simultaneous percussive piling activity is proposed as part of the proposed development; see Chapter 5: Demolition and Construction. Response to 4.6.3 (vi) A brief description of the construction timing and methodologies has been provided in this ES chapter with full details of construction methodologies provided in Chapter 5: Demolition and Construction.

Table 9.1 Summary of consultation		
	the spawning and migratory periods of fish can be identified.	
Marine Management Organisation Scoping Opinion received 25 October 2023	**Shellfish** 4.7.1 Relevant data sources have been identified and have scoped in the relevant shellfish receptors. The MMO would expect impacts on shellfish receptors (non-commercial) to also be included.	Response to 4.7.1 Impacts on both commercial and non-commercial shellfish receptors have been included in this ES chapter. A discussion of shellfish species identified as being present within the study area is presented in the baseline conditions section.
Cornwall Council Scoping Opinion received 06 October 2023	No comments specific to the Marine Ecology ES Chapter received. Comments in the appendices from Falmouth Harbour Commissioners are dealt with separately in this table. Comments from the Environment Agency are dealt with in the next row of this table.	Responses to Falmouth Harbour Commissioners and Environment Agency comments are provided in this table.
Environment Agency Scoping Opinion response dated 14 September 2023	**Habitats and Biodiversity** The Scoping document is comprehensive on this matter and we are encouraged to note that Marine Ecology, Commercial Finfisheries and Shellfisheries, Noise and Vibration and Underwater Noise are all scoped in topics as these could each has some bearing on the impact to protected habitats and species. However, we would advise that there is minimal detail on the management of invasive non-native species which may be found at the site and what biosecurity measures will be implemented to eliminate them and/or avoid their spread. As the proposed development lies within the Fal & Helford SAC Natural England will take the lead on biodiversity. We have a tidal encroachment policy and where development involves the loss of intertidal foreshore we would raise objections unless adequate mitigation or compensation is proposed. The proposal would need to achieve a biodiversity net gain to be in line with the Government's 25 Year Environment Plan, the NERC Act 2006 (section 40 & 41), the NPPF (paragraphs 170 & 175) and the Environment Bill (schedule 15).	We are pleased to read that you consider the scoping document comprehensive in terms of marine ecology receptors. Consideration has been given to the potential spread of INNS within this ES chapter. It should be noted that the proposed development site is already an active international port and so it is highly likely that INNS have already colonised hard structures to a certain degree. Consultation with Natural England has been undertaken throughout the pre-planning stage of the project. No loss of intertidal foreshore is predicted as a result of the proposed development. Changes to intertidal hard structures (revetment) are detailed in the BNG Assessment for the proposed development (15743-RAM-FD-SW-RP-EV-00023).
Natural England, MMO, Cefas August to October 2022	Correspondence and meetings to discuss the scope of the Benthic Survey	The scope of the benthic survey was agreed with all parties. Refer to Technical Appendix 9.2 for the scope and associated comments and agreements.
Natural England DAS advice and Meetings held in 2024	As part of the consultation process, Natural England were contacted in respect of the definition of a 'maerl bed' and its application to the data collected as part of the Benthic Ecology survey (the results of which can be found in Technical Appendix 9.3 – Benthic Ecology Survey Report)	A technical note (Technical Appendix 9.5) has been prepared in relation to the distribution of maerl habitats within the site boundary and zone of influence within the Fal and Helford SAC, and the potential impacts on these habitats arising from the proposed development.

9.3 Assessment Scope

9.3.1 This assessment has been undertaken through the interpretation of baseline data, literature reviews, relevant legislation, consultation and professional judgement in accordance with the guidelines produced by CIEEM[19] for Ecological Impact Assessments and by reference to relevant legislation and policy. The principles and approach of the CIEEM guidelines have been followed as far as possible, however standard EIA terminology has 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.

9.3.2 The aims of the assessment have been to:

- identify the presence of habitats, flora and fauna of conservation importance within the study area through consultation, desk-based research and field studies;
- evaluate the sensitivity of the ecological receptors by determining their importance in terms of their nature conservation value, combined with their sensitivity to individual impacts;
- identify potential impacts and effects on marine flora, fauna and habitats of conservation importance; and
- assess the residual effects taking into account the implementation of additional mitigation, if required.

Technical Scope

9.3.3 The technical scope of the assessment has considered the potential impacts and likely effects of the proposed development on marine ecology in relation to designated sites, habitats and protected species.

9.3.4 The following potential impacts associated with the demolition and construction stage have been considered:

- Habitat removal and disturbance;
- Overshadowing;
- Elevated suspended sediment concentrations;
- Suspended sediment deposition;
- Contaminated sediment mobilisation and deposition;
- Underwater noise and vibration;
- Introduction and/or spread of invasive non-native species; and
- Vessel strike.

9.3.5 The following potential impacts associated with the operational stage have been considered:

- Propellor wash and scour;
- Overshadowing;
- Sediment dispersion and deposition from maintenance dredging;
- Vessel strike; and
- Underwater noise and vibration from the presence of additional vessels.

Spatial Scope

9.3.6 A standard minimum 2 km study area from the boundary of the site was used for the identification of non-statutory designated sites, important habitats and species (Figure 9.1). The study area comprises both intertidal and subtidal environments within the Fal Estuary and its tributaries, which support benthic invertebrate communities, migratory and non-migratory fishes and marine mammals. Specific study areas have been defined below for fish, marine mammals and benthic ecology.

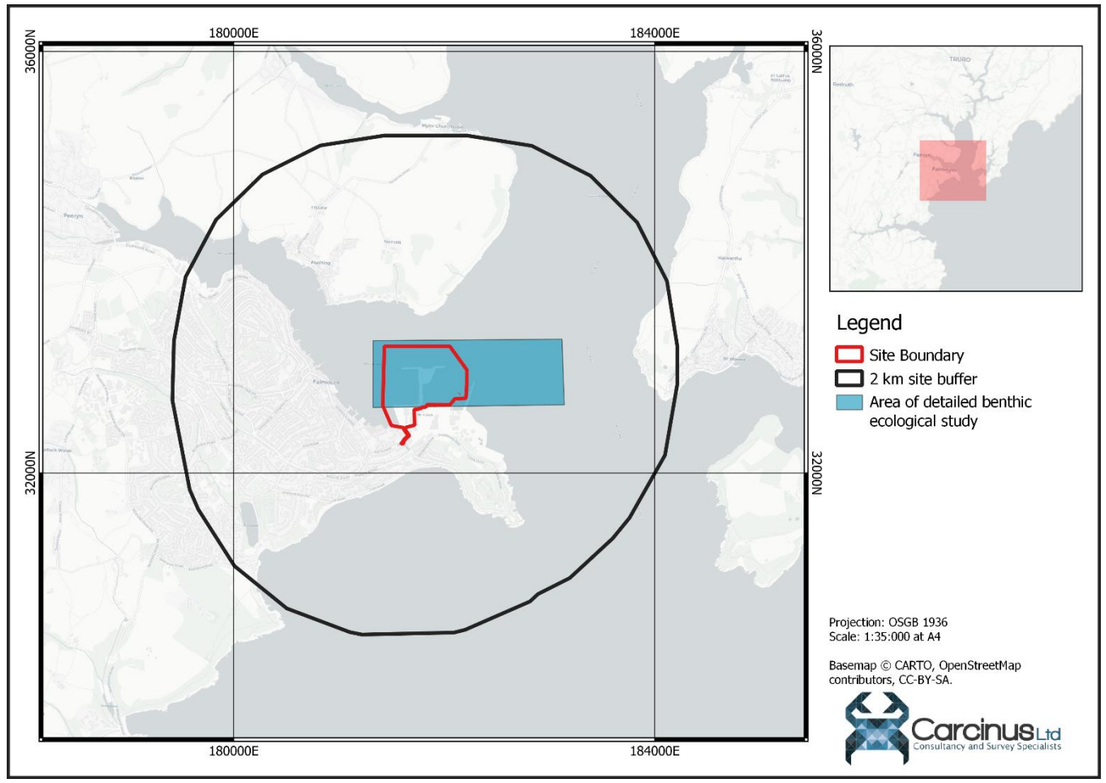


Figure 9.1 Area within 2 km of site boundary.

9.3.7 The site is approximately 47.2 ha of which approximately 39.6 ha (89%) is the marine component and is situated on the south bank of the river Penryn at the confluence with the Fal estuary. The study area excludes terrestrial environments, which are considered within the Ecological Impact Assessment (EcIA) (Technical Appendix 2.11).

9.3.8 The extent of the study area was determined using professional judgement to ensure all effects likely to arise from the proposed development are considered.

Benthic Ecology

9.3.9 The study area for benthic ecology has been divided into two parts:

- an area of approximately 115 Ha shown shaded blue in Figure 9.1, comprising the marine area within the site boundary and in Carrick Roads, which represents a worst-case study area in terms of potential direct and indirect impacts as well as providing survey coverage and an understanding of the wider area. This area was the focus of the 2023 marine ecological survey and is considered in detail; and
- a wider area (~1,000 Ha) consisting of the marine environment within 2 km of the site boundary, using existing data sources, to provide further context to the survey information.

9.3.10 Regional information from survey reports published by Falmouth Harbour Commissioners, Cornwall Inshore Fisheries and Conservation Authority (C-IFCA) and others have also been used to provide context.

Fish and Shellfish Ecology

9.3.11 The Fal estuary covers an area of approximately 2,400 ha, with surrounding land cover predominately rural apart from the town of Falmouth and the city of Truro. The study area for Fish and Shellfish ecology incorporates the Fal Estuary, starting at the upstream tidal limit at Tresillian and extending out into Falmouth Bay (Figure 9.2). This area includes several EA monitoring points, data from which are held in the National Fish Populations Database (NFPD). The closest monitoring point is 2.7 km upstream of the proposed development. This study area is considered appropriate to adequately account for the fish and shellfish communities (including both commercial and non-commercial communities) that have the potential to be impacted by the proposed development. Both Transitional and Coastal (TraC) and Freshwater surveys have been considered.

9.3.12 Some fisheries data sources are available based on the relevant International Council for the Exploration of the Sea (ICES) Ecoregion and statistical rectangle. The proposed development is located within ICES Ecoregion XI (Celtic Seas) and sits near the border between ICES rectangle 29E4 and 29E5 (Figure 9.2) which cover the western tip of Cornwall and Looe Bay respectively.

Marine Mammals

9.3.13 Marine mammal species are generally highly mobile and transitory in nature. This chapter has therefore looked at the occurrence of species not only within the Fal Estuary but also over the wider western English Channel. The status and activity of marine mammals known to occur at or adjacent to the site is considered in the context of regional population dynamics at the scale of the Fal Estuary (where possible) or the western English Channel, depending on the data available for each species. Only marine mammal sightings within the Fal Estuary are assessed in this chapter, as the conservation status of populations that remain outside the estuary would not be affected by the proposed development. This extent is considered to be robust in terms of accounting for the marine mammal species and communities have the potential to be impacted by the proposed development.

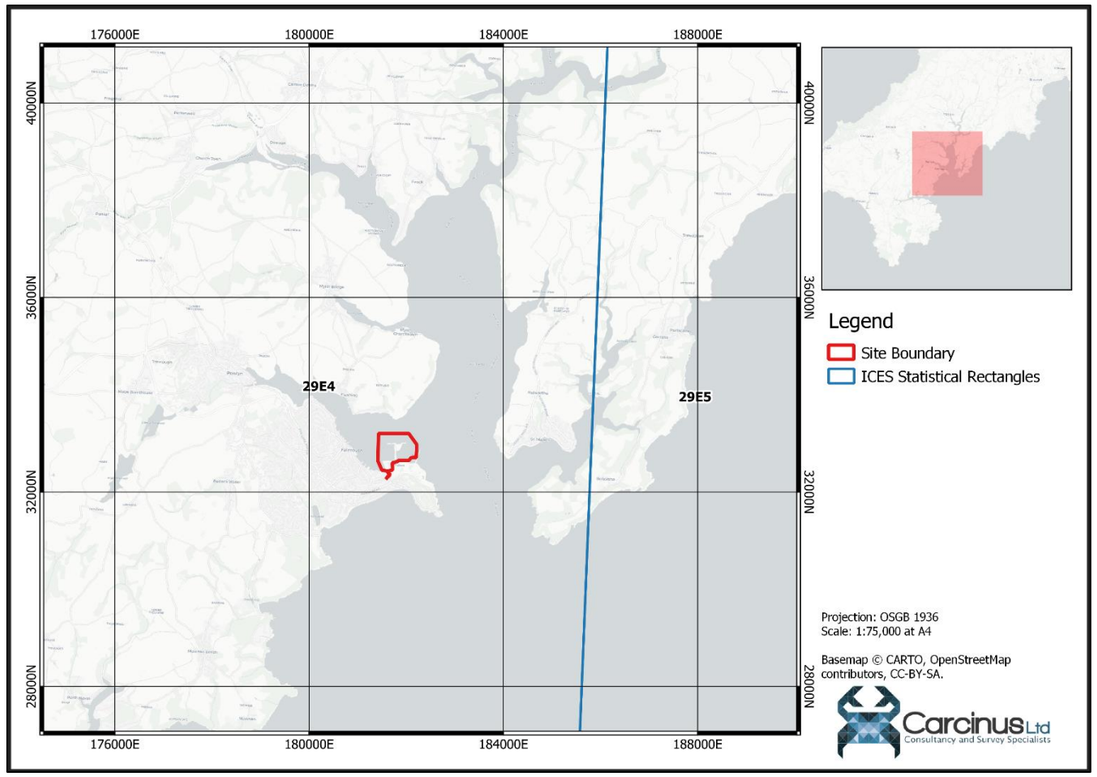


Figure 9.2 Approximate study area for fisheries and marine mammal assessments.

Temporal Scope and Assessment Scenarios

9.3.14 The assessment has considered impacts arising during the demolition and construction stage and the operational stage. Impacts arising during demolition and construction stage would be expected to be temporary and short-term (up to five years) in nature based on an approximately three year construction programme. Impacts arising during the operational stage would be expected to be permanent and long-term in nature (i.e. more than 10 years).

9.3.15 The works anticipated to potentially impact marine ecology are all works within the marine environment. Impacts have been assessed against the existing marine ecology baseline, using survey data from 2023, as well as existing survey data from 2002 to 2023. This is considered to robustly reflect the current baseline.

9.4 Baseline Characterisation Method

Desk Study

9.4.1 Baseline ecological information was obtained through collection and review of past findings from relevant studies and surveys regarding the ecological character of the marine component of the site and study area. Baseline characterisation was collated combining a thorough desk-based study of extant data. The datasets and associated sources for each of the receptors can be summarised as follows:

Benthic Ecology

- Biosys Marine Benthic Surveys[20];
- Marine Life Information Network (MarLIN)[21];
- MAGIC Map[22];
- Reporting by Natural England and others into the benthic habitats within the Fal and Helford SAC[23,24,25]; and
- Other peer-reviewed literature (cited within text).

Fish and Shellfish Ecology

- Data from the EA National Fish Populations Database for Freshwater and Transitional and Coastal Waters[26];
- Reporting published by C-IFCA[27]; and
- Other peer-reviewed literature (e.g. Ellis *et al.*[28] and Coull *et al.*[29])

Marine Mammals

- SCANS (Small Cetaceans in European Atlantic Waters and the North Sea) IV data[30];
- SCOS (Special Committee on Seals) Reports and data published by the Sea Mammal Research Unit[31]; and
- Other peer-reviewed literature (cited within text).

All receptors

- A search of all species recorded within 2 km of the proposed development was also made of the Environmental Records Centre for Cornwall and the Isles of Scilly (ERCCIS)[32].

9.4.2 Further information about fish and shellfish populations, as well as fishing activities within the study area, can be found in Chapter 10: Commercial Fisheries and Shellfisheries.

Field Study

9.4.3 Subtidal benthic habitat surveys were undertaken at the site as part of a multidisciplinary ecological survey. Full findings from this survey are presented in ES Volume 2: Technical Appendix 9.3: May 2023 Benthic Ecology Survey Report. The scope of this survey was agreed with both Natural England and the MMO.

9.4.4 Specific estuarine intertidal and subtidal fisheries surveys were not undertaken for the proposed development because EA NFPD TraC and Freshwater fisheries monitoring data were available for the Fal Estuary and these data provide a robust basis for assessment purposes, providing a sufficient spatial and temporal coverage. The data were gathered from estuarine sites within 10 km of the site, covering

[20] Environment Agency, 'Marine Benthic Surveys (Biosys)', 19 May 2022, https://environment.data.gov.uk/dataset/8cd194cd-cec3-4f21-83d4-984add281dc4.
[21] The Marine Biological Association of the UK, 'Home - MarLIN - The Marine Life Information Network', 2024, https://www.marlin.ac.uk/.
[22] Department for Environment, Food and Rural Affairs, 'Magic Map Application', accessed 2 April 2024, https://magic.defra.gov.uk/magicmap.aspx.
[23] C. Allen et al., 'Fal and Helford SAC Maerl Drop-down Video and Dive Survey 2013.', A report to Natural England by Seastar Survey Ltd. (Seastar Survey Ltd, 2014).
[24] Sheehan, E.V. et al., 'Testing the Resilience of Dead Maerl Infaunal Assemblages to the Experimental Removal and Re-Lay of Habitat', *Marine Ecology Progress Series* 535 (15 September 2015): 117–28, https://doi.org/10.3354/meps11400.
[25] Cornwall Council, 'Carbon Accounting and Nature Recovery Options for Blue Carbon Ecosystems in the Fal & Helford Estuary, Cornwall' (Truro: Cornwall Council, 2024).
[26] Environment Agency, 'Transitional & Coastal Water Fish Surveys (NFPD)', 30 June 2022, https://environment.data.gov.uk/dataset/11254005-e58b-4354-9c56-0d459665d1b8.
[27] https://www.cornwall-ifca.gov.uk/
[28] J Ellis et al., 'Spawning and Nursery Grounds of Selected Fish Species in UK Waters', Science Series Technical Report (Lowestoft: Cefas, 2012), https://www.cefas.co.uk/publications/techrep/techrep147.pdf.
[29] K. A. Coull, R. Johnstone, and S. I. Rogers, 'Fisheries Sensitivity Maps in British Waters' (UKOOA Ltd., 1998), https://www.cefas.co.uk/media/o0fgfobd/sensi_maps.pdf.
[30] SCANS IV reporting and distribution maps available from: https://www.tiho-hannover.de/en/clinics-institutes/institutes/institute-of-terrestrial-and-aquatic-wildlife-research-itaw/scans-iv-survey
[31] SCOS Reports and Data available from: http://www.smru.st-andrews.ac.uk/scos/scos-reports/
[32] ERCCIS 'Public Data Dashboard', Public Data Dashboard, 2022, http://erccis.org.uk/explore/public/dashboard.

a period 2000 – 2024. Fish species within the Fal Estuary are well understood and their mobile nature would not warrant a site-specific survey. Consideration of freshwater monitoring locations was specifically related to the potential for the Fal Estuary to act as a migration corridor for migratory species such as salmonids.

9.4.5 The EA uses a multi-method sampling methodology to adequately sample the fish populations and incorporates freshwater, intertidal and subtidal techniques. The techniques used at the TraC sites considered within this chapter were as follows:

- Electric Fishing (Pulsed Direct & Direct Current; Catch Depletion & Single Catch methods);
- Beam Trawl Netting (1.5 and 2.4 m);
- Fyke Netting;
- Seine Netting; and
- Otter Trawl Netting.

9.4.6 Marine Mammal data collection was based on desk studies and incidental sightings compiled by the Environmental Records Centre for Cornwall and the Isles of Scilly (ERCCIS)[32]. In addition, data were collated from a number of sources including internet searches, existing literature and other sources. No site specific marine mammal surveys have been carried out on the site, given the highly mobile nature of this species group, and the fact that monitoring data of appropriate temporal and spatial scope was available.

9.5 Assessment Method

9.5.1 This assessment has been compiled with principal reference to the CIEEM guidelines on EcIAs, which has been adapted to the generic and widely accepted EIA methodology of using a matrix approach to determine the likely significant effects.

Methodology

9.5.2 The assessment methodology for both the demolition and construction stage and operational stage comprised the following steps:

- The marine ecology baseline was defined, i.e. an assessment of the site and its current status, condition and ecological value using a geographic frame of reference was made and using a combination of new and existing survey data and literature review;
- The potential effects from the proposed development (both direct and indirect) on important marine ecological features were defined using professional judgement and where possible quantified;
- Consideration was given to avoidance, mitigation, compensation and enhancement measures (the 'mitigation hierarchy') integral to the proposed development; and
- Once measures to avoid and mitigate ecological effects were finalised, the significance of the residual effects (after mitigation) on marine ecological features were assessed.

9.5.3 In addition, consideration has been given to inter-cumulative effects, using professional judgement.

9.6 Assessment Criteria

9.6.1 The criteria used to assess if an effect is significant or not, are set out in subsequent sub-sections. This has been determined by consideration of the ecological value and the sensitivity of the receptor, magnitude of impact and scale of the effect. In considering the significance of an effect, consideration was given to the duration and frequency of the effect, the geographical extent of the effect, the likelihood of occurrence (where relevant) and the application of professional judgement.

Ecological Value and Sensitivity Criteria

9.6.2 Guidance provided by CIEEM has been used to determine the ecological value of the site and ecological receptors identified. When assigning value to an ecological feature or resource, the following considerations have been taken into account:

- Geographical context of the site, for example international, UK, national, regional, metropolitan, borough, local;
- Designated sites and features, such as SACs, SPAs, SSSIs, SINCs, National and Local Nature Reserves (NNRs and LNRs);
- Biodiversity value, BAPs, including Habitat and Species Action Plans, rare or uncommon species, endemic species, notably large populations considered uncommon or threatened in a wider context, habitat diversity and connectivity;
- Potential value of a feature. If targets are in place for a SSSI to meet 'favourable conditions' this should be the benchmark against which impacts are assessed. Similarly, for BAPs, Habitat Action Plans and Species Action Plans, if a detailed management plan is in place and the chance of failure is low, the site should be valued as if the intended resource already exists;
- Secondary or supporting value of the feature, i.e. they may not be of any particular ecological interest, but they may perform an ecological function;
- Social value of the feature, which is used and enjoyed by many people, e.g. sites that provide the only visual and/or physically accessible area of semi-natural green space for a local community;
- Economic value of the feature such as the profit made from visits to a bird hide and angling; and
- Legal protection for both sites and species.

9.6.3 It is important to note the difference between the biodiversity value of a receptor and its legal status. Features of high biodiversity value may not necessarily attract legal protection and vice versa. For example, some species are likely to be considered of high biodiversity value even if it does not receive any formal statutory protection.

9.6.4 In addition to determining the ecological value, in accordance with CIEEM guidelines, where it is appropriate to consider the social/community or economic value of a receptor, an appropriate level of value has been attributed within the identified geographical scale.

9.6.5 To determine which ecological features (habitat or species) are included within the impact assessment, the receptors that are susceptible and sensitive to impact have been assessed. The threshold for inclusion within the impact assessment has been defined as:

- any sites, habitats or species that are considered to be of at least local biodiversity value;
- sites, habitats and/or species that receive legal protection or are referenced in policy (e.g. BAPs); and
- habitats forming corridors and commuting networks for important species (e.g. for migratory fish).

9.6.6 In accordance with CIEEM guidelines, each ecological feature has been assessed as valuable, or potentially valuable, based on criteria presented in Table 9.2. Due to the high mobility of marine receptors and connected nature of the marine environment, these criteria differ from those typically used within a terrestrial-focused Ecological Impact Assessment.

Table 9.2 Receptor Value and Importance Criteria

Value	Geographical Importance	Criteria
High	International	• An internationally designated site or candidate site, i.e. a SPA, provisional SPA, SAC, candidate SAC, Ramsar site, or an area which would meet the published selection criteria for designation. • A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat that is essential to maintain the viability of a larger whole. • Sites supporting populations of internationally or European important species.
	National (England)	• A nationally designated site, i.e. SSSI, NNR or discrete area which would meet the published selection criteria for national designation (e.g. SSSI selection guidelines). • A viable area of a priority habitat identified in the UK BAP, or smaller areas of such habitat essential to maintain wider viability.

Table 9.2 Receptor Value and Importance Criteria		
Value	**Geographical Importance**	**Criteria**
		• Viable populations of nationally important species that are of threatened or rare conservation status, including those identified as priority species in the UK BAP.
Medium	Regional (South-West)	• Sites that exceed the local-level designation but fall short of SSSI selection criteria. • Smaller areas of key habitat identified in the UK BAP that are essential to maintain wider viability. • Viable populations of nationally scarce species identified in Regional BAP and/or regularly occurring populations of a regionally important species. • Fish and shellfish species of commercial importance.
Low	Local (e.g. within the study area)	• Sites recognised by local authorities (e.g. LNR). Areas of habitat or populations/assemblages of species that appreciably enrich the local habitat resource. • Viable populations of species identified in the District BAP and/or regularly occurring populations of species important at the Local scale.
	Within the zone of influence	• Sites that retain habitats and/or species of limited ecological importance due to their size, species composition or other factors.

9.6.7 In order to translate CIEEM guidelines into the standard EIA assessment methodology, the ultimate ecological value and receptor sensitivity has been classified as high, medium or low based on professional judgement, combining the geographical importance of a receptor with the potential for the receptor to be sensitive to a potential impact. For example, a species of international value may be highly insensitive to a potential impact, and therefore whilst the receptor geographical importance may be at an international level and therefore of high value, if the receptor has a very low sensitivity (highly insensitive) to an impact, the overall 'receptor value and sensitivity' would be low.

Magnitude of Impact Criteria

9.6.8 The impacts have been characterised according to the following variables:

- Magnitude and extent - Quantitative size of an impact (e.g. area of habitat/ number of individuals);
- Timing – When the impact may occur;
- Duration and reversibility - Timescale of impact (days/weeks/months/years) until recovery. Permanent impacts are described as such, and likelihood of recovery is detailed where appropriate;
- Frequency - Frequency of impact (if appropriate; described as low to high and quantified where possible);
- Complexity - Whether the impact would directly or indirectly affect the feature; and
- Adverse/Beneficial - If the impact would be beneficial or detrimental to the feature.

9.6.9 The magnitude of impact has been classified as low, medium or high, in accordance with the criteria set out in Table 9.3.

Table 9.3: Impact Magnitude Criteria	
Magnitude of Impact	**Criteria**
Low	• No impact on sites of international, national or local importance; • Temporary disturbance or damage to a small part of a feature of local importance; • Loss of or damage to land of negligible nature conservation value; and

Table 9.3: Impact Magnitude Criteria	
Magnitude of Impact	**Criteria**
	• No reduction in the legally protected, nationally rare, nationally scarce or notable (regional / local level) species on the site or its immediate vicinity.
Medium	• Temporary disturbance to a site of local value, but no permanent damage; • Loss of, or permanent damage to a feature with some ecological value in a local context but that has no nature conservation designation; • A minor impact on a legally protected species but no significant habitat loss or reduction in Favourable Conservation Status (FCS); and • A minor impact on populations of nationally rare or scare species or species that are notable at a regional or local level.
High	• Loss of, permanent damage to integrity of any part of a site of international or national importance; • Loss of a substantial part or key feature of a site of local importance; • Loss of FCS of a legally protected species; • Loss of or damage to a population of nationally rare or scarce species; • Temporary disturbance to a site of international or national importance, but no permanent damage; • Loss of, or, permanent damage to any part of a site of local importance; • Loss of a key feature of local importance; • A substantial reduction in the numbers of legally protected species such that there is no loss of FCS but the population is significantly more vulnerable; and • Reduction in the amount of habitat available for a nationally rare or scarce species, or species that are notable at a regional or local level.

9.6.10 In addition to the absolute magnitude of each impact, the scope for temporal and spatial overlap between a given impact and a given receptor has been considered. For example, if the area of a sediment plume is large in the context of a given area but does not reach a sensitive habitat, the magnitude of impact would be low due to minimal exposure of the receptor to the impact. Similarly, if an activity generates noise over a wide area at a high volume, but the noise is generated at a time when a sensitive receptor is not present in the area, the magnitude of the impact on that specific receptor would be low as there is no temporal overlap and therefore no exposure of the receptor to that impact.

Significance of Effect Criteria

9.6.11 The ecological significance of the impact is defined by CIEEM[19] as "is an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features' or for biodiversity in general. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national/local nature conservation policy) or more wide-ranging (enhancement of biodiversity). Effects can be considered significant at a wide range of scales from international to local".

9.6.12 The matrix in Table 9.4 describes the approach that has been adopted in determining the significance of the effect. This method identifies this as a function of the magnitude of the impact (magnitude, probability and reversibility of impact) and affected receptor value and sensitivity (sensitivity, geographical value and importance).

9.6.13 Although EcIA guidelines do not recommend such an approach for assessment, it has been included for consistency across the wider EIA. The matrix has been used together with the application of professional judgement to ensure an appropriate level is attributed. In addition, a precautionary approach has been taken with the reasonable worst-case scenario assessed for each impact, in order to account for uncertainty or lack of baseline survey data in the assessment.

9.6.14 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 five years) or medium-term (5-10 years) or permanent (10 years or more).

9.6.15 Only those effects considered to be **Moderate** or **Major** are considered to be **significant** effects.

Table 9.4 Significance of Effect Criteria (Significant Effects in Bold)

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

Nature of Effect Criteria

9.6.16 The nature of the effect is in accordance with Chapter 2: EIA Process and Methodology and has been described as either adverse, neutral or beneficial:

- Adverse – detrimental or negative effect to an environmental resource or receptor; and
- Beneficial – advantageous or positive effect to an environmental resource or receptor.

9.7 Assumptions and Limitations

9.7.1 The assessment has relied on various published datasets. The data contained within them has broadly been taken at face value, with no significant verification of the data undertaken beyond a high level review to ensure there are no significant apparent errors.

9.7.2 There are considered to be no further material gaps or uncertainties relating to the assessment that would compromise the ability to undertake robust assessment of impacts. Small uncertainties have been overcome by adopting the precautionary principle so that assessment conclusions err on the side of caution.

9.8 Baseline Conditions

Existing Baseline

Benthic Ecology

9.8.1 The baseline benthic ecological conditions have been derived from a variety of resources. Two separate ecological studies of the benthic environment in the vicinity of the proposed development have been carried out. A high-level drop-down video (DDV) survey was undertaken in May 2022, the findings of which were used to inform the scope of a multidisciplinary ecological study in 2023, comprising targeted DDV transects as well as Day Grabs for fauna ID and particle size distribution (PSD) analysis. The scope of this latter survey was agreed with Natural England and the Marine Management Organisation (Technical Appendix 9.2). The survey was conducted in May 2023 and therefore is considered to robustly represent the existing baseline conditions at the site. Relevant results from these studies have been presented in this chapter and the full 2022 and 2023 survey reports are presented in ES Volume 1 Technical Appendix 9.1 and ES Volume Technical Appendix 9.3 respectively.

9.8.2 In addition, a request for a standard 2 km data search was made to the Environmental Records Centre for Cornwall and the Isles of Scilly (ERCCIS) from the centre point of the proposed development's site boundary[33] (approximate search area is shown in Figure 9.3 and the full report is presented in Technical Appendix 9.4). The above data were supplemented by a review of extant peer-reviewed and grey literature.

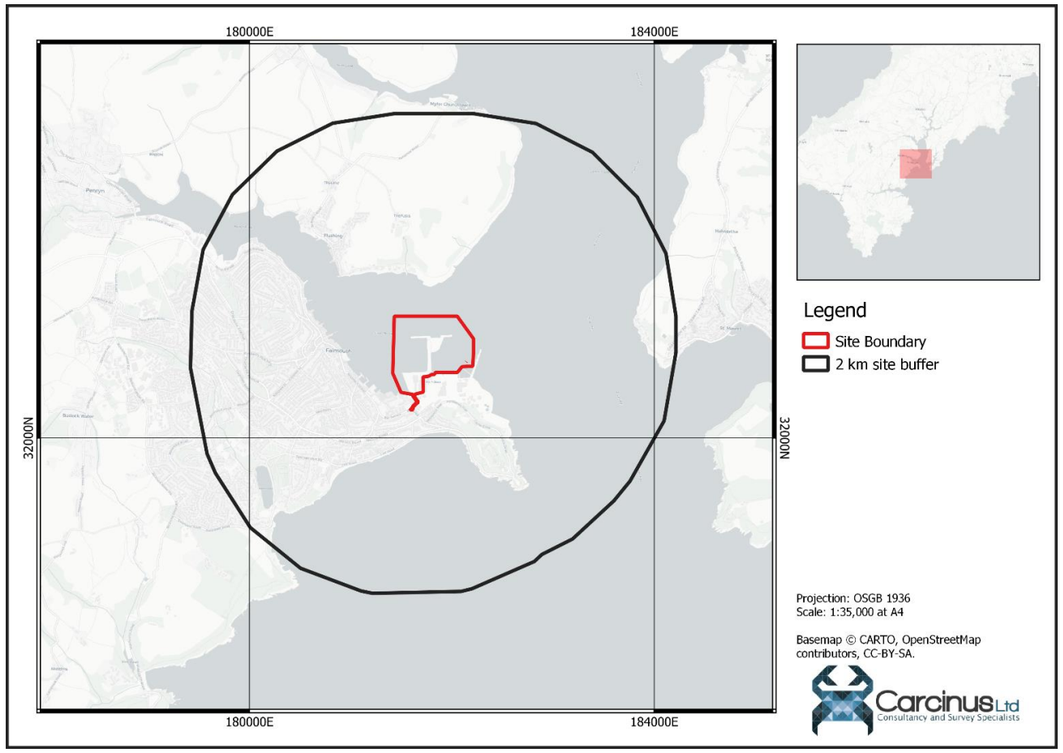


Figure 9.3 2 km boundary from the site used for ERCCIS data search.

May 2022 DDV Survey

9.8.3 A total of 30 DDV transects were surveyed in the vicinity of the proposed development, including the waters immediately around the dock structures and within the main approach channel near to St Mawes (Figure 9.4).

[33] ERCCIS, 'J0710 Marine Ecology ES Data Search 02/04/2024', ERCCIS Data Search Report, Report on Data Hosted at ERCCIS on Species, Habitats, and Non-Statutory Designations (Truro: Environmental Records Centre for Cornwall and the Isles of Scilly, 2024).

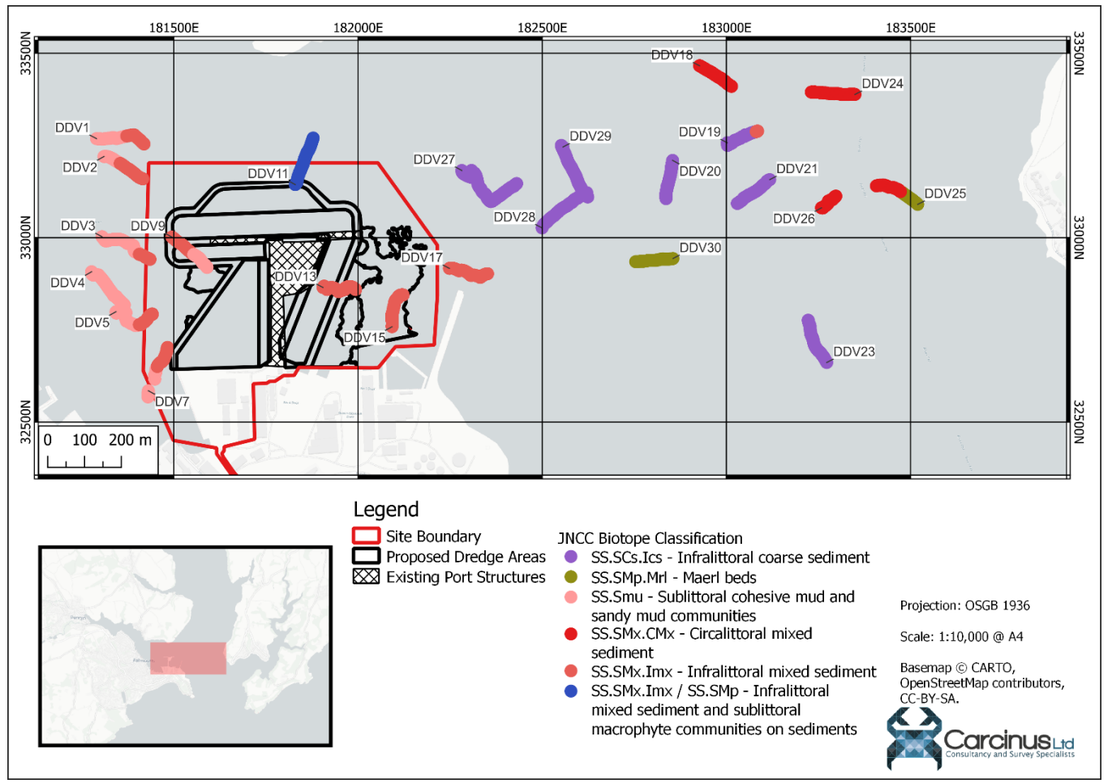


Figure 9.4 Biotopes identified during the May 2022 DDV Survey.

9.8.4 Biotopes in the west of the survey area (near to Falmouth Docks) comprised Infralittoral Mixed Sediments (SS.SMx.IMx) and Infralittoral Sandy Mud (SS.SMu.ISaMu) sediments. Biotopes to the east of the proposed development (within the approach channel) included Sublittoral Macrophyte Dominated Communities (SS.SMp and SS.SMp.KSwSS). In the far north-east of the survey area, substrates consisted of Infralittoral Muddy Sand (SS.SSa.IMuSa). Maerl Bed biotopes (SS.SMp.Mrl and SS.SMp.Mrl.Pcal.R) were identified in two locations in the eastern part of the survey area (green areas on Figure 9.4 above).

9.8.5 Notable fauna identified during the survey included Sabellid worms such as *Myxicola infundibulum* and *Sabella* spp. were very common, being recorded in the majority of transects. 'True' crabs (Infraorder Brachyura) and teleost fish were also common. The leathery sea squirt *Styela clava* was noted in DDV9, near the dock jetty. This is a non-native species, first recorded in the UK in Plymouth in 1953 but has since been recorded in various ports throughout Europe[34].

May 2023 Multidisciplinary Ecological Survey

9.8.6 The 2023 survey was more targeted and involved the surveying of 15 DDV transects and the collection of 29 day grab samples for taxonomic ID and particle size distribution analysis concentrated around the proposed development's site boundary (Figure 9.5).

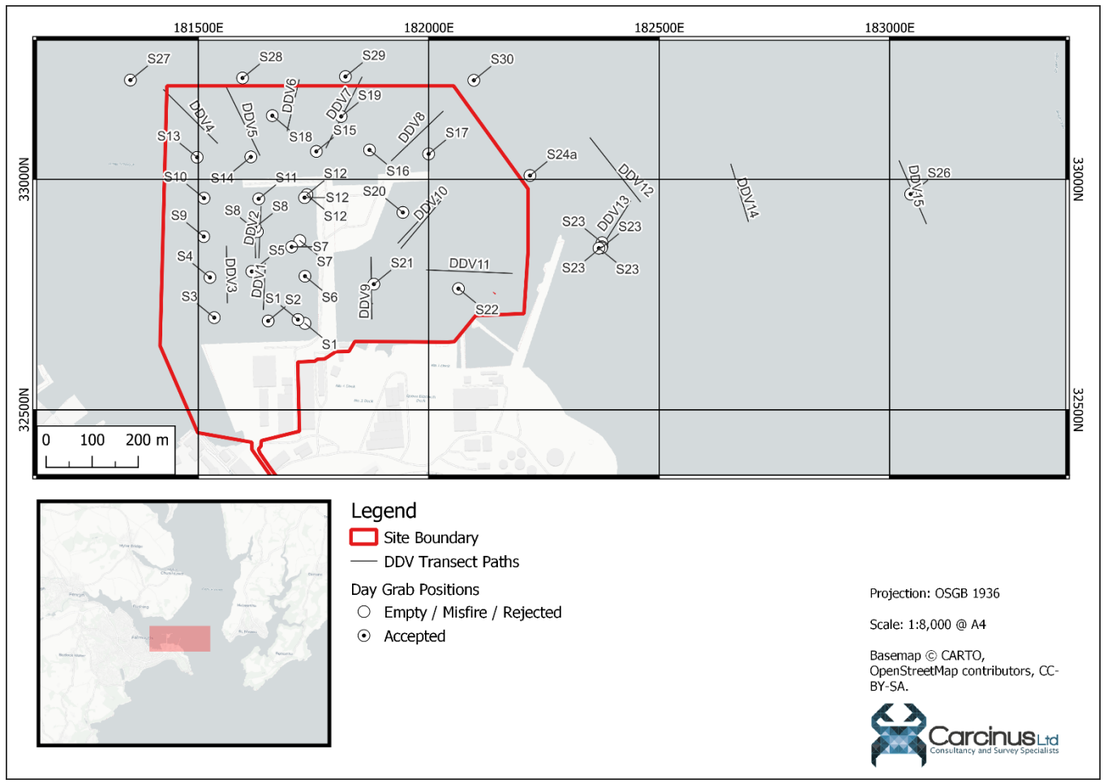


Figure 9.5 Grab locations and DDV Transects surveyed in the May 2023 survey.

9.8.7 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 (Figure 9.6).

[34] A. H. Neish, 'Styela Clava: Leathery Sea Squirt', Marine Life Information Network: Biology and Sensitivity Key Information Reviews, 2007, https://www.marlin.ac.uk/species/detail/1883.

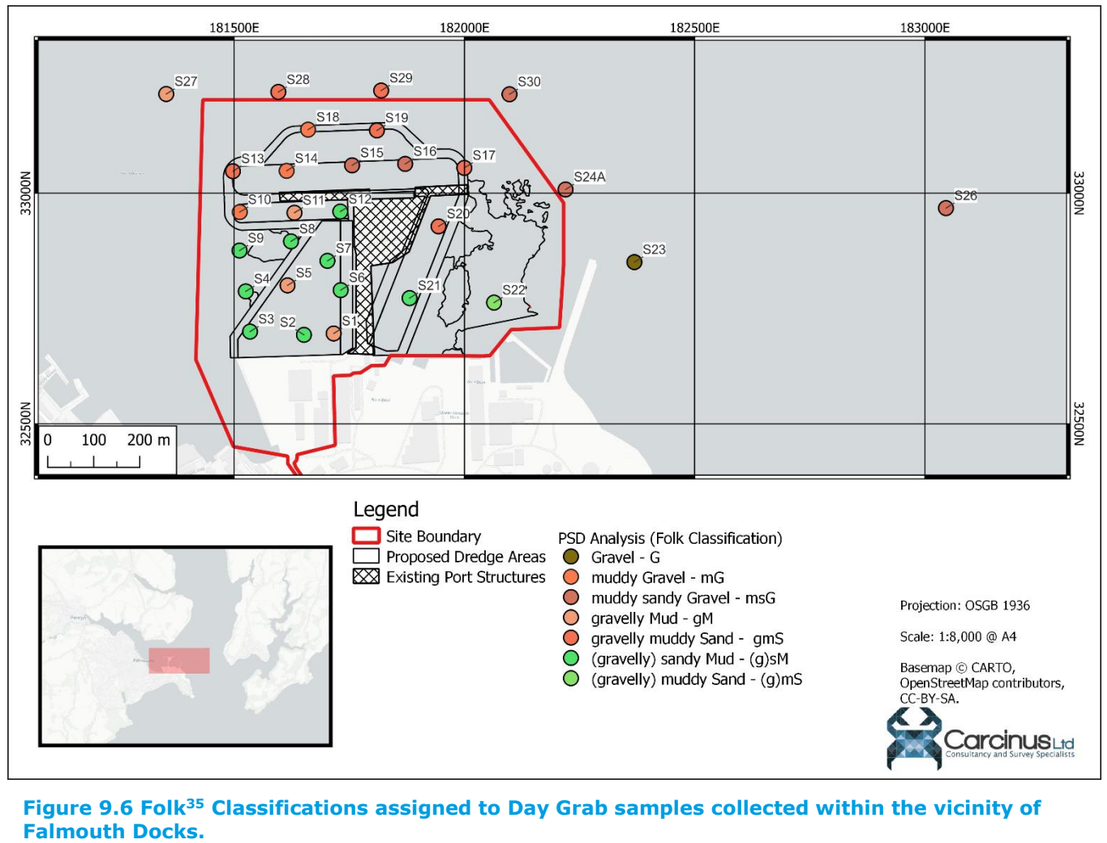


Figure 9.6 Folk[35] Classifications assigned to Day Grab samples collected within the vicinity of Falmouth Docks.

9.8.8 During taxonomic identification, fauna samples were subdivided into >1.0 mm and 0.5-1.0 mm size fractions (having been sieved over a 0.5 mm mesh in the field). Across the two size classes, 48,648 individuals from 336 different taxa (14 different phyla) were identified. The highest number of fauna were identified in S23 (to the east of the Eastern Breakwater in the outer array). At all stations apart from S17, individuals in the >1.0 mm size class were more numerous.

9.8.9 Diversity in the samples was quantified using Simpson[36] and Shannon-Wiener[37] Diversity Indices. Within the 0.5-1.0 mm size class, S23 was the most diverse sample and in the >1.0 mm size class S14 (north of Queens' wharf) was the most diverse. Across both size classes, stations in the western and eastern berth pockets had lower diversity than stations north of Queens' Wharf. Stations in the eastern part of the survey array had a relatively high diversity in the 0.5-1.0 mm size class but much lower diversity in the >1.0 mm size class.

9.8.10 Overall the grab sampling indicates the area is reasonably diverse, but is not particularly notable in the context of the wider Fal and Helford Estuary complex, which is renowned for the high infaunal diversity[38].

9.8.11 Within the >1.0 mm size class, polychaete worms dominated the observed diversity, being the most numerous taxa in all but one (S22) sample. Other common classes were Clitellata (Annelida), Bivalvia (Mollusca) and Malacostraca (Arthropoda). Within the 0.5-1.0 mm size class, Ostracoda and Malacostraca dominated, being the most numerous taxa in 22 of 29 samples. The polychaete *Mediomastus fragilis* was very common across the survey array in both size classes.

9.8.12 Hierarchical cluster analysis performed on the 0.5-1.0 mm and >1.0 mm species matrices indicated five distinct nodes with >25% similarity. The analysis grouped those samples in the western berth pocket together, as well as grouping those samples north of Queen's Wharf. Samples in the far east of the survey array were grouped separately from other samples in both size classes. Two-dimensional non-metric multidimensional (2-D nMDS) plots of the fauna matrices illustrated that within the 0.5-1.0 mm size class presence of the polychaetes *Galathowenia oculata*, and *M. palmata* as well the horsehoe worm Phoronis (Phoronida) was associated with the mud dominated sediments observed in the western berth pocket. Within the >1.0 mm size class, the more sand/gravel dominated sediments in the northern and far eastern areas of the survey array were associated with taxa such as platyhelminthes, *Urothoe elegans*, *Hiatella arctica* and juvenile Corphidae.

9.8.13 The standard approach to assigning biotopes is that the biotope/habitat complex should be present over an area of >25 m², and the approach briefly involves characterising the environment (depth, wave/tide exposure and sediment type) before looking at the species assemblage and the relative abundance of each taxa within the sample[39]. This process was carried out using the merged 0.5-1.0 mm and >1.0 mm fauna community (separate biotope classifications based on the DDV imagery is presented below) and the biotopes identified are presented in Figure 9.7.

9.8.14 Generally, mixed sediment habitat complexes were found in the Eastern Berth Pocket (south of Queen's wharf) and in the northern-most part of the survey array. Sandy mud complexes were found within the Western Berth Pocket and coarse sediment complexes were found immediately north of Queens' wharf and in the far eastern region of the survey array.

[35] Robert L. Folk, 'The Distinction between Grain Size and Mineral Composition in Sedimentary-Rock Nomenclature', *The Journal of Geology* 62, no. 4 (July 1954): 344–59, https://doi.org/10.1086/626171.
[36] E. H. Simpson, 'Measurement of Diversity', *Nature* 163, no. 4148 (April 1949): 688–688, https://doi.org/10.1038/163688a0.
[37] C. E. Shannon, 'A Mathematical Theory of Communication', *Bell System Technical Journal* 27, no. 3 (July 1948): 379–423, https://doi.org/10.1002/j.1538-7305.1948.tb01338.x.
[38] JNCC, 'Fal and Helford - Special Areas of Conservation', Special Areas of Conservation: Sites, 2004, https://sac.jncc.gov.uk/site/UK0013112.
[39] M.E.V Parry, 'Guidance on Assigning Benthic Biotopes Using EUNIS or the Marine Habitat Classification of Britain and Ireland (Revised 2019)', JNCC Report (Peterborough: Joint Nature Conservation Committee, September 2019), https://data.jncc.gov.uk/data/f23a26d7-07ad-4291-a42d-b422dad82351/JNCC-Report-546-REVISED-WEB.pdf.

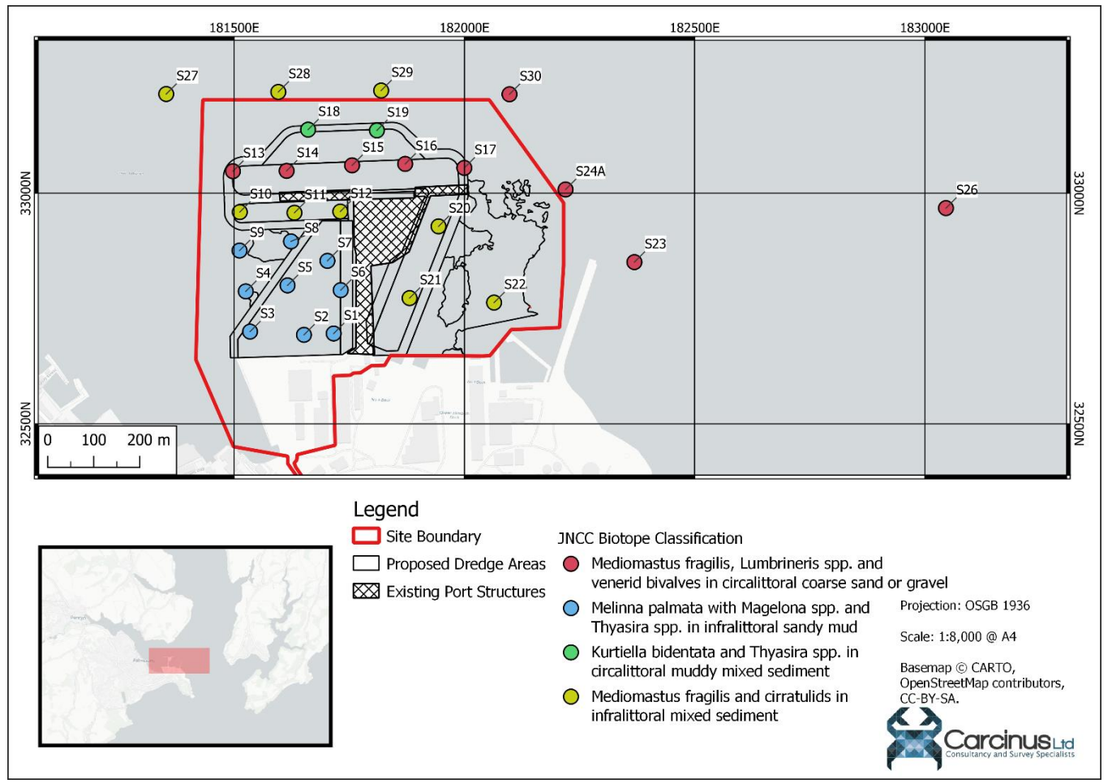


Figure 9.7 JNCC Biotopes assigned to grab samples collected during the May 2023 survey.

9.8.15 Four different biotopes were assigned to samples collected within the site boundary. The most common biotopes were *Melinna palmata* with *Magelona* spp. and *Thyasira* spp. in infralittoral sandy mud (SS.SMu.ISaMu.MelMagThy)[40], *Mediomastus fragilis* and cirratulids in infralittoral mixed sediment (SS.SMx.IMx.MedCirr)[41], and *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel (SS.SCS.CCS.MedLumVen)[42] each of which was assigned to nine samples. *Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment (SS.SMx.CMx.KurThyMx) [43] was assigned to two samples.

9.8.16 SS.SCS.CCS.MedLumVen was assigned to Stations S13 – S17, S23, S24A and S26, and comprised the most gravel-dominated sediments throughout the survey array. The biotope is listed as on the UK Biodiversity Action Plan (as since superseded by the UK Post 2010 Biodiversity Framework)[44] and as a Habitat of Principle Importance (HPI) under the Natural Environment and Rural Communities (NERC) Act 2006. SS.SMx.CMx.KurThyMx was assigned to Stations S18 and S19, north of Queen's Wharf, and is also listed as an HPI.

9.8.17 Along most of the DDV transects, biotope classification was stopped at Level 4 (habitat complex) in most instances due to a lack of characterising epifauna. The distribution of habitat complexes (and biotopes where possible) across the survey array is presented in Figure 9.8.

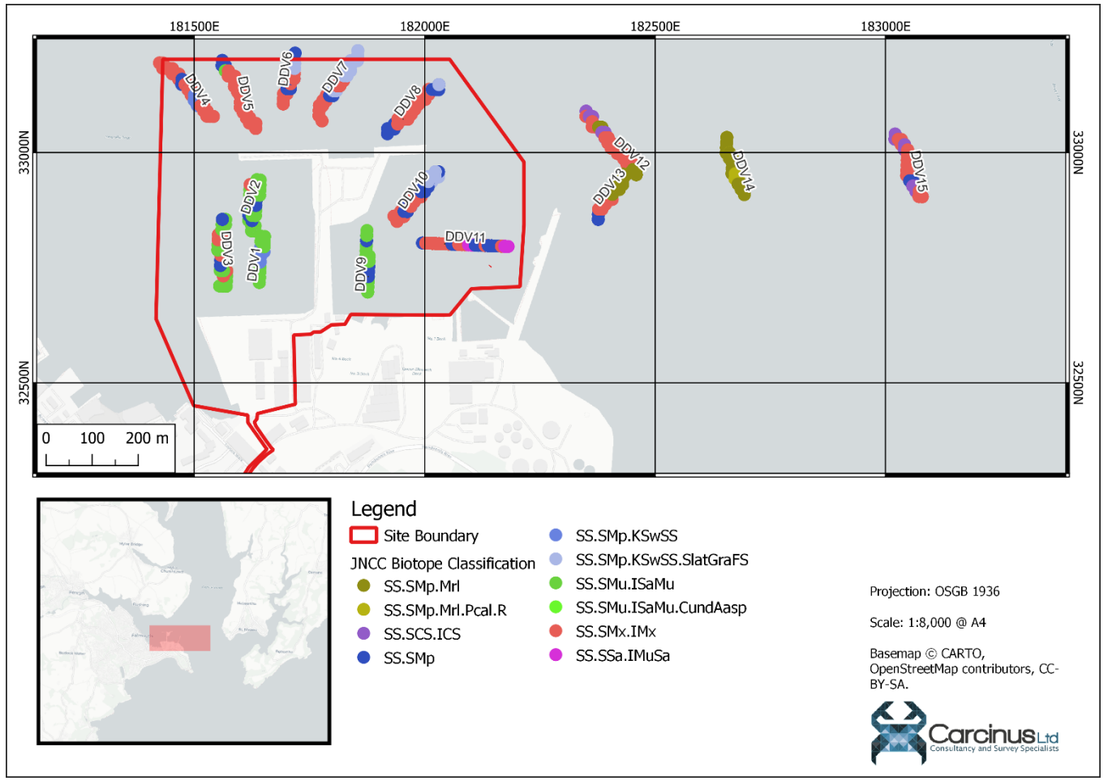


Figure 9.8 Biotopes/Habitat complexes assigned to DDV transects surveyed in May 2023.

9.8.18 The three transects within the Western Berth Pocket (DDV1 – DDV3) were classified as being Infralittoral Sandy Mud (SS.SMu.ISaMu)[45], Kelp and Seaweed Communities on Sublittoral Sediment (SS.SMp.KSwSS)[46], Infralittoral Mixed Sediment (SS.SMx.IMx)[47], and Sublittoral Macrophyte Dominated Communities on Sediments (SS.SMp)[48].

9.8.19 Transects north of the Northern Wharf (DDV4 – DDV8) were identified to be include Infralittoral Mixed Sediment, Kelp and Seaweed Communities on Sublittoral Sediment, Sublittoral Macrophyte Dominated Communities, and Infralittoral Sandy Mud. The biotope *Saccharina latissima* and Red Seaweeds on Infralittoral Sediments (SS.SMp.KSwSS.SlatGraFS)[49] was identified in the northern parts of DDV6, DDV7 and DDV8. This biotope is listed as an HPI.

9.8.20 Within the Eastern Berth Pocket, DDV9 was classified as Infralittoral Sandy Mud and Sublittoral Macrophyte Dominated Communities along its length. The anemone *Cylista undata* was identified in one

[40] JNCC, 'Melinna Palmata with Magelona Spp. and Thyasira Spp. in Infralittoral Sandy Mud - JNCC Marine Habitat Classification', Marine Habitat Classification, 2024, https://mhc.jncc.gov.uk/biotopes/jnccmncr00001988.
[41] JNCC, 'Mediomastus Fragilis and Cirratulids in Infralittoral Mixed Sediment - JNCC Marine Habitat Classification', 2024, https://mhc.jncc.gov.uk/biotopes/jnccmncr03000002.
[42] JNCC, 'Mediomastus Fragilis, Lumbrineris Spp. and Venerid Bivalves in Circalittoral Coarse Sand or Gravel - JNCC Marine Habitat Classification', Marine Habitat Classification, 2024, https://mhc.jncc.gov.uk/biotopes/jnccmncr00002012.
[43] JNCC, 'Kurtiella Bidentata and Thyasira Spp. in Circalittoral Muddy Mixed Sediment - JNCC Marine Habitat Classification', Marine Habitat Classification, 2024, https://mhc.jncc.gov.uk/biotopes/jnccmncr00001996.
[44] JNCC, 'UK BAP Priority Habitats', 2023, https://jncc.gov.uk/our-work/uk-bap-priority-habitats/.
[45] JNCC, 'Infralittoral Sandy Mud - JNCC Marine Habitat Classification', Marine Habitat Classification, 2024, https://mhc.jncc.gov.uk/biotopes/jnccmncr00002092.
[46] JNCC, 'Kelp and Seaweed Communities on Sublittoral Sediment - JNCC Marine Habitat Classification', Marine Habitat Classification, 2024, https://mhc.jncc.gov.uk/biotopes/jnccmncr00001537.
[47] JNCC, 'Infralittoral Mixed Sediment - JNCC Marine Habitat Classification', The Marine Habitat Classification for Britain and Ireland Version 22.04, 2022, https://mhc.jncc.gov.uk/biotopes/jnccmncr00001565.
[48] JNCC, 'Sublittoral Macrophyte-Dominated Communities on Sediments - JNCC Marine Habitat Classification', Marine Habitat Classification, 2024, https://mhc.jncc.gov.uk/biotopes/jnccmncr00002039.
[49] JNCC, 'Saccharina Latissima and Red Seaweeds on Infralittoral Sediments - JNCC Marine Habitat Classification', Marine Habitat Classification, 2024, https://mhc.jncc.gov.uk/biotopes/jnccmncr00000002.

stills image along this transect, and was subsequently classified as *Cylista undata* and *Ascidiella aspersa* on infralittoral sandy mud (SS.SMu.ISaMu.CundAasp)[50]. DDV10 and DDV11 were classified as Infralittoral Mixed Sediment, Sublittoral Macrophyte Dominated Communities and Infralittoral Muddy Sand. The north-eastern part of DDV10 transitioned to *Saccharina latissima* and Red Seaweeds on Infralittoral Sediments.

9.8.21 Biotopes/habitat complexes in the outer channel (DDV12 – 15) were generally similar to other parts of the study area, containing Infralittoral Mixed Sediment, and Sublittoral Macrophyte Dominated Communities. In addition, Infralittoral Coarse Sediment was also classified along transects in this area.

9.8.22 The Outer Channel is the only place where maerl habitat was recorded. Maerl beds (SS.SMp.Mrl)[51] and *Phymatolithon calcareum* maerl beds in infralittoral clean gravel or coarse sand (SS.SMp.Mrl.Pcal.R)[52] biotopes and habitat complexes were recorded along DDV12, DDV13, and DDV14. DDV14 was entirely maerl habitat.

9.8.23 SACFOR analysis[53] was carried out on the stills collected during the 2023 DDV Survey. In total, 71 different taxa were identified. The most common were red algae (Rhodophyta) and brown algae (Phaeophyceae) with 27 and 20 different taxa respectively. As discussed above, these groups were common within all areas of the survey array and contributed to the classification of several transects as being Sublittoral Macrophyte Dominated Communities. In terms of the fauna identified, six different crustaceans, five polychaete worms, three cnidarians (anemoned) and fish, and one echinoderm were identified.

Notable Flora and Fauna

9.8.24 The main species of conservation importance recorded was maerl, the distribution of which is discussed in paragraphs 9.8.34 – 9.8.36. In addition, sea anemones of the genus *Edwardsia* sp. were identified in the grab samples from every station except for S24A. Some members of this genus are listed in the UK BAP[54].

9.8.25 The English government have identified 39 marine species indicators of the pressures that invasive species exert on biodiversity[55]. Two invasive species of marine alga, *Bonnemaisonia hamifera* and *Asparagopsis armata* were identified, the latter being particularly common in the transects north of the Northern Wharf. Within the grab samples, the barnacle *Austrominius modestus* and the red ripple bryozoan *Watersipora subatra* were identified. *A. modeustus* was identified in station S23 and *W. subatra* was identified in Station S11 and S12.

9.8.26 Several other invasive non-native species, not observed in the project surveys, have been recorded in Falmouth harbour. These include the American slipper limpet (*Crepidula fornicata*), the leathery sea squirt (*Styela clava*) and the Pacific oyster (*Magallana gigas*)[56]. Many of these species already have a very well-established and long-standing presence along the coasts of England (O'Riordan et al., 2020[57]; Blanchard, 1997[58]).

9.8.27 The carpet sea squirt *Didemnum vexillum*, which can grow very rapidly, and has the potential to form large masses on artificial structures, has been found in marinas and harbours along the south coast from Lymington to Brighton including at Southampton and Portsmouth[59]. There have also been records from Plymouth and Kingswear in Devon. However, no records indicating the presence of this species in Falmouth were found.

9.8.28 Falmouth Docks is an active international dock and so the presence of non-native species is fairly typical, and all non-native species discussed here have previously been identified within the waters of Falmouth Docks. The spread of INNS is prohibited under the Wildlife and Countryside Act 1981[60].

9.8.29 A standard datasearch was requested from ERCCIS for 2 km from the centre point of the proposed development[61]. The report summarises a search of statutory sites, non-statutory sites, other sites, habitats and species within the specified area of study. The datasearch identified 183 different species as being recorded within 2 km of the proposed development from 1960 – present. Of these, six fauna are listed as Species of Principle Importance (SPI) on the NERC Act and on the UK BAP:

- *Calvadosia campanulate*, four records, most recently recorded in 2020 at Gyllyngvase Beach;
- St John's jellyfish *Calvadosia cruxmelitensis*, three records, most recently in 2021 at Castle Beach;
- Kaleidoscope jellyfish *Haliclystus auricula*, ten records, most recently in 2021 at Castle Beach;
- Native oyster *Ostrea edulis*, twelve records, most recently recorded in 2017 at Green Bank;
- European spiny lobster *Palinurus elephas*, most recently recorded in 2019 within Falmouth Bay (50°09'27"N, 005°01'59"W); and
- Trembling seamat *Victorella pavida*, four records, most recently observed in 1985 at Swanpool.

9.8.30 Also recorded were four different algae species listed on the UK BAP and the NERC Act as SPI:

- *Cruoria cruoriaeformis*, two records, most recently recorded in 1985 in the Fal Estuary (50°09'26"N, 005°02'22"W);
- *Grateloupia montagnei*, three records, most recently recorded in 1985 at Trefusis Cliffs;
- Coral maerl *Lithoamnion coralloides* (see paragraph 9.8.34 – 9.8.36 for more detail on the distribution of this habitat); and
- Common maerl *Phymatolithon calcareum* (see paragraph 9.8.34 – 9.8.36 for more detail on the distribution of this habitat).

9.8.31 In addition to the species of conservation importance, 11 invasive non-native species were recorded as present within 2 km of the proposed development:

- Harpoon weed *A. armarta*, 47 records most recently in 2019 within Falmouth Bay (50°08'43"N, 005°03'01"W);
- Compass sea squirt *Asterocarpa humilis*, 17 records, most recently in 2016 at Falmouth Haven;
- *A. modeustus*, 52 records, most recently in 2016 at Castle Beach;
- *Botrylloides violaceus*, 6 records, most recently in 2016 at Falmouth Haven;
- *Corella eumyota*, 15 records, most recently in 2015 at Port of Pendennis;
- *Crangonyx pseudogracilis*, 1 record, most recently in 1970 at Swanpool;
- Slipper limpet *Crepidula fornicata*, 23 records, most recently in 2016 in Falmouth Haven;
- Pacific oyster *Crassostrea gigas*, 8 records, most recently in 2020 at Gyllyngvase Beach;
- Colonial sea squirt *Perophora japonica*, 2 records, most recently in 2015 at Port of Pendennis Marina;
- Leathery sea squirt *Styela clava*, 72 records, most recently in 2016 at Falmouth Haven; and
- *W. subatra*, 20 records, most recently in 2021 at Silver Steps.

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[50] JNCC, 'Cylista Undata and Ascidiella Aspersa on Infralittoral Sandy Mud - JNCC Marine Habitat Classification', Marine Habitat Classification, 2024, https://mhc.jncc.gov.uk/biotopes/jnccmncr00002010.
[51] JNCC, 'Maerl Beds - JNCC Marine Habitat Classification', Marine Habitat Classification, 2024, https://mhc.jncc.gov.uk/biotopes/jnccmncr00001554.
[52] JNCC, 'Phymatolithon Calcareum Maerl Beds with Red Seaweeds in Shallow Infralittoral Clean Gravel or Coarse Sand - JNCC Marine Habitat Classification', Marine Habitat Classification, 2024, https://mhc.jncc.gov.uk/biotopes/jnccmncr00001497.
[53] JNCC, 'SACFOR Abundance Scale', in *Marine Nature Conservation Review: Rationale and Methods. Coasts and Seas of the United Kingdom.*, MNCR Series (Peterborough: Joint Nature Conservation Committee, 1996), https://mhc.jncc.gov.uk/media/1009/sacfor.pdf.
[54] JNCC, 'List of UK BAP Priority Marine Species (2007)', UK Biodiversity Action Plan, 2007.
[55] C.A Harrower, S. L Rorke, and H. E Roy, 'Pressure from Invasive Species - Technical Document' (Wallingford, Oxfordshire: UK Centre for Ecology and Hydrology, 2021), https://data.jncc.gov.uk/data/647caed5-93d0-4dc0-92bf-13d231a37dda/ukbi2023-techbg-b6.pdf.
[56] See the Environmental Code of Practice for Cornish Ports including Falmouth:: https://www.falmouthharbour.co.uk/wp-content/uploads/2021/12/Environmental-Code-A5.pdf
[57] O'Riordan, R. M., Culloty, S. C., McAllen, R., & Gallagher, M. C. (2020). The biology of *Austrominius modestus* (Darwin) in its native and invasive range. Oceanography and Marine Biology: An Annual Review, 58, 1-78
[58] Blanchard, M. (1997). Spread of the slipper limpet *Crepidula fornicata* (L. 1758) in Europe. Current State and consequences. Ecology of Maine Molluscs, 61(2), 109-118.
[59] https://www.marlin.ac.uk/species/detail/2231
[60] Secretary of State, Wildlife and Countryside Act 1981 (as amended).
[61] ERCCIS, 'J0710 Marine Ecology ES Data Search 02/04/2024'.

Seagrass Meadows

9.8.32 Based on Natural England survey data from 2022 (the most recent for which data are available)[62], there are 18.225 ha of subtidal seagrass within 2 km of the proposed development. The largest is at Penarrow Point to Trefussis (1.3 km from Falmouth Docks) and the nearest is at Flushing, on the north bank of the Penryn River (380 m from Falmouth Docks) (Figure 9.9). These seagrass beds are generally stable, with the habitat extents remaining broadly similar from 1997 – present. There are also areas of intertidal mudflat upstream within the Penryn River.

Subtidal Kelp

9.8.33 The biotopes SS.SMp.KwSS and SS.SMp.KwSS.SlatGraFS were identified within DDV19 (within the western dock basin), along the northern part of DDV6 and DDV7 (north of queens wharf), as well as the north-eastern end of DDV10_2 (in the eastern dock basin). Furthermore, the Level 3 Habitat SS.SMp was identified in several other locations. Kelp habitats were identified during the ROV survey also within the western dock basin. Figure 9.9 indicates the approximate presence of this habitat within the study area. However, these were not recorded as kelp beds or forests due to relatively low abundance of plants within high percentage cover by red algae.

Maerl Habitat

9.8.34 The biotopes and habitat complexes SS.SMp.Mrl and SS.SMp.Mrl.Pcal.R were only observed in transects DDV12 – 14 in the eastern part of the survey array. *Phymatolithon calcareum* (maerl) was identified during the SACFOR analysis of still images taken along these transects also. It was recorded in all stills along DDV14 (as Super Abundant, 80-100% cover in 8 of the 13 stills from this transect).

9.8.35 Following NE's advice, the maerl habitats within the site boundary and likely area of impact have been reviewed in line with the general descriptions of maerl habitat types provide in the Fal and Helford SAC's Conservation Advice Package, which have been extracted as follows:

- pristine live maerl beds with up to 100% live maerl coverage;
- extensive areas of dead maerl with little to no live maerl;
- extensive areas of dead and crushed maerl;
- living maerl overlying dead maerl; and
- areas of maerl in sediment.

9.8.36 Figure 9.9 presents the distribution of the various habitat types within the study area, based on a precautionary approach to habitat classification. The only habitat types present were "areas of maerl in sediment" and "living maerl overlying dead maerl".

9.8.37 During project specific survey work "Living maerl overlying dead maerl" was present to the east of the site boundary, in a band towards the opposite site of the Fal. Within the site boundary, and the areas around the band of 'living maerl overlying dead maerl' were "areas of maerl in sediment". In total there were 95 ha of maerl habitat within the study area, of which 28 ha has been classified "living maerl overlying dead maerl", based on a precautionary approach to classification.

9.8.38 The 'maerl in sediment' habitat type covers a broad range of maerl presence ranging from small dead maerl fragments, or debris on sediments, to 3D aggregations of maerl with structural and ecological complexity. The 'maerl in sediment' within the site boundary and inner harbour, is made up of small (<1 cm) dead fragments, sitting on muddy/sandy sediment. There is no 3-dimensional structure to the maerl in this area and functionally, the habitat is a sediment one. For the 'living maerl overlying dead maerl' there is a gradient of habitats from 2D to 3D habitat, in a west to east direction, such that the structurally complex 3D maerl habitats, with live and dead maerl, are found outside the zone of influence for the development (see Figure 3.5 in Technical Appendix 9.3).

9.8.39 A detailed review of maerl habitats in the region of the project, based on project survey findings and available literature is provided in Technical Appendix 9.5 Maerl Technical Note.

Sensitive Receptors

9.8.40 Figure 9.9 presents a map of the geographical distribution of relevant habitats designated as Higher Sensitivity under the Water Framework Directive.

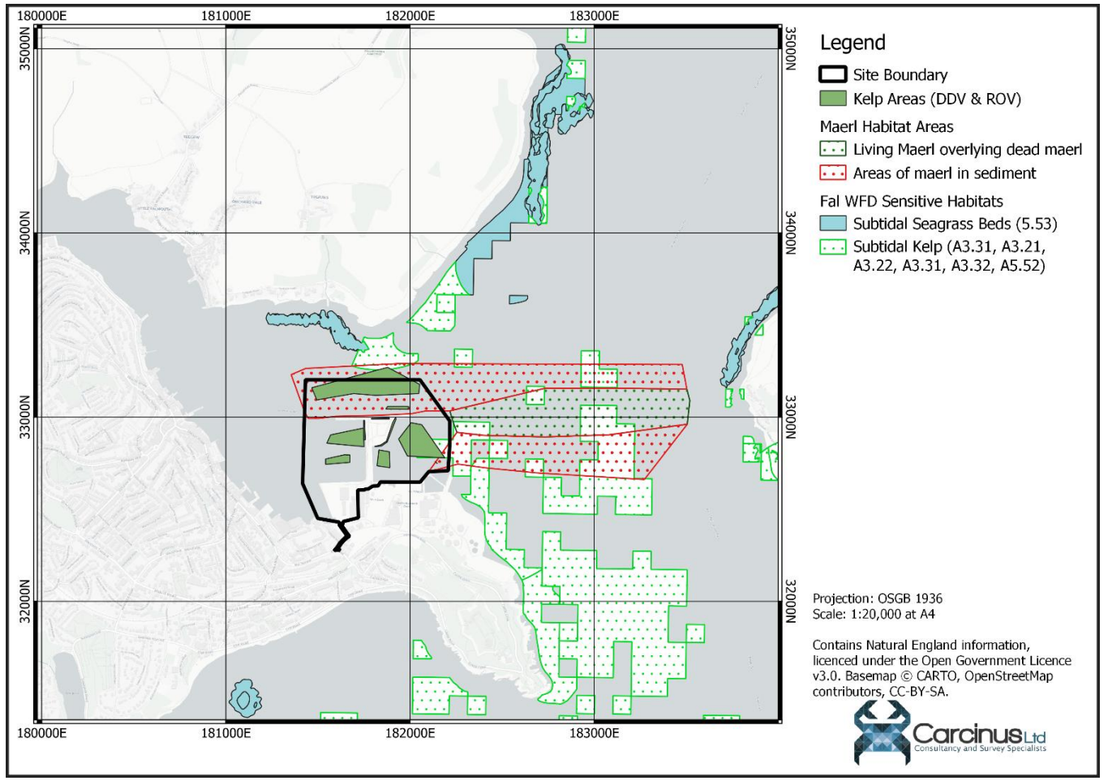

Figure 9.9 Relevant sensitive habitats within the vicinity of the proposed development. WFD habitats extracted from Natural England's Marine Habitats and Species Open Data.

9.8.41 Maerl beds are distributed throughout the Fal Estuary with significant areas of habitat on the eastern side of the Fal Estuary near St Mawes. Based on data collected during ecological studies in 2022 and 2023 these beds do not extend to the development footprint.

9.8.42 To fully understand the distribution of this key habitat type within the site boundary and area of impact, as well as the potential impacts arising from the proposed development, Natural England requested that a technical note collating all of the relevant information regarding the likely impacts of the proposed development on maerl habitat. This technical note is presented in Technical Appendix 9.5: J0710/24/10/07 Ramboll Falmouth Technical Note – Maerl. This note should be read in conjunction with this chapter.

9.8.43 Other subtidal habitats within the vicinity of the proposed development include a mix of coarse and mixed sediments. Seagrass meadows are also relatively widely distributed within the estuary, with the nearest bed at Flushing, on the northern bank of the Penryn river.

9.8.44 Infauna communities within the proposed development footprint and surrounding areas are dominated by polychaete worms and small crustaceans of the classes Ostracoda and Malacostraca. There were no protected species identified in the infauna samples from within the proposed development footprint and surrounding area. Native oyster *O. edulis* and spiny shellfish *P. elephas* are listed on the UK BAP list of

[62] Natural England, 'National Seagrass Layer (England)', 10 May 2024, https://www.data.gov.uk/dataset/aa1787a7-71fb-4c44-bf27-7825f9c5ee64/national-seagrass-layer-england.

important species and Species of Priority Importance on the NERC Act. Both are widely distributed within the estuary and subject to commercial fishing activity.

9.8.45 There are historic occurrences (1985) of the trembling sea mat *V. pavida* within 2 km of the proposed development, although this species requires highly sheltered saline lagoons with variable salinity to survive, and so is highly unlikely to exist outside of the Swanpool Lagoon in which it has been found.

Fish and Shellfish Ecology

9.8.46 This section provides the baseline for the fish and shellfish ecological communities (including both commercial and non-commercial species), i.e. the animals and populations themselves. The baseline for the commercial fisheries and shellfisheries that target these communities (i.e. the fishing activity and effort) is fully described in ES Chapter 10: Commercial Fisheries and Shellfisheries. Cross references between the two chapters are present where necessary.

9.8.47 To provide the appropriate ecological context for mobile fish species, information available for the tidal River Fal/Truro between Tresilian (the upstream limit of tidal incursion) and where the river meets the sea (taken to be a line drawn between 50° 10’.330N, 005° 02’.740W and 50° 10’.372N, 005° 01’.376W) was examined. This area is the same as that covered by the Fal Fishery Order[63]. The adjacent channels and tributaries to the main estuary, namely the Percuil River, Penryn River, Mylor Creek and Restronguet Creek have also been considered. Collectively these waterbodies are referred to as the Fal Estuary. The body of water seaward of the Fal Estuary is hard to define, it is referred to as the English Channel, north east Atlantic and Celtic and Irish seas by different sources. For the purposes of this chapter, it is referred to as either the north-east Atlantic or the sea.

9.8.48 No site specific fisheries surveys have been carried out on the site, given the highly mobile nature of this species group, and the fact that monitoring data of appropriate temporal and spatial scope were available. The Environment Agency (EA) publish ‘TraC’ data from fisheries monitoring of Transitional and Coastal waters throughout the UK. There are 13 different monitoring locations, comprising five different survey methodologies within the Fal Estuary (Figure 9.10). The data from these surveys, along with species records held by ERCCIS[64], have been used to inform this baseline.

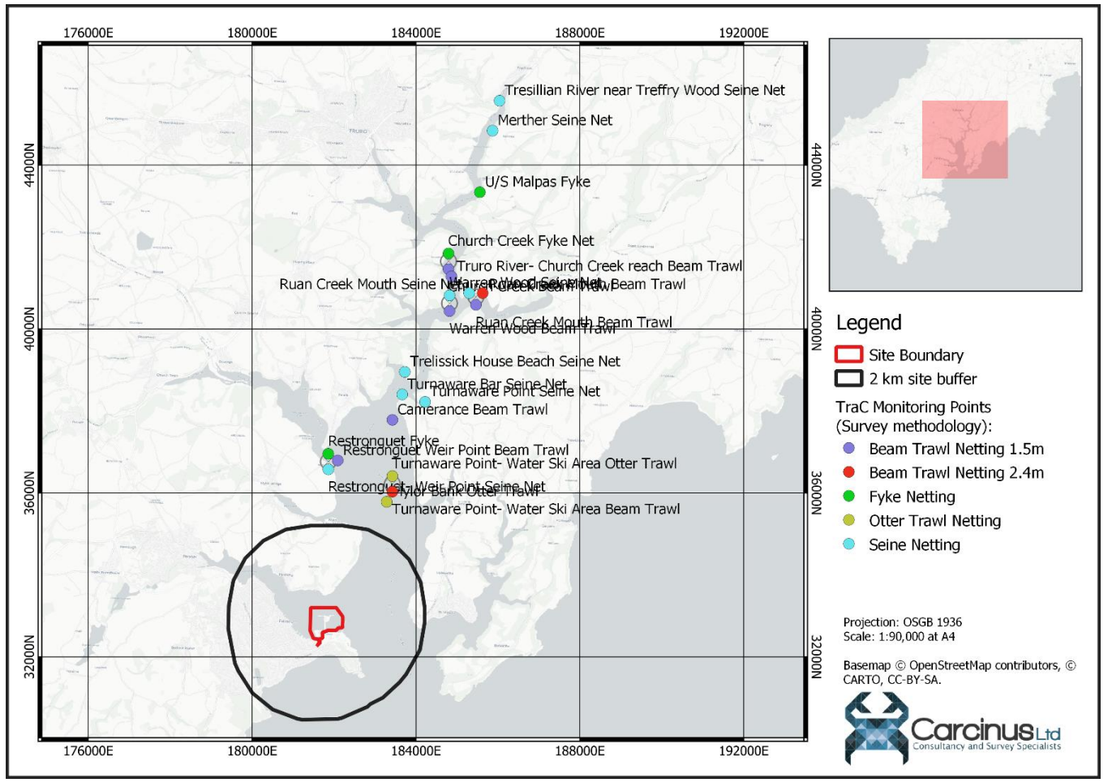

Figure 9.10 Locations of EA TraC Fisheries Monitoring[65] within the Fal Estuary

9.8.49 There were 195 records of bony (Actinopterygii) and cartilaginous (Chondrichthyes) fish, from the period 1962 to 2023, in the ERCCIS database, within 2 km of the proposed development. The review has considered in particular data from the last 10 available years (2014-2023), accounting for 28 records, across 11 different species. These records include many opportunistic sightings, evident in the type of fish species recorded, including basking shark and blue-fin tuna, which give useful information on potential presence within the vicinity of the proposed development rather than a reliable estimate of abundance.

9.8.50 In the Fal estuary the EA undertake biannual monitoring of the fishes in order to ascertain the ecological status of the fish communities[65]. These fish range from estuarine/brackish to fully marine species with no estuarine requirement, with a number of species which require and/or utilise the estuarine environment to varying degrees. Transitional waters may include nursery areas or routes important for migration of species to freshwater or marine spawning grounds.

9.8.51 Monitoring data covering the period 2002 – 2023 were downloaded from the TraC database for the following 13 sites within the Fal Estuary (Figure 9.10). These sites were sampled using multiple gear types:

- Camerance – 1.5 m Beam Trawl;
- Church Creek – 1.5 m Beam Trawl and Fyke Net;
- Merther – Seine Net;

[63] Secretary of State, The Fal Fishery Order 2016.
[64] ERCCIS, ‘J0710 Marine Ecology ES Data Search 02/04/2024’.
[65] Environment Agency, ‘Ecology & Fish Data Explorer’, EA Ecology and Fish Data Explorer, 2024, https://environment.data.gov.uk/ecology/explorer/.

- Mylor Bank – Otter Trawl;
- Restronguet – 1.5 m Beam Trawl, Seine Net and Fyke Net;
- Ruan Creek Mouth – Seine Net, 1.5 m and 2.4 m Beam Trawl;
- Trelissick House Beach – Seine Net;
- Tresillian River – Seine Net
- Truro River Church Creek – 1.5 m Beam Trawl;
- Turnaware Bar – Seine Net;
- Turnaware Point – 2.4 m Beam Trawl, Otter Trawl and Seine Net;
- Upstream of Malpas – Fyke Netting; and
- Warren Wood – 1.5 m Beam Trawl and Seine Netting.

9.8.52 The EA TraC data have been summarised in order to analyse the species commonly sampled in the Fal, as a means of understanding the presence of a range of different fish groups including migratory and pelagic fish. The most common survey approaches were seine netting and beam trawls. Over 96% of all fish sampled were collected in seine netting, whilst in the beam trawls there were more demersal fish caught. However, the species list was similar enough to combine the data for this review.

9.8.53 In addition to the TraC fisheries monitoring, consideration has also been given to EA monitoring in freshwater environments, to establish the importance of the study area as a migration corridor for diadromous fish such as salmonids or eel. There were 19 freshwater fish monitoring points upstream of the proposed development that have been sampled between 2000 and 2024. However, there are some limitations to this dataset, which have been noted[66].

9.8.54 The fish identified across all available data can be grouped into four main categories depending on their life history traits[67]. The four categories are:

- Estuarine residents – fish that spend their entire life within the Fal Estuary, e.g. gobies *Pomaotoschistus* spp. and seahorse *Hippocampus* spp.;
- Marine fish – live and spawn in the marine environment but use the Fal Estuary and tidal tributaries as foraging grounds. Both demersal and pelagic marine fish are considered here – e.g. Dover sole *Solea solea* and herring *Clupea harengus*;
- Diadromous fish – use the Fal Estuary as a migration corridor to either freshwater or saltwater habitats for spawning. The group can be divided further into catadromous fish which migrate to marine environments for spawning, such as European eel *Anguilla anguilla* and anadromous fish which migrate from marine environments to freshwater environments for spawning (such as salmon *Salmo salar* and Shad *Alosa* spp.); and
- Cartilaginous Fish – these are species of fish whose skeleton is made of cartilage rather than bone forming the class Chondrichthyes. Within this class is the subclass Elasmobranchs, which comprise sharks, rays, skates, and others. There have been sightings of several charismatic elasmobranchs including basking shark and rays.

9.8.55 A review of the potential for shellfish and fish spawning and nursery grounds within the Fal has also been included.

Estuarine Residents

9.8.56 Gobies are common in many habitats and are regularly found in estuaries. Gobies were both common and abundant in the TraC survey data, with 8 different species. Gobies accounted for almost 18% of the total abundance of fish sampled. Species included two goby species of particular interest. Couch's goby *Gobius couchi* is a small goby listed on Schedule 5 of the Wildlife and Countryside Act. It has only been recorded within four locations in the British Isles including at the Turnaware Point and Bar sampling sites. Although numbers of individuals caught were low, Couch's goby were recorded in most sampling years. This species is not thought to be sensitive to increases in suspended sediment concentrations or changes in wave regime or water flow.

9.8.57 Giant goby *G. cobitis* is another rare goby species listed on the Wildlife and Countryside Act, generally found in intertidal rockpools but it has been very occasionally recorded in upper estuary seine netting within the Fal. However, there were low numbers of individuals counted. In contrast Couch's goby was observed in most years sampled around Turnaware Point and Bar.

9.8.58 The long snouted sea horse has been recorded once in EA monitoring, at Restronguet Weir Point in 2006. It was most recently recorded on the ERCCIS database with an observation in 2022 from the seagrass meadow off Flushing in 2022, within 2 km of the proposed development (upstream). A number of other species often associated with seagrass meadows such as pipefish were also observed but only occasionally in the upstream EA surveys.

Marine Fish

9.8.59 The marine fish fauna of the study area is typical of the nearshore mixed sediment habitats such as those found within the Fal Estuary with a range of pelagic and demersal/benthic species.

9.8.60 Across the whole TraC data set, sand smelt accounted for 45% of the total fish counted. Sand smelt generally live in semi-isolated populations around river estuaries and are commonly caught in large numbers[68]. Together with pilchard (18.2%) and sprat (9.9%), these species accounted for almost 75% of all fish caught. There were also herring but only in low numbers, accounting for 1.6% of all fish collected. For sampling across all years, sand smelt, pilchard and sprat plus the sand goby and common goby were responsible for 91% of all fish sampled.

9.8.61 Demersal species include the butter fish *Pholis gunnellus,* the dragonet and gurnards and a number of flat fish including plaice *Pleuronectes platessa*, dab *Limanda limanda* and flounder *Platicthys flesus*. The flounder was the most common flat fish but the abundance of all was very low in comparison to other demersal species. Epibenthic fish include pollack *Pollachius pollachius*, whiting *Merlangius merlangus*, poor cod *Trisopterus minitus* and three spined stickleback *Gasterosteus aculeatus*.

9.8.62 The flounder is predominantly a marine species but can also be found in estuaries where it is tolerant of low salinity levels. Unlike other species of Pleuronectidae, it often spends part of its life cycle in freshwater and regularly makes its way into rivers. Flounder juveniles penetrate upstream to freshwater nursery grounds, gradually moving downstream whilst remaining in estuarine environments until sexual maturity[69]. The IFCA reports that adult flounder spend their lives feeding in the tidal Fal Estuary, congregating in late spring, prior to their spawning grounds approximately 30 km offshore[70]. This species has been caught at a number of EA TraC sampling stations, in most years surveyed though the numbers captured were low. The migration periods for this species are spring and summer months (Table 9.5).

Diadromous Fish

9.8.63 Diadromous fish migrate between both freshwater and marine habitats during their lifecycle. These fish are dependent on the quality of these different ecosystems and require connectivity between them, meaning they are at risk to disturbance which may prevent them from moving between the sea and rivers.

9.8.64 Within the Fal Estuary, the diadromous species sea trout *Salmo trutta,* European eel *Anguilla Anguilla,* flounder *P. flesus* are known to be present. Records of other diadromous species are limited, although vary rare and infrequent records of Allis shad *Alosa alosa*, twaite shad *Alosa fallax,* and Atlantic salmon *Salmo salar* have been noted. There are no designated sites for diadromous fish species in the study area, including upstream of the proposed development.

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66 These surveys had the following limitations: the maximum number of surveys at any one site is four; none of the sites have been sampled since 2023; only six sites have been sampled since 2022; and nine have not been sampled since 2014. Nevertheless, the data are able to establish if there are important species (particularly migratory species) likely to be moving through the estuary, within the vicinity of the proposed development.

67 A Franco et al., 'Life Strategies of Fishes in European Estuaries: The Functional Guild Approach', *Marine Ecology Progress Series* 354 (7 February 2008): 219–28, https://doi.org/10.3354/meps07203.

68 Tubbs, Colin (1999). The Ecology, Conservation and History of the Solent. Packard Publishing. p. 40. ISBN 1853411167.

69 Allan T. Souza et al., 'Population Ecology and Habitat Preferences of Juvenile Flounder Platichthys Flesus (Actinopterygii: Pleuronectidae) in a Temperate Estuary', *Journal of Sea Research* 79 (May 2013): 60–69, https://doi.org/10.1016/j.seares.2013.01.005.

70 J Small, 'Flounder (Platichthys Flesus) Species Profile' (Southern IFCA, 2021), https://secure.toolkitfiles.co.uk/clients/25364/sitedata/Redesign/Key_Species/Flounder-Species-Profile.pdf.

9.8.65 The River Fal is classified as a principal sea trout river in the UK, meaning that there are greater than 50 rod catch a year. The EA freshwater fish data, across 36 survey events over 24 years at 19 upstream sites recorded a total of 1,738 brown / sea trout *S. trutta*, which is an average of <50 fish per survey. A range of life histories can often be observed in the same population, with some individuals remaining in freshwater for their entire life, whilst others migrate to estuarine or fully marine environments. It is impossible to say whether the fish caught in the Fal were resident brown trout or migratory sea trout as the species are the same. By way of context, between 2000 and 2013, an average of 10,636 sea trout moved past the Gunnislake Weir fish counter on the river Tamar each year and the fixed trap counter at this location recorded 20,810 fish between 2000 and 2024, more than ten times as many as recorded across all 19 sites within the Fal estuary complex combined. On this basis, the numbers of trout occurring in the Fal is considered relatively small in the context of other rivers nearby and therefore is not considered important at a regional level but instead at a local level. They are a Section 41 species of principal importance as part of the NERC Act 2006.

9.8.66 The River Fal has been identified as a recovering salmon river, which the EA have stated as meaning a population has started to re-establish after a period of absence[71]. The Southwest office of the EA reported that salmon fry was caught in the tributaries of the Fal in 2005, having not been recorded in 25 years[72]. It was at this stage that the River Fal was declared a recovering salmon river. However, no further evidence was found to show that salmon fry was caught in the river in more recent years. The River Fal does not support a salmon fishery and no records of salmon *Salmo salar* were found within EA freshwater fish dataset[73]. Overall, the River Fal is not considered to be important for salmon migration.

9.8.67 Across the same time period and survey locations, 41 adult European eel and 122 elvers were recorded in rivers upstream of the proposed development. This species is catadromous, spawning in the Sargasso Sea in the tropical Atlantic and the larvae migrate using ocean currents to continental Europe. The elvers, or glass eel, migrate into coastal and estuarine waters between April to September. The yellow eels can remain in fully marine habitats, estuaries, populate the lower reaches of rivers or migrate to river head waters. There they may remain for between five and 20 years before they mature to silver eels and embark on their seaward spawning migration.

9.8.68 Shad *Alosa* spp. are large migratory fish related to herrings, which live in coastal waters and spawn in freshwaters. There are two species of shad that occur in UK waters; the Allis shad *A. alosa* and twaite shad *A. fallax*. Both species are of conservation importance. A single twaite shad was recorded on the ERCCIS database in 2007 within 2 km of the proposed development but there were no individuals recorded at all in the TraC dataset. There is no evidence that the species use the Fal to breed.

9.8.69 The migratory periods of the diadromous fish known to use the Fal Estuary is provided in Table 9.5. This table highlights the species which could occur within the study area and forms the focus of the impact assessment for migratory fish.

Table 9.5 Migratory Periods for Diadromous Fish in the Fal Estuary

Name	Life History Stage	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Sea trout	Adult	↓							↑	↑	↑		↓
	Smolt				↓	↓	↓		↑	↑			
Eel	Glass eel				↑	↑	↑	↑	↑	↑			
	Yellow eel												

Table 9.5 Migratory Periods for Diadromous Fish in the Fal Estuary

Name	Life History Stage	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
	Silver eel				↓	↓	↓	↓	↓	↓	↓	↓	
Flounder	Adult			↓	↓								
	Juvenile					↑	↑	↑					
Key:	Spawning times	↑ Upstream migration			↓ Downstream migration								

Cartilaginous Fish

9.8.70 Cartilaginous fishes known to be present in the Fal Estuary range from small dogfish *Scyliorhinus canicular* to basking shark *Cetorhinus maximus* as well as blue skate *Dipturus batis,* the thornback ray *Raja clavata* and spotted ray *R. montagui*. Fish species in this group are frequently conferred protection under national and international legislation.

9.8.71 In the past 10 years on the ERCCIS database there were four records of basking shark and two of thornback ray. Elasmobranchs including thornback ray, common dogfish *Scyliorhinus canicular* and the nursehound *Scyliorhinus stellaris* were also caught in low numbers, during EA TraC surveys, mostly at the upstream Turnaware sampling stations (Figure 9.10). The low number of recordings likely reflects these species are not usual estuarine residents but may very occasionally be present in the outer estuary/nearshore coastal zone.

Shellfish

9.8.72 The Fal Estuary is an important Production Area for commercial shellfish species[74]. Mussels (*Mytilus* spp.), native oyster *Ostrea edulis*, Pacific oyster *Crassostrea gigas* and variegated (Queen) scallop *Mimachlamys varia* are all classified for harvest within the Fal Estuary[75]. In the 2022-2023 season, a total of 67,823 kg of shellfish were harvested from within the Fal Estuary[76]. There are no Classified harvesting areas (Bivalve Mollusc Classification Zone, BMCZ) within the proposed development footprint but there are three within 2 km of the proposed development: Upper Flushing, Lower Flushing and Mylor Bank. There are also active fisheries for lobster, crabs and crawfish that land to ports within the Fal (see ES Chapter 10: Commercial Fisheries and Shellfisheries for more detail). Figure 9.11 shows the distribution of designated and classified areas in the Fal Estuary.

[71] Cefas, 2023. Assessment of salmon stocks and fisheries in England and Wales. Standing report on methods, approaches, and wider stock conservation and management considerations in 2023.
[72] Falmouth Packet, 2006. Salmon back in the Fal. https://www.falmouthpacket.co.uk/news/cornwall_news/745695.salmon-back-fal/
[73] Langston, W.J., Chesman, B.S., Burt, G.R., Taylor, M., Covey, R., Cunningham, N., Jonas, P. and Hawkins, S.J., 2006. Characterisation of the European marine sites in south west England: the Fal and Helford candidate Special Area of Conservation (cSAC). *Hydrobiologia*, *555*, pp.321-333.
[74] Carcinus, 'Review of the Upper and Lower Fal Estuary 2010 Sanitary Surveys', Carcinus report on behalf of the Food Standards Agency, to demonstrate compliance with the requirements for classification of bivalve mollusc production areas in England and Wales under retained EU Law Regulation (EU) 2019/627. (Hampshire: Carcinus Ltd., 2021), https://www.carcinus.co.uk/wp-content/uploads/2021/03/J0591_20_11_06_Fal_Estuary_Sanitary_Survey_Review_v3.1_FINAL.pdf.
[75] Food Standards Agency, 'Current Classification List and Sampling Plans (May 2024)' (Food Standards Agency, 2 May 2024), https://www.food.gov.uk/sites/default/files/media/document/Classification%20list%20and%20sampling%20plans%20-%202%20May%202024.xlsx.
[76] Cornwall IFCA, 'Summary Statistics Season 2022 - 2023.', Monthly Fal Fishery Catch Statistics (Truro: Cornwall IFCA, 2024), https://secure.toolkitfiles.co.uk/clients/17099/sitedata/Research_Reports/2022-23-Fal-Oyster-Permit-Report.pdf.

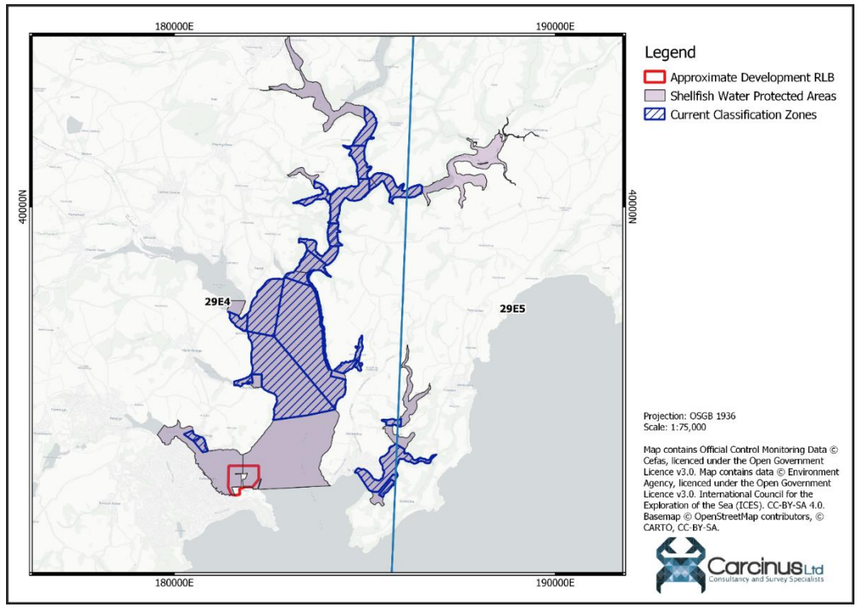

Figure 9.11 Designated Shellfish Waters and Classification Zones within the Fal Estuary

Spawning and nursery grounds

9.8.73 Ellis *et al*.[77] compiled updated maps of the spawning and nursery grounds of selected fish species around the British Isles. The data presented in that report identify that the site is within the spawning area of nine commercially important species, and within the nursery area of five commercially important species (herring, cod, whiting, plaice and the lesser sandeel *Ammodytes tobianus* in the United Kingdom.

9.8.74 There are limited data regarding the location of spawning and nursery grounds for most species of fish. Data from Could et al., mapping species in 1998, was updated in 2012 by Ellis et al. but this later data set is based on largely modelled data and is mapped by ICES rectangles so is now treated with caution, particularly in relation to herring and sandeel mapping. The surveys for spawning grounds etc. were generally in waters greater than 20 m water depth and there are therefore very few data available or determining the presence of important spawning and nursery grounds in estuarine locations. Some knowledge of the habitat preferences of key species is required.

9.8.75 Herring, cod, whiting, plaice and the lesser sandeel *Ammodytes tobianus* are all known to use estuarine habitats as nursery grounds. All were observed in EA surveys data, but abundance of all these species was very low suggesting presence but not a high importance, and for all species apart from whiting there are no nursery grounds mapped on the southwest coast. However, for whiting only 7 records exist in the EA Trac data set. There are nursery grounds for whiting and mackerel along the southwest coast and both species are known to utilise estuarine areas as nursery habitats. However, both species appeared only occasionally in the survey record. Therefore, whilst there will inevitably be fish utilising areas of the Fal as nursery habitats there is no indication that there are any nursery grounds of importance.

9.8.76 There are very few mapped spawning grounds for the southwest coastal region of the UK. There are extensive sprat spawning grounds but these are present around most of the UK coast. Sprat were collected in TraC survey samples, accounting for just under 10 % of all fish sampled. This species is present in the Fal but they were only recorded in relatively high numbers on a couple of occasions. It is considered that this species is present in the Fal but there is no evidence to suggest it is a key spawning area.

Summary

9.8.77 The Fal estuary is home to a wide range of fish species and commercially important shellfish such as mussels, oysters, variegated (queen scallops), crabs, and lobsters. The seabed habitats, including mudflats, seagrass and maerl beds, provide juvenile fish feeding and nursery areas but there is no indication of the presence of any important nursery grounds within the estuary.

9.8.78 The most common species recorded in EA TraC data, including just upstream of the proposed development were sand smelt, pilchards, gobies and sprat, together accounting for over 90% of fish sampled. Fish species making up the remaining 10% include flatfish and low numbers of other pelagic species such as herring, cod and whiting. There were no shad species captured in the EA data and only a single observation in 2007 recorded on the ERCCIS database.

9.8.79 Cartilaginous species such as basking shark and thornback ray have been reported within 2 km of the proposed development but consist of infrequent records indicating only very occasional presence in the estuary. There was a 2006 record of a single seahorse at Restronguet and a few entries to the ERCCIS database recording 2 observations at Flushing in 2022 and one in Falmouth harbour from 2023.

9.8.80 Other fish species of ecological importance includes diadromous fish, as they are reliant on migratory routes for their lifecycle. The only species recorded more regularly are trout and the European eel, although both have been recorded in low abundance. Both are listed as species of principal importance in Section 41 of the NERC Act 2006, however, within the study area they are not protected as part of a designated site. Both species have the potential to be present but the Fal is not a particularly important river for either species. There is limited data to suggest other diadromous species are present, including species of shad and salmon, for which only rare and old records (>10 years) of these species exist.

Marine Mammals

9.8.81 Consideration has been given to cetaceans (dolphins, porpoises and whales) and pinnipeds (seals). No site specific marine mammal surveys have been carried out on the site, given the highly mobile nature of this species group, and the fact that monitoring data of appropriate temporal and spatial scope was available.

9.8.82 The ERCCIS datasearch revealed 414 records of 12 different marine mammal species from 1974 – 2023. Species include both species of seal resident in the UK (harbour seal *Phoca vitulina* and grey seal *Halichoerus grypu)*, several dolphin/porpoise species (Atlantic White Sided Dolphin *Lagenorhynchus acutus*, Common Dolphin *Delphinus delphis*, Bottle-Nosed Dolphin *Tursiops truncatus*, Risso's dolphin *Grampus griseus*, Striped Dolphin *Stenella coeruleoabla*, harbour porpoise *Phocoena phocoena* and Orca *Orcinus orca*), as well as three whale species (humpback whale *Megaptera novaeangliae*, long-finned pilot whale *Globicephala melas* and minke whale *Balaenoptera acutorostrata*). There are also several records of un-identified whales and dolphins. Almost a quarter of the records were of strandings.

9.8.83 Large cetaceans including whales (and orca) are semi-regularly sighted in the waters off Falmouth[78,79,80]. These are considered to be vagrants or occasional visitors and so this section primarily considers the most commonly observed species. Systematic surveys undertaken for the SCANS IV project indicate the cetacean species most likely to be observed in the waters off the south Cornwall coast are bottle nosed dolphin *T. truncatus*, common dolphin *D. delphis* and the harbour porpoise *P. phocoena.* Both species of seal have also been observed.

Sensitive Receptors

Pinnipeds

9.8.84 There are two species of true seal (Phocidae) native to the UK; the grey seal *H. grypus* and the harbour/common seal *P. vitulina*. The Sea Mammal Research Unit conduct regular aerial surveys of seals,

[77] Ellis, J., Milligan, S. P., Readdy, L., Taylor, N. & Brown, M. J., 2012. Spawning and Nursery Grounds of Selected Fish Species in UK Waters. https://www.cefas.co.uk/publications/techrep/techrep147.pdf

[78] 'Humpback Whales off the Coast of Falmouth Pull in Large Crowds', *BBC News*, 23 February 2024, sec. Cornwall, https://www.bbc.com/news/uk-england-cornwall-68379116.

[79] 'Moment Duo on Boat Have Close Encounter with Minke Whales Captured on Camera', ITV News, 20 July 2022, https://www.itv.com/news/westcountry/2022-07-20/moment-duo-on-boat-have-close-encounter-with-minke-whales-captured-on-camera.

[80] Aaron Greenaway, 'Video Shows Majestic Minke Whales in Cornish Waters', Cornwall Live, 16 June 2020, https://www.cornwalllive.com/news/cornwall-news/video-shows-majestic-minke-whales-4229263.

focussing their survey efforts on Scotland and eastern England, which hosts the majority of seals in the UK (> 95% of both species)[81]. Local records indicate the harbour seal is rarely recorded in the vicinity of the proposed development. In the period from 1989 to 2023, of the 110 records submitted to ERCCIS all but one were grey seals.

9.8.85 The breeding season for grey seals varies depending on the population but is typically from early September to late December in the UK. Seals appear at favoured haul-out sites; females give birth, suckle the young for 3-4 weeks then mate with dominant male 'beach masters' before returning to sea, leaving the pups to fend for themselves[82]. The pup seals spend their first two years at sea foraging and can travel over 600 km during this period[83].

9.8.86 Grey seals moult in the spring approximately three to five months after the breeding season. The moult can last between one and three months, shedding and renewing fur essential to maintain thermal regulation[84]. During the moult, seals remain hauled out and the greatest numbers of grey seals are observed during this time[85].

9.8.87 Following the two main haul-out periods of breeding and moulting, grey seals return to the water to forage. This is crucial to replace energy reserves lost whilst breeding and moulting. Their diet is commonly composed of benthic and demersal fishes such as sandeel *Ammodytes* spp., whiting *Merlangus merlangius* and flounder *Platicthys flesus*[86] (see Fish and Shellfish Ecology for further detail on these prey species). Foraging can take place close to haul-out sites or in offshore waters, but typically grey seals forage close to haul out sites if food is sufficiently abundant[87].

9.8.88 There are no notable haul out sites for grey seals within the Fal Estuary (Figure 9.12). The nearest are on the western side of the Lizard Peninsula and off Salcombe. Individuals from these populations may use the waters of the Fal Estuary for feeding from time-to-time.

9.8.89 The Sea Mammal Research Unit provide data on the mean predicted density of grey seals from haul-out sites in the British Isles, as a percentage of the total at-sea population (Figure 9.12[88]). The data suggest that the waters of the Fal Estuary contain <0.001% of the total population. Furthermore, the data for Cornwall and the Isles of Scilly are based on tagging studies conducted in south west Wales and south east Ireland (and none of these tagged individuals visited haul out sites in southwest England). Thus, grey seals are expected to be occasional visitors only to waters within the vicinity of the proposed development.

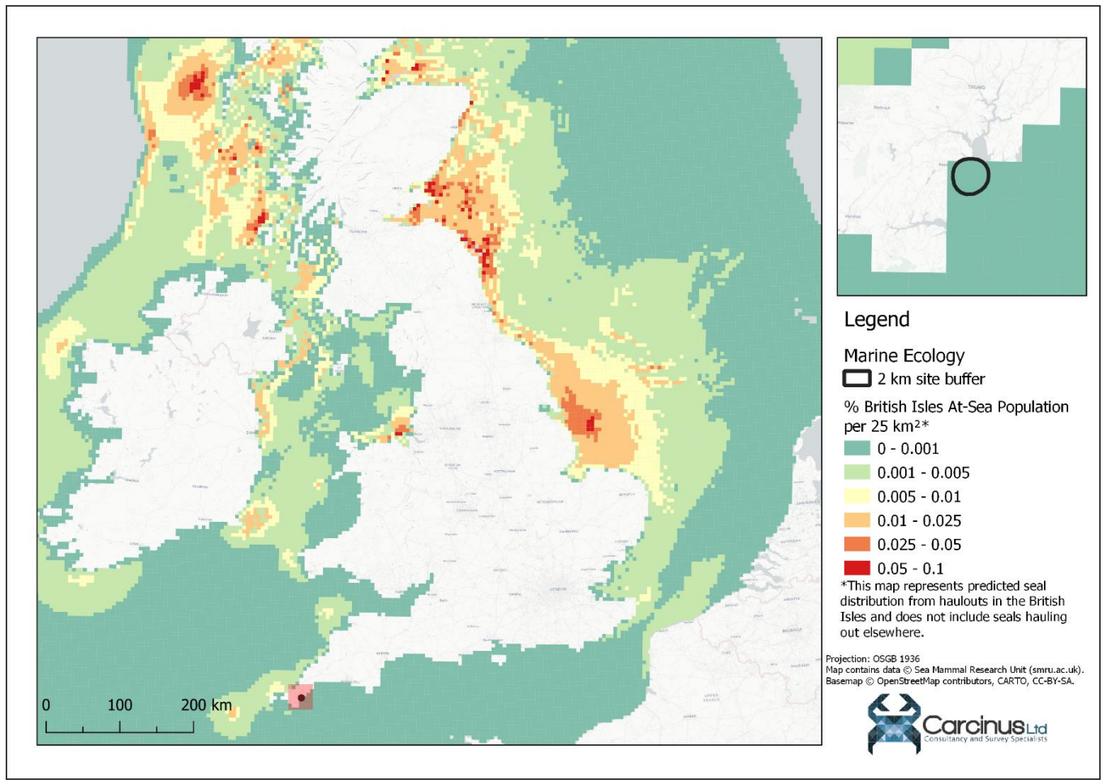

Figure 9.12 Predicted distribution of grey seals from haul-out sites in the British Isles as a percentage of the total at-sea population

Cetaceans

9.8.90 The cetacean species with the most records on the ERCCIS database for opportunistic sightings in the vicinity of the proposed development are bottle-nosed dolphin *T. truncatus*, common dolphin *D. delphis* and harbour porpoise *P. phocoena*. Data from the systematic SCANS IV surveys also reflect this, with density estimates based on summer sightings available for the same species and the minke whale[89].

9.8.91 The most ERCCIS sightings were for the common dolphin[90] though many of the records, 47 of a total of 110 in the period 1980 to 2023, were of strandings. The common dolphin was often observed in groups, with several records of over 50 animals in a pod from Pendennis Point. In 2008 a pod of around 40 individuals became stranded in various rivers and creeks upstream in the Fal Estuary, with more than half found dead on arrival. An investigation into the stranding event posited that a potential cause for the stranding was a large naval exercise across the south-west coast, due to the extensive use of high-energy SONAR. A causal link was not proven but was thought to be the most plausible explanation[91].

81 SCOS. (2022). Scientific advice on matters related to the management of seal populations: 2020. Natural Environmental Research Council, Sea Mammal Research Unit. University of St Andrews, St Andrews: http://www.smru.st-andrews.ac.uk/scos/scos-reports/.

82 Shawn R. Noren et al., 'Body Condition at Weaning Affects the Duration of the Postweaning Fast in Gray Seal Pups (Halichoerus Grypus)', *Physiological and Biochemical Zoology* 81, no. 3 (May 2008): 269–77, https://doi.org/10.1086/528777.

83 J. J. Reilly, 'Adaptations to Prolonged Fasting in Free-Living Weaned Gray Seal Pups', *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology* 260, no. 2 (1 February 1991): R267–72, https://doi.org/10.1152/ajpregu.1991.260.2.R267.

84 Ruth H. Leeney et al., 'Abundance, Distribution and Haul-out Behaviour of Grey Seals (Halichoerus Grypus) in Cornwall and the Isles of Scilly, UK', *Journal of the Marine Biological Association of the United Kingdom* 90, no. 5 (2 August 2010): 1033–40, https://doi.org/10.1017/S0025315409991512.

85 Jessica Schop et al., 'Onset and Duration of Gray Seal (Halichoerus Grypus) Molt in the Wadden Sea, and the Role of Environmental Conditions', *Marine Mammal Science* 33, no. 3 (July 2017): 830–46, https://doi.org/10.1111/mms.12404.

86 P. S Hammond et al., 'Background Information on Marine Mammals for Stategic Environmental Assessment 8' (St Andrews: Univeristy of St Andrews, 2005).

87 D Thompson et al., 'Movements, Diving and Foraging Behaviour of Grey Seals (Halichoerus Grypus)', *Journal of the Zoological Society of London* 224 (1991): 223–32.

88 Carter,M, and Debbie JF Russell, 2021. 'At-Sea Density Maps for Grey and Harbour Seals in the British Isles (2020) (Dataset)', multipart/x-zip (University of St Andrews, 2021), https://doi.org/10.17630/DCEBB865-3177-4498-AC9D-13A0F10B74E1.

89 Gilles, A, Authier, M, Ramirez-Martinez, NC, Araújo, H, Blanchard, A, Carlström, J, Eira, C, Dorémus, G, Fernández-Maldonado, C, Geelhoed, SCV, Kyhn, L, Laran, S, Nachtsheim, D, Panigada, S, Pigeault, R, Sequeira, M, Sveegaard, S, Taylor, NL, Owen, K, Saavedra, C, Vázquez-Bonales, JA, Unger, B, Hammond, PS (2023). Estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys. Final report published 29 September 2023. 64 pp. https://tinyurl.com/3ynt6swa

90 ERCCIS, 'J0710 Marine Ecology ES Data Search 02/04/2024'.

91 CWTMSN and BDMLR, 'Report on the Mass Stranding and Rescue of Common Dolphins in Porth Cree, the Percuil River, Falmouth, SW England, June 2008' (Cornwall Wildlife Trust Marine Strandings Network and British Divers Marine Life Rescue, May 2009), https://bdmlr.org.uk/wp-content/uploads/2020/04/resources-bdmlr-cwtmsn-report-may09.pdf.

9.8.92 Common dolphins have two calving peaks, spring and autumn, with a gestation period of approximately 11 months[92]. They are opportunistic feeders and as a consequence their diet is driven by the availability of foraging resource. Common prey items include small schooling fish such as cod, hake, mackerel and sardine. During winter months, common dolphin move from their offshore habitats to aggregate in the western approaches of the English Channel[93]. Sightings of this species in winter are possible from the shore in Falmouth, when certain prey items move closer inshore. However, common dolphins are still present during summer months within the study area but in lower densities.

9.8.93 The distribution of common dolphins in the north east Atlantic is strongly associated with coastal shelf waters[94] with population density much lower in offshore areas. In some areas this species is regularly sited in small groups but have been observed in 'megapods', aggregations of more than 100 individuals[95]. However, the density of common dolphin, as determined by the SCANS IV systematic surveys, in the survey block CS-A which covers the waters of the south Cornwall coast, was relatively low at 0.0395 individuals per km^2. The highest density of 1.03 individuals/km^2 of this species in the SCANS-IV survey area was in survey block CS-C, which covers an area of the Celtic Sea from the western tip of Cornwall and the north-west corner of Spain.

9.8.94 Striped dolphin *S. coeruleoabla* are much less frequently observed than common dolphin although in summer 2023 a pair of common/striped dolphin hybrids were observed off Falmouth swimming with a pod of common dolphins[96]. This record is thought to be the first record of such a hybrid present in the area. However, the SCANS IV surveys found this species to be more common in offshore waters.

9.8.95 Bottle-nosed dolphins are a coastal/estuarine species generally, typically in groups of between six and 25 individuals, generally containing females and their calves which remain with their mothers for approximately four years. Males sometimes separate off from the main group and live a more isolated lifestyle. Similar to common dolphins, they are opportunistic feeders that target a wide variety of schooling fish including herring, mackerel, cod and bass. There were 104 ERCCIS records this this species over the period 1991-2022, with generally small groups or individual animals observed. This species spends the winter months in the southern Cornwall, moving further north-eastward during spring and summer[97].

9.8.96 The bottle-nosed dolphin estimate for SCANS IV block CS-A was 0.0395 individuals/km^2. The highest density was recorded in block CS-C covering the southern Irish Sea between north Cornwall and South Wales, with an estimate of 0.4195 individuals/km. This species was observed in high density in the Bay of Biscay and the north-west coast of Scotland as well.

9.8.97 Harbour porpoise have been recorded in the vicinity of the proposed development, but infrequently. There were 29 ERCCIS records, accounting for fewer than 100 individuals observed in the period 1986 - 2023. They are highly mobile cetaceans that forage for a wide variety of small fishes including herring *Clupea harengus*, sandeel *Ammodytes* spp., pout *Trisopterus luscus,* poor cod *T. minutus*, and gobies (Gobidae)[92] but their diet is related to the local availability of different prey resources. Their feeding pattern is also closely related to the tidal cycle, utilising the tidal race to herd and catch shoaling fish[92]. Harbour porpoise follow a seasonal movement remaining inshore during summer months and moving offshore during the winter[98]. This seasonal movement is likely to be due to changes in prey availability.

9.8.98 The harbour porpoise is a coastal species known to utilise estuarine environments, shallow bays and tidal channels less than 200 m depth. Most sightings of this species occur within 10 km of the coast and typically individual animals or small groups are spotted. The SCANS IV data[94] for the region of the Celtic and Irish Seas in which the proposed development is located (CS-A) had a population density of 0.07 animals per km² and a total abundance of 3,420 individuals (Giles et al., 2024). The SCANS-IV report notes that the frequency of sightings of harbour porpoise within the English Channel is steadily increasing, but still lower than in the Celtic Sea.

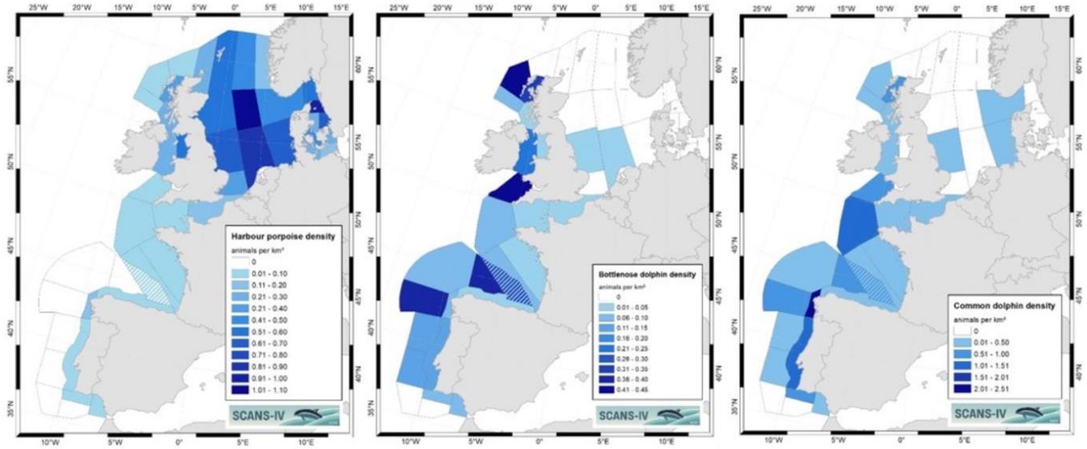

Figure 9.13 Estimated density (animals per km²) for harbour porpoise, bottlenose dolphin and common dolphin in the north-east Atlantic. Figures taken from the SCANS-IV Report[94].

9.8.99 In summary, there is the potential for marine mammals to be present in the vicinity of the proposed development but these are likely to be relatively infrequent and in low density. Seasonality is difficult to predict in the key cetacean species known to be present within the study area (i.e. common dolphin, bottlenose dolphin, and harbour porpoise) and are present throughout the year. However, in the study area, common dolphins are generally found in higher densities, closer inshore, during winter months, whilst bottlenose dolphins and harbour porpoise can be found in higher numbers during summer months.

Designated Sites

Benthic Ecology

9.8.100 There are several statutory designated sites for benthic ecological receptors within 2 km of the proposed development, and their status and features are described in the following paragraphs.

9.8.101 The Fal and Helford Special Area of Conservation (SAC)[99] covers an area of >6,300 Ha and contains the following Annex I habitats as a primary reason for selection:

- *Sandbanks which are slightly covered by sea water all the time*. This feature includes the seagrass meadows and maerl beds throughout the site.
- *Mudflats and sandflats not covered by seawater at low tide*. Sheltered intertidal mudflats and sandflats representative of those throughout southwest England. Particularly recognised for the faunal community living within the sediments.

[92] Reid, Evans, and Northridge. 2003. 'Atlas of Cetacean Distribution in North-West European Waters', *Joint Nature Conservation Committee*, vol. 81 (Peterborough: Joint Nature Conservation Committee, 2003), http://www.ncbi.nlm.nih.gov/pubmed/17578592.
[93] de Boer, M.N., Saulino, J.T., Leopold, M.F., Reijnders, P.J. and Simmonds, M.P., 2012. Interactions Between Short-Beaked Common Dolphin (Delphinus delphis) and the Winter Pelagic Pair-Trawl Fishery ff Southwest England (UK).
[94] A Gilles et al., 'Estimates of Cetacean Abundance in European Atlantic Waters in Summer 2022 from the SCANS-IV Aerial and Shipboard Surveys.', Small Cetaceans in European Atlantic Waters and the North Sea - SCANS, 29 September 2023, https://tinyurl.com/3ynt6swa.
[95] Michael Cairns, 'Superpod of 100 Dolphins Spotted off Falmouth Coast', *The Valley* (blog), 20 January 2017, https://www.thevalleycornwall.co.uk/news/superpod-of-100-dolphins-spotted-off-falmouth-coast/.
[96] 'Hybrid Dolphins Spotted off Coast of Falmouth', BBC News, 21 August 2023, https://www.bbc.com/news/articles/cy9wgxedd21o.
[97] Wood, C.J., 1998. Movement of bottlenose dolphins around the south-west coast of Britain. *Journal of Zoology*, *246*(2), pp.155-163.
[98] M. B Santos and G. J Pierce, 'The Diet of Harbour Porpoise (Phocoena Phocoena) in the Northeast Atlantic: A Review', *Oceanography and Marine Biology, An Annual Review, Volume 41*, 31 July 2003, 363–69, https://doi.org/10.1201/9780203180570-36.
[99] JNCC, 'Fal and Helford - Special Areas of Conservation'. https://sac.jncc.gov.uk/site/UK0013112

- *Large shallow inlets and bays*. The Falmouth Ria receives a low freshwater input and as a consequence there are a variety of marine habitats from extremely sheltered embayments to exposed coast. The algal flora is considered to particularly diverse, including extensive maerl beds off St Mawes Bank.
- *Atlantic salt meadows (Glauco-Puccinellietalia maritimae)*. The saltmarsh vegetation in a ria is a physiographic type restricted to south-west England and west Wales and found in the upper reaches of estuaries.

9.8.102 The Falmouth Bay to St Austell Bay Special Protection Area (SPA)[100] covers an area of almost 26,000 Ha. Impacts on avian receptors (for which SPAs are designated to protect) are outside the scope of this chapter, but they are considered fully in ES Volume 2: Technical Appendix 2.12 (HRA). The benthic ecological features of the development site and surrounding area may provide an important food resource for some features of the SPA and potential indirect effects are commented on where appropriate.

9.8.103 The Lower Fal and Helford Intertidal Site of Special Scientific Interest (SSSI)[101] covers an area of 277.7 ha and is wholly contained within the Fal and Helford SAC. It contains a range of sediment types from open shore coarse mixed and sands to fine soft muds, which in turn support a rich community of burrowing polychaete worms, bivalve molluscs and echinoderms. The entire SSSI is in favourable condition. Identified pressures on this site include water company discharges contributing to water pollution and the risk of spread of invasive and non-native species.

9.8.104 The South-Central region of the Cornwall National Landscape[102] includes the Fal Estuary, and the presence of marine habitats and species documented in the other statutory designations are also recognised here.

Fish Ecology

9.8.105 There are no statutory designated sites for fish ecology nature conservation within the Fal Estuary. The area is however designated as a Shellfish Water under the Water Framework Directive[103].

Marine Mammals

9.8.106 There are no statutory designated sites for marine mammals within the Fal Estuary or adjacent coastline. The nearest SACs designated for the presence of marine mammals is the Bristol Channel Approaches SAC[104], designated for the presence of harbour porpoise *P. phocoena*. This is approximately 110 km away from the proposed development.

Sensitive Receptors

9.8.107 Baseline data on benthic, fish and shellfish and marine mammal species and habitats with a biodiversity value recognised through legislation or conservation plans were examined. A summary of the sensitive receptors identified are presented in Table 9.6, with justification for their selection based on the criteria outlined in Table 9.2.

Table 9.6: Summary of Sensitive Receptors

Receptor	Value	Justification
Benthic ecology	High	Maerl beds, a sub-feature of the Large shallow inlets and bays (H1160) designated habitat of the Fal and Helford SAC, are internationally important. They are a Habitat of Principle Importance, Priority Marine Feature and listed by OSPAR as a threatened or declining habitat. The two maerl species present, *Phymatolithion calcareum* and *Lithothamnion corallioides* were recorded within 2 km of the site boundary, principally to the east of the site near St Mawes. Seagrass habitat is widespread throughout the Fal (18 ha recorded in 2022). This is an Annex I Habitat, a Habitat of Principle Importance, a Priority Marine Feature and is listed by OSPAR as a threatened or declining habitat. This habitat was not recorded within the site boundary. No other habitats that were observed within the project specific site boundary or study area are specifically designated by the SAC but there are a number that do have conservation value. Subtidal kelp beds, listed as a Higher Sensitivity Habitat under the Water Framework Directive, were identified within the study area but are generally found around the mouth of the Fal. Kelp plants were identified within the site boundary but this is not considered to comprise a subtidal kelp bed. The remaining habitats are sediment dominated habitats with a widespread distribution.
Fish and shellfish	Medium	A wide range of fish species have been observed in the Fal estuary. There are migratory trout and European eel in the Fal though the numbers recorded are relatively low. The river is classified as a principal sea trout river in the UK. Sea trout are protected under the Salmon and Freshwater Fish Act[105] and under Section 41 of the NERC Act. Overall, a small number (in the context of the south-west of England) move through and past the site boundary each year. The River Fal has been identified as a recovering salmon river. However, the River Fal is not considered to be important for salmon migration, with no records of this species occurring in the river since 2005. Non-migratory fish observed are dominated by sand smelt, pilchard and gobies, as well as a range of demersal and pelagic species. Also present in the vicinity of the study area is the long-snouted (spiny) seahorse, protected under Section 41 of the NERC Act and The Wildlife and Countryside Act, and are a Feature of Conservation Importance for MCZs, though there are only a few records and this species is not specifically protected in the Fal. The habitats within the Fal likely provide nursery habitat for some fish species but there is no evidence to indicate there are any important spawning grounds. There are shellfish areas within the study area, of high local importance for fisheries, including mussels, native oyster, Pacific oyster, variegated (Queen) scallop, lobsters, and crabs. The nearest shellfish classified harvesting area is 750 m to the north-west of the proposed development.
Marine mammals	High	All cetaceans are European Protected Species and specifically protected in the UK under the Wildlife and Countryside Act 1981. Seals are protected by the Habitats Directive in the EU and the Conservation of Seals Act in the UK. Records indicate only occasional presence of marine mammals within the Fal though they are of high value on the basis of their conservation importance.

[100] Natural England, 'Falmouth Bay to St Austell Bay SPA', Natural England Conservation Advice for Marine Protected Areas, 2022, https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9020323&SiteName=falmouth&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&HasCA=1&NumMarineSeasonality=3&SiteNameDisplay=Falmouth%20Bay%20to%20St%20Austell%20Bay%20SPA.

[101] Natural England, 'Lower Fal and Helford Intertidal SSSI', Designated Sites View, accessed 31 October 2022, https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=s2000174.

[102] Cornwall National Landscape. Available [online] at: https://cornwall-landscape.org/#sections.

[103] Environment Agency, 'CARRICK ROADS SHELLFISH WATER Monitoring Site', Catchment Data Explorer, 2023, https://environment.data.gov.uk/catchment-planning/MonitoringSite/371059.

[104] JNCC, 'Bristol Channel Approaches / Dynesfeydd Môr Hafren - Special Areas of Conservation', 2024, https://sac.jncc.gov.uk/site/UK0030396.

[105] *UK Government, 'Salmon and Freshwater Fisheries Act 1975', 1975, https://www.legislation.gov.uk/ukpga/1975/51?view=plain.*

Table 9.6: Summary of Sensitive Receptors		
Receptor	**Value**	**Justification**
Fal and Helford SAC	High	The proposed development is located within the Fal and Helford SAC. Annex I Habitats that are a primary reason for the designation of this site are within the proposed development footprint, and throughout the wider estuary. There are intertidal habitats designated by the Lower Fal and Helford Intertidal SSSI but this is outside the site boundary and there is no impact pathway to intertidal habitats which are outside the zone of influence for SSC. Potential impacts to designated site integrity are assessed in Technical Appendix 2.12 Habitats Regulations Assessment.

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

- Large oceanic migratory fish species such as basking shark and bluefin tuna, as these are only occasionally sighted in the area during summer months and do not regularly enter estuarine environments such as that of the proposed development location.
- Artificial habitats adjacent to the dock structure.

9.9 Assessment of Effects

9.9.1 The following assessment provides a summary of all impacts identified during scoping, and those which have been noted as the EIA has progressed. All impacts are not necessarily relevant to all stages of the project, and thus impacts and effects have been assessed with the stage of the project at which they will occur. These are demolition and construction stage and operational stage.

9.9.2 A number of impact pathways affecting the Fal Estuary as a result of the demolition and construction, and operational development stages of the proposed development have been excluded from the assessment based on professional judgement. The justification for why these potential impacts require no further assessment is provided in Table 9.7.

Table 9.7: Impact pathways excluded from assessment	
Potential Impact and Likely Effect	**Rationale**
Benthic Ecology	
Increased levels of noise and vibration during the demolition and construction stage.	Benthic ecological communities are generally highly insensitive to noise and so are excluded from the assessment.
Obtrusive light during both demolition and construction and operational development stage.	Impacts from obtrusive light have been scoped out of the EIA for this development. It is considered that industry standard lighting control measures would be secured through the CEMP. Whilst there is the potential for light spill as a result of lighting used during construction, the CEMP would ensure that any effects would be mitigated such that any light spillage would be insignificant in line with ILP guidance.
Fish Ecology	
Increased levels of noise and vibration caused by terrestrial activities during demolition and construction and operational stages.	Penetration of terrestrially generated noise into the marine environment will be negligible and as such no significant effect on fish receptors is anticipated. However, underwater noise is included in the assessment.
Marine Mammals	
Increased levels of noise and vibration caused by terrestrial activities during demolition and construction and operational stages.	Penetration of terrestrially generated noise into the marine environment will be negligible and as such no significant effect on marine mammal receptors is anticipated. However, underwater noise is included in the assessment.

Demolition and Construction Effects

9.9.3 The potential impacts and likely effects on marine ecological receptors during the demolition and construction stage would be as follows:

Habitat Removal and Disturbance - The proposed development would cause habitat removal and disturbance through two main processes: dredging operations to increase water depths within the site boundary and the installation of new piles to support new wharf structures. The proposed development would comprise berth pockets of depths of -10.5 m CD for Western Wharf, Queens Wharf, the FLOW mooring area and South of Queens. A surface skim of -5.5 m CD would be undertaken as part of the proposed development. Dredging works would also involve the removal of underwater obstructions on the seabed from a demolished timber jetty within the western berth pocket and grading of sides. In total 643,000 m³ of sediment would be removed from within the site boundary. The footprint of the proposed dredged area is 23.25 ha. The new wharf structures would be supported by a number of piles up to 1.32 m in diameter. Disturbance may occur as a result of vessel propeller wash and wake wash but vessels will be moving slowly so this is considered to result in a negligible effect, particularly within the dredged footprints where any disturbance from propellor wake and wash will be entirely overridden by the dredging.

Overshadowing - During the operational stage of the proposed development, the main pathway to a change in ecologically relevant light is additional overshadowing from the new footprint of the wharf and from the presence of additional berthed vessels. The proposed development would increase the area of suspended deck and wharf structures from 11,644 m^2 to 26,133 m^2, a total increase of 14,489 m^2. The areas directly beneath the new wharf structures would be permanently shaded and areas just beyond shaded to differing extents throughout each day and throughout the year. The worst-case scenario would occur during early mornings/late evenings in winter months, as the sun is typically lowest in the sky. The construction works would be facilitated by additional vessels being present within the site boundary, which would cause temporary reductions in underwater illumination. However, this is considered to be negligible in relation to existing operations and is not considered further.

Elevated suspended sediment concentrations - Dredging operations as a result of the proposed development would cause increases in suspended sediment concentrations (SSC) within the study area (the dredge footprint and the plume caused). ES Volume 2: Technical Appendix 6.3 presents the results of the sediment plume study, which modelled the sediment plume generated by dredging operations. The study involved three simulations of dredging activity over a 15-day period, for dredging to the north of Queen's Wharf, dredging within the Eastern Berth Pocket (Western Wharf) and dredging in the Western Berth Pocket (the FLOW Deck). Impacts resulting from increases in SSC relate

to decreases in the availability of light at the seabed (impacting photosynthetic species) or potentially clogging the feeding structures of filter feeding organisms[106].

Suspended Sediment Deposition - The sediment mobilised into the water column during dredging operations would be dispersed away from the site by natural water circulation before being redeposited on the seabed in a different area. This type of sediment deposition is referred to as 'light' within the Marine Evidence-Based Sensitivity Assessment (MarESA) list of pressures[106] as it results from settling out of silt/sediments rather than direct deposition of dredged material. In addition to modelling the plume of SSC increase, the accumulation of dredged sediment over the entire dredging campaign has been modelled. Baseline deposition is generally very low at the site with rates less than 2 cm/year. Outside the site, rates are less than 0.5 cm per year (Technical Appendix 6.2 Sediment Transport Modelling).

Contaminated Sediment Mobilisation and Deposition – Ground investigations undertaken at the site have indicated the presence of elevated concentrations of a variety of contaminants in all dredge locations, particularly copper, mercury, and lead, TBT and polycyclic aromatic hydrocarbons (PAHs). A total of up to 221,000 m³ (~34 %) of the dredging arisings are therefore not suitable for disposal at sea and will be removed for landside treatment and disposal. Whilst a 10 m³ lidded bucket will be used for all dredging operations, minimising the amount of sediment released, there still lies the potential for mobilisation and re-deposition of contaminated sediments. Modelling has been undertaken to determine levels of sediment deposition resulting from dredging operations and the degree of change is used to assess the potential impact from contaminants.

Underwater noise and vibration - Anthropogenic noise refers to any man-made sound or vibration[107] which can disturb the natural behaviour of animals, mask biologically useful signals and impair their hearing or even, in extreme cases, cause injury/death. For marine fauna, physical injury is caused by a large and sudden change in pressure leading to barotrauma (e.g. bursting of swim-bladder or blood vessel), or by the cumulative amount of sound that an animal is exposed to that can lead to auditory effects. Auditory effects are often associated with a 'Threshold Shift' in hearing, either a temporary (TTS) or permanent (PTS) impairment in the sound detection capability of a given species. PTS is considered to be injury. Lethal effects generally arise from severe barotrauma in an animal in close proximity to a highly intensive impulsive sound sources, such as explosions from the detonation of UXO. Auditory effects, which can also lead to mortality, can occur over larger distances if animals are exposed for long periods of time. Disturbance to marine fauna can also occur at sounds levels lower than those that cause injury, by masking vocalisations or disturbing normal behaviour. Further explanation of the terminology used in assessing the impacts of anthropogenic noise on marine fauna are presented in ES Chapter 7: Underwater Noise and Technical Appendix 7.1: Underwater Noise Modelling Report. Much of the detail in terms of quantifying the extent of underwater noise generation resulting from the proposed development is presented in those documents, but figures/data are presented in this chapter where appropriate.

Introduction and/or spread of marine invasive non-native species - During the proposed development invasive non-native species (INNS) could be introduced to the marine environment via contamination on equipment and new materials installed in the marine environment, from biofouling on the underside of vessels used during project activities and via the release of ships ballast water. The spread of existing INNS could also occur as a result of the disposal of dredged sediment to a disposal site.

Vessel strike - During the construction and demolition stage of the proposed development, vessels would be required, such as for the dredging operations, use of barges, and other workboats. This would see an increase in the number of vessels used around Falmouth Docks and close to the proposed development, which could lead to injury/mortality of marine mammals using the waters in the vicinity of the site.

Benthic Ecological Communities

Habitat Removal and Disturbance

Description of Impact

9.9.4 See Paragraph 9.9.3, point 0.

Magnitude of Impact

9.9.5 The extent of habitat disturbance and loss as a result of both the dredging operations and pile installations would alter throughout the demolition and construction stage, with a gradual transition from the existing baseline conditions to those predicted for the operational development. The worst-case scenario would occur once construction is complete.

9.9.6 The proposed construction activities would result in the loss of all benthic habitats within the dredge footprint and beneath the footprint of each newly installed pile. The study area contains a variety of benthic ecological communities and habitats, and the magnitude of impact on each of them varies depending on the specific distribution of the given community or habitat in relation to the dredge pocket and the wider study area, as well as the recoverability potential of that community or habitat. Following the criteria set out in Table 9.3, the magnitude of impact on each of the different communities/habitats is set out in Table 9.8.

9.9.7 The seabed habitat within the direct footprint of the dredging and the installation of piling is dominated by subtidal sediments, with most other habitats beyond the site boundary.

Table 9.8 Magnitude of impact justification for each of the benthic ecological receptors identified as a result of habitat removal and disturbance.

Receptor	Magnitude of Impact	Justification
Intertidal and Subtidal Benthic Ecological Communities	**Low**	Benthic infaunal ecological communities within the proposed dredge pocket are typical of the wider sediment habitats of the Fal estuary. Removal of the sediments within the dredge pocket are small in extent and represent only a small fraction of the benthic infaunal communities that are throughout the entire study area. Whilst some communities will be removed the dredged area will become colonised once conditions, particularly the sediment characteristics such as contamination levels, are suitable. The area of direct habitat removal and disturbance also includes works to the intertidal revetment around the western wharf supporting a limited intertidal benthic assemblage.
Subtidal seagrass meadows	**Not applicable**	No subtidal seagrass habitat exists within the dredge footprint and therefore no potential impact exists for direct removal and disturbance.
Subtidal kelp bed	**Not applicable**	Areas of subtidal kelp, including the biotope "*Saccharina latissima* and Red Seaweeds on Infralittoral Sediments" were found within the dredge pocket. However, kelp observed within the site boundary is present in low coverage and the biotope is dominated by red algae and would not qualify as kelp bed.
Maerl beds	**Not Applicable**	Maerl beds, as an Annex 1 habitat and designating feature of the Fal and Helford SAC, are particularly sensitive to abrasion and habitat removal. However, no areas defined as being maerl beds under the JNCC's Marine Habitat Classification System were identified as being present within the dredge footprint. The term 'maerl beds' is a broad term to which several different classification systems can and have historically been applied to define areas

[106] H Tyler-Walters et al., 'Marine Evidence-Based Sensitivity Assessment (MarESA) - Guidance Manual' (Plymouth, UK: Marine Biological Association of the UK, 2023), https://www.marlin.ac.uk/assets/pdf/MarLIN-MarESA-Manual-Jun2023.pdf.

[107] Vibration represents the mechanical movement effect to a receptor and is outside of the audible range of that individual (the audible range being associated with noise).

Table 9.8 Magnitude of impact justification for each of the benthic ecological receptors identified as a result of habitat removal and disturbance.		
		of this habitat. Project specific surveys (ES Volume 2: Technical Appendix 9.5) reviewed areas of maerl habitat within the site boundary according to the five different descriptions in the conservation advice package for the Fal and Helford SAC. In the 6.1 Ha proposed dredge pocket the habitat was described as 'areas of maerl in sediment'. However, these habitats lacked any 3D structure, with maerl thalli not being longer than 1 cm and in the majority of areas was only a surface veneer of dead maerl gravel with low percentage cover. Thus, the 'areas of maerl in sediment' mapped within the dredge footprint do not function or act as a maerl bed and have been identified as sediment dominated biotopes. No other maerl habitat types were present within the dredge pocket.
Key Subtidal Biotopes	**Low**	Two biotopes of conservation importance, "*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel" and "*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment" were found within the northern part of the pocket. Direct removal of sediments characterised by their infauna represents a step change in biotope. Both biotopes are considered to have medium resilience to this impact and recovery of the species assemblage can occur over the medium term[108,109] The former is relatively widely distributed across the southern coast of England[110]. The latter is also common around the coast of England.

Value/Sensitivity of Receptor

9.9.8 The study area contains a variety of benthic ecological communities and habitats that have differing ecological importance and value (Table 9.6): Intertidal and subtidal benthic ecological communities that are of **low** value due to their importance on a regional scale; Subtidal seagrass meadows that are of **high** value due to their importance on an international scale; Subtidal kelp beds that are of **high** value due to their importance on a national scale; Maerl beds that are of **high** value due to their importance on an international scale; and Subtidal biotopes such as "*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel" and "*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment" that are of **high** value due to their importance on a national scale.

Significance of Effect

9.9.9 The value/sensitivity of the "areas of maerl in sediment" habitat within the dredge pocket is **low** because it is not structurally or functionally characteristic of a maerl bed. The maerl in the dredge pockets comprises small fragments of dead thalli only. Based on the **low** magnitude of impact and **low** value/sensitivity of the intertidal and subtidal benthic ecological communities within the dredge pockets, the overall effect of habitat removal and disturbance would be **Negligible Adverse** and therefore **not significant**. Significant effects are not predicted as the maerl habitat that would be removed is very low quality in the context of the study area and the pristine maerl habitats present elsewhere in the Fal Estuary.

<u>Elevated Suspended Sediment Concentrations</u>

Description of Impact

9.9.10 See Paragraph 9.9.3 point 0.

Magnitude of Impact

9.9.11 The sediment plume modelling study presents timeseries of the changes in SSC at several locations across the site. The locations modelled are shown in Figure 9.14 and their positioning is as follows:

1. Position within the Western Berth Pocket;
2. Position north of Queens' Wharf;
3. Position at Western extent of live maerl thalli recorded during ecological studies;
4. Position within highest quality (maximum % cover of live maerl) identified during Carcinus surveys;
5. Position within subtidal seagrass and kelp beds off Flushing Beach;
6. Position of 'maerl' south east of the breakwater, based on historic data;
7. Position near the southern extent of the sediment plume;
8. Position within the Eastern Berth Pocket; and
9. Position north-west of the site boundary, outside the predicted zone of influence.

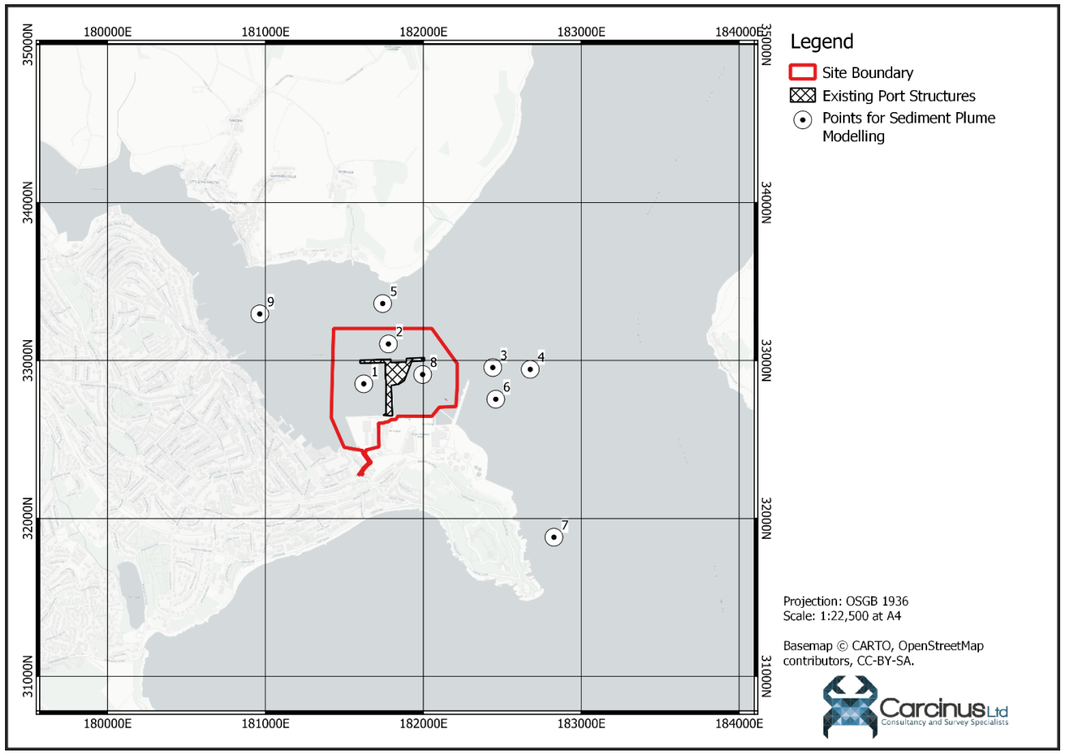

Figure 9.14 Locations for use in timeseries modelling

9.9.12 The modelling shows that high levels of SSC are restricted to the immediate area around the dredge pockets as follows:

- Dredging operations in the Eastern Berth Pocket would cause a maximum increase in SSC at Point 8 and Point 2, in very close proximity to the dredge pockets and within the site boundary, peaking

[108] H Tillin and A Watson, 'Mediomastus Fragilis, Lumbrineris Spp. and Venerid Bivalves in Circalittoral Coarse Sand or Gravel', in *Marine Life Information Network: Biology and Sensitivity Key Information Reviews* (Plymouth, UK, 2024), https://www.marlin.ac.uk/habitat/detail/382.

[109] E.S.R De-Bastos, C.E Marshall, and A Watson, 'Kurtiella Bidentata and Thyasira Spp. in Circalittoral Muddy Mixed Sediment', in *Marine Life Information Network: Biology and Sensitivity Key Information Reviews* (Plymouth, UK, 2024), https://www.marlin.ac.uk/habitat/detail/374.

[110] JNCC, 'Mediomastus Fragilis, Lumbrineris Spp. and Venerid Bivalves in Circalittoral Coarse Sand or Gravel - JNCC Marine Habitat Classification'.

at 6.2 and 6.3 mg/l respectively. The average increase in SSC is highest at 0.3 mg/l at Point 8. At all stations outside the site boundary the maximum increase in SSC is predicted to be between 0.1 and 0.2 mg/l;

- Dredging operations north of Queens' Wharf would cause a maximum peak concentration increase in SSC of 13.7 mg/l at Point 2. The average increase in SSC at this location is 0.8 mg/l. The average increase in SSC is 0.4 mg/l at Point 1, 0.2 mg/l at Point 2. At all locations outside the site boundary the maximum increase is 3.5 mg/l at point 3 and 0.5 mg/l or less everywhere else; and
- Dredging operations in the Western Berth Pocket would cause a maximum increase in SSC of 78.1 mg/l at Point 1, with an average increase in SSC at this location of 3.7 mg/l. The peak concentration increase at Point 2 is 4.4 mg/l, with an average increase in SSC of 0.1 mg/l. At the other locations, the predicted peak concentration increase is 0.3 mg/l or less.

9.9.13 At sites outside the site boundary, including at sites 3, 4 and 6 to the east of the Eastern Breakwater, where live maerl was identified as present, the average increase in SSC at all sites is less than 0.1 mg/l. The maximum increase is 3.5 mg/l, which will occur for a very short period, on some tides only.

9.9.14 At all sites, increases in SSC are predicted to be very short-lived, returning to baseline levels shortly after the completion of dredging operations. There would be no long-term increase[111] in SSC within the site boundary or wider zone of influence. The study area has generally low turbidity naturally, with baseline levels of SSC reported to be in the region of 6-40 mg/l, though most values recorded at regular monitoring stations were in the <3 mg/l range inside the site boundary and between 5 and 10 mg/l to the north of Queen's Wharf (Technical Appendix 6.2 Sediment Transport Modelling).

9.9.15 Naturally occurring weather events such as floods, large tides or severe storms can increase SSC concentrations to levels above those caused by dredging[112]. For example, in August 2023 Storm Antoni caused unseasonably strong winds, gusting up to 70 mph and coincided with a temporary ten-fold increase in turbidity levels within the site boundary.

9.9.16 It is therefore considered likely that the temporary increase in SSC is within the range of natural variability though dredging will take place over many weeks. However, the period of increase in SSC is short-lived and by restricting dredging to the late ebb and early flood tide the intensity and extent of the increase in SSC outside the immediate dredge footprints in very limited (Technical Appendix 6.3 Sediment Plume Modelling). Thus, the magnitude of impact for all benthic habitats is therefore considered to be **low**.

Value/Sensitivity of Receptors

9.9.17 The study area contains a variety of benthic ecological communities and habitats that have differing ecological importance and value (Table 9.6):

- Intertidal and subtidal sediment benthic ecological communities that are of **low** value due to their importance on a regional scale;
- Subtidal kelp forests that are of **high** value due to their importance on a national scale;
- Maerl beds that are of **high** value due to their importance on an international scale; and
- Subtidal biotopes such as "*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel" and "*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment" that are of **high** value due to their importance on a national scale.

Significance of effect

9.9.18 Despite the fact that some benthic ecological receptors are of high importance, the low magnitude of effect from the limited increase in SSC means that the overall significance of effect does not exceed **Minor Adverse** and is therefore **not significant** for all benthic ecological receptors.

Suspended Sediment Deposition

Description of Impact

9.9.19 See Paragraph 9.9.3 point 0.

Magnitude of Impact

9.9.20 The magnitude of impact on each of the identified benthic ecological receptors is described and justified in Table 9.9.

Table 9.9 Magnitude of impact justification for each of the benthic ecological receptors identified as a result of fine sediment deposition

Receptor	Magnitude of Impact	Justification
Intertidal and Subtidal Benthic Ecological Communities	**Low**	Benthic ecological communities of the sediment-based habitats within the study area are typical of the wider Fal estuary. The sediment deposition is greatest within the site boundary, particularly within a small area to the west of Queen's Wharf. Outside the site boundary, deposition is also highest to the west of the site. To the east deposition is mostly below 5 mm with a small patch predicted close to the end of the eastern breakwater, but to 10 mm only. These values also consider the effect of all dredging, a highly precautionary approach since each pocket is most likely to be dredged separately, allowing for some redistribution of sediments between each campaign. Even allowing for the total dredge effect sediment deposition less than 5 cm is considered to be 'light' (MarESA[113]) and most benthic biota may be able to adapt, i.e. vertically migrate through the deposited sediment. In some areas, deposition of dredged material is unlikely to exceed natural deposition, estimated to be around 2 cm within the site boundary and 0.5 cm outside.
Subtidal seagrass meadows	**Not applicable**	The modelled sediment deposition plume does not indicate that any fine sediment would settle out on areas of seagrass so there is no pathway for impact and this habitat is not considered further.
Subtidal kelp beds	**Low**	Whilst there are kelps within the site boundary and wider study area, including the biotope "*Saccharina latissima* and Red Seaweeds on Infralittoral Sediments" these are occasional plants in a dense cover of red algae. These habitats are therefore, not considered to be kelp beds or forests. Some higher density cover of kelps have been recorded to the south east of the Eastern Breakwater. Impacts to kelps would be restricted to those outside the dredge pocket as habitats within the dredge pocket would have been cleared during dredging operations. Point 3 and 6 (Figure 9.14) are near to areas of subtidal kelp outside of the dredge pocket. However, the habitats to the north of Queen's Wharf were not observed to be kelp beds or forest, due to low abundance. However, modelled deposition at Point 3 and 6, outside the site boundary, would be 0.7 mm and 0.6 mm respectively. This is a negligible depth of sediment deposition, particularly considering the nature of the habitat, and is within the range of natural variability.
Maerl beds	**Low**	The sediment deposition footprint is mostly contained within the site boundary as a result of restricting dredging activity to a specific tidal window which significantly minimises sediment dispersion. Outside the site boundary a small area to the east of the site boundary, including a

[111] Defined as a change in water clarity sufficient to cause a change in one rank on the Water Framework Directive scale (e.g. from clear to intermediate for one year).

[112] W Parr et al., 'Turbidity in English and Welsh Tidal Waters', 1998.

[113] Tyler-Walters et al. Available from:

Table 9.9 Magnitude of impact justification for each of the benthic ecological receptors identified as a result of fine sediment deposition

		small finger of deposition from the tip of the Eastern Breakwater is predicted, with a deposition depth up to 10 mm in an area of habitat that occurs in the mapped boundary between "areas of maerl in sediment", and "living maerl overlying dead maerl" (Technical Appendix 9.5). The biotopes mapped in this area, on the basis of project specific DDV surveys in 2022 and 2023 are *Sublittoral macrophyte-dominated communities on sediments* (SS.SMp) and Infralittoral mixed sediments (SS.SMx.Imx). There was some maerl observed but this was low coverage of dead maerl with a 2D structure. Outside of these areas predicted deposition declines to less than 1 mm at distances of 370 m (west of the site), and 300 m (east of the site). The depth to which sediment is reported to result in maerl mortality from the deposition of fine sediments is 20 mm. However, most of the maerl in this area is already dead and the deposition depth is lower than this so any mortality is expected to be very limited. The modelling of sediment deposition was undertaken on a highly conservative basis, assuming each of the three dredging campaigns take place sequentially and immediately following the previous campaign, assuming no interval between each campaign. However, dredging is not likely to occur in this way since each pocket will be dredged entirely separately as the construction programme will focus on one area of the wharf at a time. Thus, a time gap between each dredging area will occur, of months probably, allowing some removal of deposited sediments due to water movements, particularly as the maerl habitat in this area is not of a structural nature to trap and retain these deposited sediments. In addition, the modelling around the Eastern Breakwater represents a more simplified and conservative structure than actually exists, and so the limited dispersion outside of the site boundary is likely to be lower and less extensive than modelled. At the tip of the Eastern Breakwater, the 2022 DDV survey recorded (in DDV17) a mixed sediment habitat fairly bare of life with anthropogenic debris clearly visible. Thus, deposition on the mapped maerl is considered unlikely to change the function of the habitat as the maerl fragments present are too small to give the habitat a three-dimensional structure.
Key Subtidal Biotopes	**Low**	Two biotopes of conservation importance, "*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel" and "*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment" were found sediment deposition area. Sensitivity to light deposition, such as that resulting from dredging dispersion is low and not sensitivity respectively[114,115]. Both habitats are widely distributed across the southern coast of England[116].

Value/Sensitivity of Receptor

9.9.21 The study area contains a variety of benthic ecological communities and habitats that have differing ecological importance and value (Table 9.6):

- Intertidal and subtidal benthic ecological communities that are of **low** value due to their importance on a regional scale;
- Subtidal kelp forests that are of **high** value due to their importance on a national scale;
- Maerl beds that are of **high** value due to their importance on an international scale; and
- Subtidal biotopes such as "*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel" and "*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment" that are of **high** value due to their importance on a national scale.

Significance of Effect

9.9.22 Based on the **low** magnitude of impact and **low** value/sensitivity of the generic intertidal and subtidal benthic ecological communities within the study area, the overall effect of fine sediment deposition would be **Negligible Adverse** and therefore **not significant**.

9.9.23 Despite the **high** value of subtidal kelp forests, the magnitude of impact on subtidal kelp within the study area is **low** as kelp forest was not observed within the zone of influence, meaning that the overall effect of fine sediment deposition would be **Minor Adverse** and therefore **not significant**.

9.9.24 Maerl bed habitats have a **high** value/sensitivity, and the magnitude of impact on "areas of maerl in sediment" sediment deposition footprint, where the maerl is largely small fragments of dead thalli and not an ecological functioning maerl bed, is **low**. The overall effect of sediment deposition would be **Minor Adverse** and therefore **not significant**. Significant effects are not predicted as sediment as whilst "areas of maerl in sediment" will have some and areas of "living maerl overlying dead maerl" would experience deposition of mobilised sediments the depths are limited and the habitat structure is not likely to significantly affected.

9.9.25 Based on the **low** magnitude of impact and **high** value/sensitivity of the notable biotopes within the study area, the overall effect of fine sediment deposition would be **Minor Adverse** and therefore **not significant**.

<u>Mobilisation and deposition of contaminated sediments</u>

Description of Impact

9.9.26 See Paragraph 9.9.3 Point 0.

Magnitude of Impact

9.9.27 The mobilisation and deposition of contaminated sediments is determined by the extent of sediment dispersion and deposition, as detailed in the previous two pathways, as well as the behaviour of the sediment bound contamination itself.

9.9.28 There are areas of sediment within the dredge pockets that have contamination concentrations, for some elements (Cu, Pb, Hg, Zn, TBT, PCBs), above Cefas Action Level 2 and are considered the greatest risk in terms of mobilisation and deposition in other areas. During the mobilisation of sediments, some sediment bound contamination will partition from the sediment-bound phase to the aqueous phase.

9.9.29 Modelling of the concentration of contaminants into the aqueous phase was undertaken, for the unmitigated Scenario 1, and compared against EQS values for maximum allowable concentration (MAC) and annual average (AA) (Technical Appendix 6.3 Sediment Plume Modelling). This modelling was applied to dredging at any tidal state, giving values estimated to be twice that which would occur following adoption of tidal state restrictions. Only TBT was found to exceed the EQS values for concentrations in water outside the site boundary, but for a very small plume area beyond the eastern breakwater only (Figures 7.1 to 7.15 of Technical Appendix 6.3). Considering the nature of water movement this is expected to be further diluted.

9.9.30 The dissolution of some contamination into the aqueous phase will reduce levels of contaminants bound within sediments, meaning that the actual concentrations of contaminants within deposited sediments would be lower than they were in the pre-dredged sediment. There is however, no estimation of the concentrations for the deposited sediments. However, the modelling of sediment dispersion and deposition (Technical Appendix 6.3) indicates very limited deposition outside the site boundary. In the areas within the mapped 'maerl in sediments' and 'live maerl over dead maerl' areas close to the Eastern Breakwater where up to a 10 mm layer of sediment deposition is modelled as a very worst-case scenario

[114] Tillin and Watson, 'Mediomastus Fragilis, Lumbrineris Spp. and Venerid Bivalves in Circalittoral Coarse Sand or Gravel'.
[115] De-Bastos, Marshall, and Watson, 'Kurtiella Bidentata and Thyasira Spp. in Circalittoral Muddy Mixed Sediment'.
[116] JNCC, 'Mediomastus Fragilis, Lumbrineris Spp. and Venerid Bivalves in Circalittoral Coarse Sand or Gravel - JNCC Marine Habitat Classification'.

most maerl was found to be dead. Where live maerl is present some contamination may occur but it is expected to be highly localised, and reducing due to water movements between dredging campaigns. The magnitude of impact is therefore, considered to be **low**.

Value/Sensitivity of Receptor

9.9.31 Biotopes (including protected biotopes) identified within the deposition footprint (but outside the dredge pocket) have low sensitivity to incidental spills of hydrocarbon, PAH heavy metal contamination[117]. They are considered to have a **low** sensitivity/value in relation to this impact pathway.

9.9.32 No subtidal seagrass meadows are within the modelled sediment deposition footprint. Whilst this habitat type is sensitive to heavy metal and organic chemical contamination, there is no pathway for impact and so the overall sensitivity/value rating is **low**.

9.9.33 The evidence on the sensitivities of maerl habitat to contamination is generally limited to assessing the acute impacts of contamination via uncontrolled releases or incidental spills rather than chronic impacts associated with long term exposure to contaminated sediments, and the habitat type is thought to be highly sensitive with low resistance and very low recoverability[118] in relation to acute exposure. On a precautionary basis is it assumed that maerl is sensitive to contamination from a range of pollutants and overall value/sensitivity is therefore considered to be **medium**.

Significance of Effect

9.9.34 Given the **low** magnitude of impact and **medium** sensitivity/value rating of the various benthic ecological receptors to deposition of contaminated sediments, the overall significance of effect is considered to be **Minor Adverse** and therefore **not significant**.

Introduction and/or spread of marine invasive non-native species

Description of Impact

9.9.35 See Paragraph 9.9.3 Point 7.

Magnitude of Impact

9.9.36 Whilst most non-native species are unlikely to become invasive, those that do can out-compete native species and introduce diseases which could result in significant changes to community composition, species diversity and mortality.

9.9.37 The construction phase involves the introduction of equipment and new materials into the harbour, including steel and concrete piles, concrete revetment and repairs to existing wharf structures (Chapter 4: Proposed Development Description).

9.9.38 The placement of materials in the marine environment is recognised as a potential route for the introduction of INNS. If they are transferred from a different marine environment and have not been decontaminated prior to placement there could be fauna, including INNS, present. However, for the proposed development the materials required during the construction period, piles and concrete structures, will not originate from the marine environment and there is therefore a negligible risk of introducing INNS.

9.9.39 Biofouling, which occurs when marine organisms attach to, or settle on, submerged surfaces such as ship hulls, buoys, and piers is a common route for the transportation of INNS to unaffected areas. Exposed surfaces on vessels and project materials can become colonised by biofilms and microorganisms, which in turn facilitate the establishment of larger organisms such as barnacles, seaweeds, encrusting bryozoans, and molluscs, many of which are recognised as MNNS in the North Sea.

9.9.40 Ballast water, used by ships and vessels to maintain stability, control trim, manage weight, and reduce stress during long voyages, can also be a route for the transport of non-native species. If ballast water is collected in one location and discharged in another, it can transport organisms, particularly larval stages, to new areas. It is estimated that over 25% of INNS in British waters have been introduced through ballast water. The discharge of untreated ballast water or sediment into different geographic locations can lead to the establishment of harmful aquatic organisms and pathogens, posing a threat to native marine species and habitats.

9.9.41 However, the potential impact of the introduction of INNS via vessel hull or ballast water and through the introduction of new material for the proposed development is considered unlikely and can be scoped out due to the implementation of the following best practice control and management measures prior to construction:

- The production of a Biosecurity Risk Assessment and Plan, as part of the CEMP that shall be developed for the proposed development prior to construction. This document will reference the Biosecurity Plan produced by Falmouth Harbour for a Biosecurity Plan for the Falmouth Haven Marina and Boat Park[119];
- All project vessels will adhere to the International Maritime Organisation (IMO) Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (Biofouling Guidelines 2011);
- All project vessels shall adhere to the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention); and
- In the event any material introduced into the marine environment, and is derived from the marine environment, it will be from a suitable source or will have been cleaned to ensure no marine INNS can be introduced.

9.9.42 Where INNS species are already present, disturbance via activities such as demolition or dredging have the potential to disperse organisms which could be transported to other locations. For example, the Harpoon weed, Asparagopsis armata, is thought to be able to reproduce via vegetative means. However, most species observed spread via larval stages and not through direct physical disturbance to adults and this pathway is not considered a likely risk. Disturbance from construction activities can also open up space, and INNS are likely to colonise more rapidly than native species. However, the species observed are known to be already present in the area.

9.9.43 These measures minimise the potential for the introduction and/or spread of INNS and the magnitude of the impact from the project is considered to be **low.**

Value/Sensitivity of Receptor

9.9.44 Sensitivity to the impact of INNS varies between habitats and the vulnerability of individual species associated with them. Whilst most non-native species are unlikely to become invasive, those that do can out-compete native species and introduce diseases which could result in significant changes to community composition, species diversity and mortality. The maerl habitat, which is a designating feature of the SAC, and is in close proximity to the proposed development, is considered particularly sensitive to the presence of the invasive slipper limpet as this species creates sediment that can disrupt existing benthic communities and clog the feeding or respiratory apparatus of some invertebrate species. Whilst this species has been recorded in the Fal it has not been observed in great densities.

Significant of Effect

9.9.45 Given the **low** magnitude of impact and **high** sensitivity/value rating of the maerl bed to INNS, the overall significance of effect is **Minor Adverse** and therefore **not significant**.

Fish Ecological Communities

9.9.46 The assessment of potential effects on fish and shellfish ecological communities considers impacts and effects on the fish and shellfish themselves (the animals and communities). Impacts and effects on the commercial fisheries and shellfisheries that target the commercial fish and shellfish species present in the Fal are presented in Chapter 10: Commercial Fisheries and Shellfisheries.

[117] H Tyler-Walters, K.A Lloyd, and A Watson, 'Mediomastus Fragilis and Cirratulids in Infralittoral Mixed Sediment.', in *Marine Life Information Network: Biology and Sensitivity Key Information Reviews* (Plymouth, UK, 2023), https://www.marlin.ac.uk/habitat/detail/1260.

[118] F Perry, H Tyler-Walters, and H Watson, 'Maerl Beds', Marine Biological Association of the United Kingdom, 2024, https://www.marlin.ac.uk/habitat/detail/255.

[119] Information available from: https://www.falmouthharbour.co.uk/environment/guidance/

Habitat Removal and Disturbance

Description of Impact

9.9.47 See Paragraph 9.9.3, point 0.

Magnitude of Impact

9.9.48 The area of lost habitat within the dredge pocket is not considered to represent a significant demersal spawning ground for fish ecological receptors. This, coupled with the availability of equivalent habitats in the near vicinity, means that the magnitude of impact of the removal of habitat through dredging on fish ecological receptors would be **low**.

9.9.49 There are classified beds for shellfish harvesting 700 m north west and 1.4 km north east of the dredge pocket. No significant aggregations of bivalves were observed during either of the two DDV studies undertaken at the site and so the area of impact is not considered to be an important shellfish habitat. The magnitude of impact on this receptor would be **low**.

Value/Sensitivity of Receptor

9.9.50 There is a lack of higher value fish and shellfish species associated with habitat that has the potential to be removed or disturbed within the footprint of the project. Demersal spawning grounds and classified beds for shellfish are found outside of the dredged footprint. Protected species such as the long snouted seahorse are recorded rarely within the estuary and located away from the potential area of effect. Overall, fish and shellfish are considered to have low ecological importance due to their value on a local scale.

Significance of Effect

9.9.51 The low importance and the low magnitude of impact means that the overall effect of habitat removal and disturbance on the fish and shellfish community of the study area (including migratory species, non-migratory species and shellfish communities) is **Negligible Adverse** and **not significant**.

Elevated Suspended Sediment Concentrations

Description of Impact

9.9.52 See Paragraph 9.9.3 point 0.

Magnitude of Impact

9.9.53 Sediment plume modelling of the dredging operations showed that predicted peak increases in SSC would be elevated at the dredging locations and in the vicinity of the site up to 300 m west of the site and up to 900 m east of the site (worst-case), at which point the peak increases in concentrations fall below 1 mg/l. Although temporary spikes of SSC can be high (peak SSC increases in the region of 200 mg/l above baseline), these are within the site boundary and predominantly within the proposed dredge area. Short-term increases in SSC outside of the site boundary would be comparable to naturally higher turbidity conditions, such as during stormy conditions, where SSC can be elevated to above 100 mg/l.

9.9.54 SSC concentrations are predicted to fall to baseline levels within a few hours of dredging activities commencing. Dredging operations are scheduled to take approximately 20 weeks at the Western Wharf, 18 weeks at the Northern Wharf (including Queen's Wharf extension) and 20 weeks at the FLOW Deck. The restriction of dredging to flood tide only (minus 1.75 hours) greatly minimises the spatial extent of this plume to close to the site boundary.

9.9.55 The sediment plume modelling shows that elevated SSC as a result of dredging will be away from known shellfish grounds within the estuary, the classification zones for shellfish to the east of the works being over 1.5 km from the proposed development. Shellfish classification zones are also found 750 m to the north-west of the proposed development. However, due to the hydrodynamics at this location, the sediment plume from the dredging doesn't extend as far to the west (i.e <500 m). The sediment plume may overlap areas of crabs and lobsters, such as slightly north of the mouth of the Fal estuary, close to Pendennis Point. Despite this, SSC concentrations at these locations will be low and would not represent a significant change from ambient.

9.9.56 The modelled sediment plume is not considered to extend far enough to represent a barrier to fish migration within the Fal estuary.

9.9.57 Overall, the magnitude of impact is considered to be **low**.

Value/Sensitivity of Receptor

9.9.58 Individuals of fish and shellfish within the estuary will experience regular changes in fine sediments due to natural variability, such as from tidal currents and storms. Other mobile species would be able to avoid areas of high increases in SSC and due to the sediment being elevated within the site boundary.

9.9.59 Fish and shellfish communities within the study area considered to have **low** importance due to their ecological value on a local scale.

Significance of Effect

9.9.60 The low importance and low magnitude of impact means that the overall effect of habitat suspended sediment concentrations on the fish and shellfish community of the study area (including migratory species, non-migratory species and shellfish communities) is **Negligible Adverse** and **not significant**.

Suspended Sediment Deposition

Description of Impact

9.9.61 See Paragraph 9.9.3 point 4.

9.9.62 Suspended sediment concentrations (SSC) and subsequent deposition as a result of the proposed dredging could transport sediment to nearby shellfish fisheries. There are not considered to be any important demersal spawning grounds within the study area (such as herring and sandeel) which are at risk from sediment deposition. Mobile species such as diadromous fish are not at risk from sediment deposition and have not been considered further.

Magnitude of Impact

9.9.63 Due to the dredging only occurring on an adjusted flood tide (late ebb tide and early flood tide), the rate of sediment released is roughly halved compared to other scenarios. Up to a few tens of centimetres of sediment deposition is predicted up to 150 m west of the site boundary and up to 50 mm of deposition (worst-case) is predicted in a localised area at the end of the eastern breakwater. Outside of these areas the predicted sediment deposition is of up to 5 mm, declining to less than 1 mm at distances of 370 m (west of the site), and 300 m (east of the site).

9.9.64 The distances over which sediment will be deposited will avoid the nearby shellfish classification zones, where native oysters, blue mussels, and scallops are known to be present. These are 750 m to the north-west of the proposed development and over 1.5 km to the east. There will be very limited deposition in the mouth of the Fal estuary, close to Pendennis Point, where crabs (velvet swimming and edible) and lobsters are also known to be present.

9.9.65 Overall, the magnitude is considered to be **low**.

Value/Sensitivity of Receptor

9.9.66 Individuals within the estuary will experience regular deposition of sediments due to natural variability, such as from tidal currents and storms. Species such as native oyster, blue mussel, and edible crab have a high tolerance of sediment concentration increases and subsequent deposition[120]. Species which are mobile, such crabs and lobsters, are able to escape low levels of sediment deposition, such as changes of 1-2 mm which are anticipated as a result of the planned dredging operations.

9.9.67 Fish and shellfish communities within the study area considered to have **low** importance due to their value on a local scale.

[120] Perry, F.,, Jackson, A., Garrard, S.L.,, Williams, E. & Tyler-Walters, H., 2023. Ostrea edulis Native oyster. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 08-04-2025]. Available from: https://marlin.ac.uk/species/detail/1146

Significance of Effect

9.9.68 The low importance and low magnitude of impact means that the overall effect of sediment deposition on fish and shellfish communities of the study area (particularly nearby shellfish species) is **Negligible Adverse** and **not significant**.

Underwater Noise and Vibration

Description of Impact

9.9.69 See Paragraph 9.9.3 point 0.

Magnitude of Impact

9.9.70 Anthropogenic underwater noise and vibration would be generated during the demolition and construction stage of the proposed development, primarily from the following:

- Demolition of the existing Northern Arm using a hydraulic hammer;
- Capital dredging for the new berths using a backhoe dredger to increase below-keel water depth adjacent to the docks; and
- Pile driving (piling) to install the new wharf structures.

9.9.71 Work by Popper *et al*. 2014[121] and Popper & Hawkins[122] forms the main guidance documents for assessing the impact of anthropogenic sound on fish. There are differences in the auditory capabilities across the different species of fish depending on their physiology and presence of auditory structures[123]. Popper *et al.* divided fish into three hearing sensitivity groups, and an additional group for fish eggs and larvae, based on these factors. A summary of these groups, including typical species that are associated with each group, is presented in Table 9.10

9.9.72 The baseline indicates the presence of migratory trout and European eel within the estuary, both species are of conservation importance, although in relatively low numbers. These species have the potential to be affected by underwater sound, which can act as a barrier to their migration in a semi-enclosed environment. These species are a Category 2 species, meaning they are sensitive to particle motion and barotrauma.

9.9.73 Herring has been recorded within the study area, but only very rarely. This species is also not specifically tied to important spawning and nursery grounds in the study area. This is also true of shad species, for which the last record of these species occurring in the estuary was a single twaite shad recorded on the ERCCIS database in 2007. These species are classified as having Category 3 hearing, but due to their limited presence within the study area and overall importance, have not been considered in detail.

Table 9.10 Grouped hearing capabilities of fish (adapted from Popper et al.)

Group	Response Parameters	Associated Species
1	Fish lacking swim-bladders that are only sensitive to particle motion (kinetic energy of sound) and respond to only a narrow band of frequencies.	All flatfish, lamprey and elasmobranchs (sharks, skates & rays).
2	Fish with swim-bladders, but in which hearing does not involve the swim bladder. These species are only sensitive to particle motion but can be impacted by barotrauma.	Trout, mackerel, European eel, pipefish.
3	Fish with specialist structures linking the swim-bladder to the ear. These fish are primarily sensitive to sound pressure but may detect particle motion. They have a wide frequency range and are the most sensitive group.	Clupeids (herring, sardines & pilchard), cod, bass and shad.

[121] Arthur N. Popper et al., *ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI-Accredited Standards Committee S3/SC1 and Registered with ANSI*, 1st ed. 2014, SpringerBriefs in Oceanography (Cham: Springer International Publishing : Imprint: Springer, 2014), https://doi.org/10.1007/978-3-319-06659-2.

Table 9.10 Grouped hearing capabilities of fish (adapted from Popper et al.)

Eggs /Larvae	Fish eggs and larvae may contain gas bubbles/developing swim bladders, rendering them susceptible to barotrauma.

9.9.74 The guidance also offers sound levels at which impulsive (e.g. pile driving) and non-impulsive (e.g. dredging) sound may cause mortality or potential mortal injury or recoverable injury (this includes injuries such as hair cell damage, minor internal or external hematoma, none of which are likely to result in mortality). The criteria are based on sound pressure as no information on the particle motion proportion of the potential impact exists. Table 9.11 presents the criteria for impulsive noise sources (pile driving) and the criteria for non-impulsive (continuous) sources are presented in Table 9.12. Thresholds of behavioural and masking response are not available for non-impulsive source; the behavioural responses are classified according to a relative risk rating as being either High, Moderate or Low with distances defined in relative terms as Near, Intermediate and Far.

Table 9.11 Impact pile driving criteria for fish

Category	Mortality / Potential Mortal Injury	Recoverable Injury	TTS	Masking	Behaviour
1 (No swim bladder)	>219 dB SEL_{cum} OR >213 dB SPL_{peak}	>216 dB SEL_{cum} OR >213 dB SPL_{peak}	>>185 dB SEL_{cum}	N: Moderate I: Low F: Low	N: High I: Moderate F: Low
2 (Swim bladder not involved in hearing)	210 dB SEL_{cum} OR >207 dB SPL_{peak}	>203 dB SEL_{cum} OR >207 dB SPL_{peak}	>186 dB SEL_{cum}	N: Moderate I: Low F: Low	N: High I: Moderate F: Low
3 (Swim bladder involved in hearing)	207 dB SEL_{cum} OR >207 dB SPL_{peak}	203 dB SEL_{cum} OR >207 dB SPL_{peak}	186 dB SEL_{cum}	N: High I: High F: Moderate	N: High I: Moderate F: Low
Eggs & Larvae	210 dB SEL_{cum} OR >207 dB SPL_{peak}	Near: Moderate Risk Intermediate: Low Risk Far: Low Risk	N: Moderate I: Low F: Low	N: Moderate I: Low F: Low	N: Moderate I: Low F: Low

Notes: Peak and Root Mean Square (RMS) level dB re 1 µPa; Sound Exposure Level (SEL) dB re 1 µPa²s; SEL_{cum} = Cumulative sound exposure level accumulated over a 24 hr period assuming stationary animals. SPL_{peak} = Peak sound pressure level. Relative risk (high, moderate, low) is given for animals at three distances defined in relative terms as Near (N), Intermediate (I) and far (F).

Table 9.12 Non-impulsive (continuous) noise impact criteria for fish

Category	Mortality / Potential Mortal Injury	Recoverable Injury	TTS	Masking	Behaviour

[122] Popper, A.N. and Hawkins, A.D. 2018. 'The Importance of Particle Motion to Fishes and Invertebrates', *The Journal of the Acoustical Society of America* 143, no. 1 (January 2018): 470, https://doi.org/10.1121/1.5021594.

[123] Anthony D. Hawkins and Arthur N. Popper, 'A Sound Approach to Assessing the Impact of Underwater Noise on Marine Fishes and Invertebrates', ed. Howard Browman, *ICES Journal of Marine Science* 74, no. 3 (1 March 2017): 635–51, https://doi.org/10.1093/icesjms/fsw205.

Table 9.12 Non-impulsive (continuous) noise impact criteria for fish

1 (No swim bladder)	N: Low I: Low F: Low	N: Low I: Low F: Low	N: Moderate I: Low F: Low	N: High I: High F: Moderate	N: Moderate I: Moderate F: Low
2 (Swim bladder not involved in hearing)	N: Low I: Low F: Low	N: Low I: Low F: Low	N: Moderate I: Low F: Low	N: High I: High F: Moderate	N: Moderate I: Moderate F: Low
3 (Swim bladder involved in hearing)	N: Low I: Low F: Low	170 dB RMS for 48 hrs	158 dB RMS for 12 hrs	N: High I: High F: High	N: High I: Moderate F: Low
Eggs & Larvae	N: Low I: Low F: Low	N: Low I: Low F: Low	N: Low I: Low F: Low	N: High I: Moderate L: Low	N: Moderate I: Moderate F: Low

Notes: RMS sound pressure levels dB re 1 µPa. All criteria are presented as sound pressure (even for fish without swim bladders) as no data for particle motion exist. Relative risk (high, moderate, low) is given for animals at three distances defined in relative terms as Near (N), Intermediate (I) and far (F).

9.9.75 Drawing on the construction methodology (set out in ES Chapter 5: Demolition and Construction), ES Chapter 7: Underwater Noise, and the description of the different hearing sensitivities and impact thresholds, Table 9.14 describes the magnitude of impact from each of the three noise-generating activities, based on the four modelled locations (Table 9.13). These locations have been chosen as they represent the worst-case scenario. Whilst a small increase in vessel movements during the demolition and construction stage would generate underwater noise, this would be non-impulsive and within an estuary with existing ambient shipping noise - as such the demolition and construction activities modelled are considered to be the worst-case noise-generating activities (Table 9.13). The modelling also does not allow for the presence of existing and new structures 'shielding' any noise.

Table 9.13 Noise activities modelled at each location

Location	Name	Activities modelled
1	Northern Arm	Demolition with hydraulic hammer
2	Western Wharf	Backhoe dredging Percussive pile driving with soft start
3	Queens wharf	Percussive piling with soft start
4	FLOW deck	Backhoe dredging Percussive pile driving with soft start

Table 9.14 Magnitude of impact justification for the various noise-generating activities associated with the demolition and construction stage

Attribute	Description
Demolition	
Source Level	Various demolition activities/methodologies will be required to remove the existing Northern Arm. The Underwater Noise Modelling report has identified that the loudest of these will be the use of a hydraulic hammer to break up any underwater structure that remains after cutting and block removal has been completed. The SEL source level for this activity has been taken to be 192 dB re 1µPA² (assumed to be used at 5 strikes per second) for up to 1 hr in any 24 hr period.
Duration	This activity would be short-term and temporary. Chapter 5: Demolition and Construction states that demolition of the Northern Arm is estimated to take 12 weeks, with a hydraulic hammer in use for only 1 hr without pause within a 24 hr period. Demolition would not occur overnight.
Magnitude of Impact	Category 2 Fish (Swim bladder not involved in hearing – e.g. sea trout and European eel): • TTS threshold exceeded within 3,300 m of Location 1 (Northern Arm) for fish remaining in place. • In a fleeing fish scenario, TTS threshold exceeded within 400 m for fleeing fish. • Recoverable injury occurs within 160 m for stationary fish and is not predicted for fleeing fish. • Mortality predicted within 60 m for stationary fish, not predicted for fleeing fish. Noise generated from Location 1 has been modelled to propagate north-east from the source. It does not extend past the deepwater channel into Carrick Roads (Figure 9.15) and is considered to avoid the main upstream migration of both trout and European eel in the estuary. The magnitude of this impact is considered to be **low** as the noise will only occur occasionally for short periods (i.e. 1 hr within a 24 hr period), allowing fish to return to areas of disturbance once the demolition works have been completed for that daily period, whilst also allowing migration to continue freely outside of these timings.
Dredging	
Source Level	A backhoe dredger will be used for the capital dredging, to reduce the sediment mobilisation caused during dredging. The noise propagation modelling has used a worst-case SPL_{rms} sound source level of 175 dB re1µPa, generated continuously for up to 24 hrs/day. In practice, some of the dredging activity noise generated could be quieter, and dredging would occur on an adjusted flood tide only to minimise potential impacts on locally protected maerl habitats (and therefore not 24 hours per day). Accordingly, the effects assessed are a worst-case scenario as the 24-hour exposure modelled is significantly higher than will occur.

Table 9.14 Magnitude of impact justification for the various noise-generating activities associated with the demolition and construction stage	
Timing /Duration	This impact would be short-term and temporary. The estimated duration of dredging operations in each area of the site is as follows: • Western Wharf: 20 weeks; • Northern Wharf & Queen's Wharf: 18 weeks; and • FLOW Deck: 20 weeks Dredging activities will be restricted to flood tide (-1.75 hrs) to minimise the potential for sediment dispersion. This has the secondary benefit of meaning that there will be at least 12 hours per day where no dredging activities occur. As shown in Chapter 5: Demolition and Construction, dredging of one area of the site and piling in another area of the site could occur concurrently. In this event, the non-impulsive noise generated by dredging would be masked by the impulsive sound generated by piling. Accordingly, the underwater noise modelling for percussive piling described below remains a worst-case.
Magnitude of Impact	Impacts on fish for continuous noises, such as that generated by backhoe dredging, are based on the RMS sound pressure level. Neither the TTS nor recoverable injury threshold is exceeded for dredging operations for either Location 2 or Location 4. Underwater noise generated by the dredging activities is not considered to be above ambient, compared to noise from other large vessels operating within the study area. The magnitude of the impact is considered to be **low**.
Pile Driving	
Source Level	The piles proposed to be used as part of the proposed development are up to 1.32 m in diameter and will initially be installed by vibro-piling to reduce noise generation, but it is assumed that impact piling (with a hammer energy of 300 kJ) will be used to drive the piles to target depth. The source level from this activity is modelled at 210 re 1µPa^2, assuming 3% sound conversion efficiency (the proportion of the hammer energy that is converted to sound energy). The duration of this activity is taken to be 4 hrs within 24 hrs (with a strike rate of 0.67 strikes per second). This is based on an assumption that two piles could be installed per day, each with approximately 6 hr total installation time of which 4 hrs is percussive piling. A soft-start procedure shall take place, whereby the initial sound source level is increased over 20 minutes to the maximum value. This has been included as an embedded mitigation measure for marine mammals, as part of the JNCC 2010 guidance for minimising the effects of impact piling.

Table 9.14 Magnitude of impact justification for the various noise-generating activities associated with the demolition and construction stage	
Timing /Duration	This impact is considered to be short term and temporary. Duration of piling works for the construction of the various wharfs is estimated as follows: • Western Wharf: 16 weeks; • Northern Wharf: 9 weeks; • Queen's Wharf extension: 5 weeks; and • FLOW Deck: 20 weeks. Only one piling rig will be operated at a time. Demolition and piling would not occur concurrently. There will be downtime whilst the piling rig moves to the next pile location. No piling will occur overnight. Up to 4 hours of percussive piling would occur per day. Figure 9.16 and Figure 9.17 show the maximum modelled distance to impact threshold for impact piling using a soft-start, for stationary and fleeing fish respectively. Percussive piling would occur only in one location at any given time, however, for illustrative purposes Figure 9.16 and Figure 9.17 overlay the exceedances for impact piling using a soft-start at all three of the modelled locations (Locations 2 (northern-most point on Western Wharf), 3 (Queen's Wharf) and 4 (FLOW Deck)), to show the maximum modelled distance to impact threshold. Refer to Technical Appendix 7.1 for all model outputs.
	For Category 2 fish, the maximum modelled distance to impact threshold for impact piling using a soft-start, at each of the three modelled locations, is as follows: Category 2 Fish (Swim Bladder involved in hearing): • TTS threshold exceeded within 4,100 m of source for fish remaining in place. Threshold exceeded within 1,500 m for fleeing fish. • Recoverable injury threshold exceeded for fleeing fish within 660 m and within 1,700 m for stationary fish. • Mortality threshold exceeded within 650 m for fleeing fish, 940 m for stationary fish.

Table 9.14 Magnitude of impact justification for the various noise-generating activities associated with the demolition and construction stage

Magnitude of Impact	For stationary fish (Figure 9.16), impact piling with soft-start at Locations 2 and 3 is predicted to cause noise levels exceeding the mortality threshold across the entirety of the entrance to the upper river Penryn. For impact piling with soft-start at Locations 2 and 3, TTS thresholds extend across to the other side of the main Fal estuary at St Mawes. Impact piling with soft-start at Location 4 is predicted to lead to threshold exceedances to the west of the Dock structure only, not extending eastwards to the main Fal estuary. A soft-start has been proposed, meaning that the sound intensity of the piling will be slowly ramped up over time. This approach has been included within the modelling above. This will allow mobile fish species to exhibit a behavioural response prior to any TTS, recoverable injury, or mortality of species. Salmonids (such as sea trout) demonstrate a startle response to sound and will change their direction of swimming to avoid areas of higher sound intensity[124]. For these species, a fleeing response is considered applicable and has been modelled, whereby the mobile fish species move away from the sound source (Figure 9.17). For impact piling with soft-start at all three modelled locations, the potential for mortality and recoverable injury in Category 2 fish species is limited to close to the proposed development (behind the existing wharf structures), whilst TTS does not extend eastwards to the main Fal estuary. Species such as trout and European eel are likely to avoid the area of effect once the soft-start is implemented for the piling. During this period of avoidance, these species are unlikely to continue their migrations through the estuary. Despite this, the impact piling is only planned for four hours a day and only in daylight hours. This will allow time for European eel and trout to continue their migrations outside of these periods. Sea trout migrations, mostly downstream movements of smolt, predominantly occur at night and therefore are more likely to avoid these periods of piling[125]. Silver eels are also known to migrate at night, during increased water flow velocities, although this is dependent on peak tidal currents[126]. Overall, mobile fish species, such as migratory trout and European eel are likely to avoid areas of noise disturbance during impact piling operations. If the fish is fleeing, then fish can continue to move within the main channel of Carrick Roads. The impact piling will also be short term and temporary meaning once the piling has stopped, fish will be able to return to these areas or continue migrations through the estuary. Although there will be some behavioural disturbance, the magnitude of impact on mobile fish receptors is **medium.**

Table 9.14 Magnitude of impact justification for the various noise-generating activities associated with the demolition and construction stage

	A number of sedentary fish species also occur within the study area, such as the shellfish, native oysters, variegated (queen) scallops, blue mussel, crabs, and lobster. Due to the sedentary nature of these species, they would be unable to avoid underwater noise disturbance during the construction stage. Despite this, due to the physiology of these species, studies have shown that these species have a low sensitivity to noise and any potential effects will be limited to within a few metres of a sound source[127,128]. The nearest classification zone for shellfish is 700m to the north-west of the proposed development, whilst crabs and lobsters occur hundreds of metres away (closer to Carrick Roads and the main channel of the Fal Estuary). These fisheries are not considered to be disturbed by underwater noise produced during the construction stage, particularly given their low sensitivity to underwater sound. The magnitude of this impact on shellfish and sedentary fish species is **low.** Seahorses are known to occur within the study area, although they are rare and have only been recorded in low numbers. A long-snouted seahorse was most recently recorded on the ERCCIS database with an observation in 2022 from the seagrass meadow off Flushing in 2022, within 2 km of the proposed development. These species have a swim bladder and have generalist hearing, being able to detect particle motion and sound pressure components[129]. They are therefore at risk from disturbance to underwater sound. The underwater sound modelling indicates potential for the impact pilling to result in TTS in individuals of seahorse at the Flushing beach location. These species are away from potential mortality or recoverable injury. Although the impact piling has been assessed as occurring for four hours in a 24-hour period (up to 4 hours of percussive piling would occur per day), this will include down-time between the installation of each pile as the piling rig manoeuvres between each pile. This allows time for the effects to any individuals from TTS to reverse. Furthermore, given the low number of seahorses present and the very rare occurrence of this species, it is unclear whether these individuals are resident close to the proposed development or elsewhere in the estuary itself. Overall, the magnitude of this impact on seahorse species is **low.**

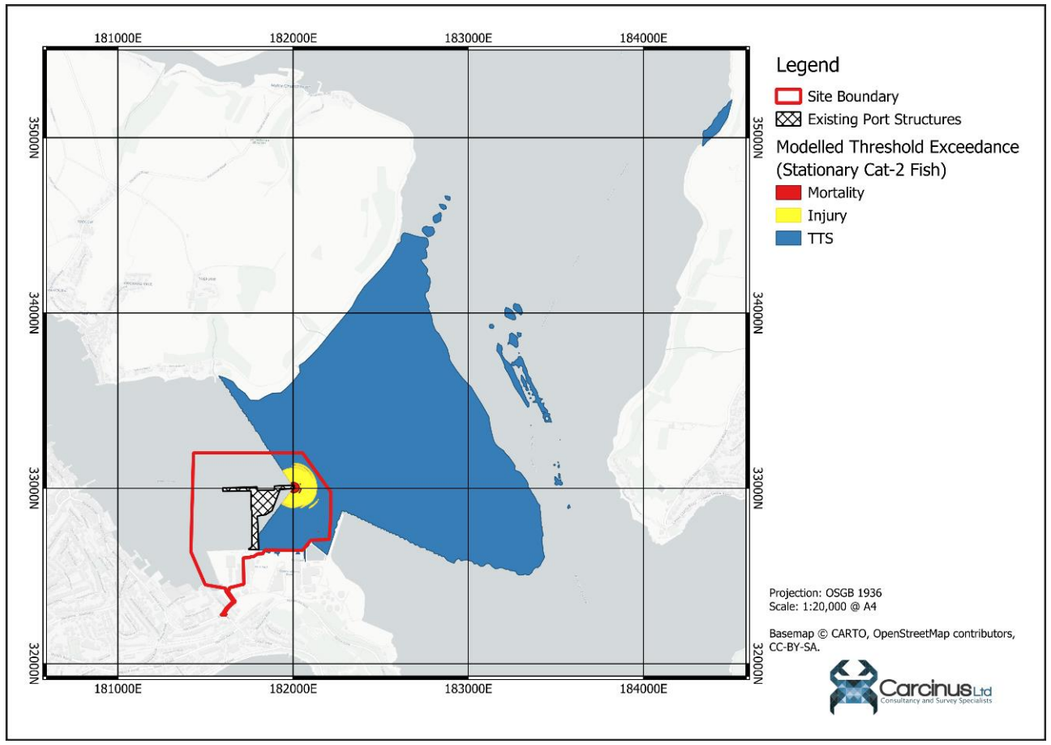

Figure 9.15 Stationary Category 2 noise threshold exceedance as a result of using the Hydraulic Hammer (at Northern Arm).

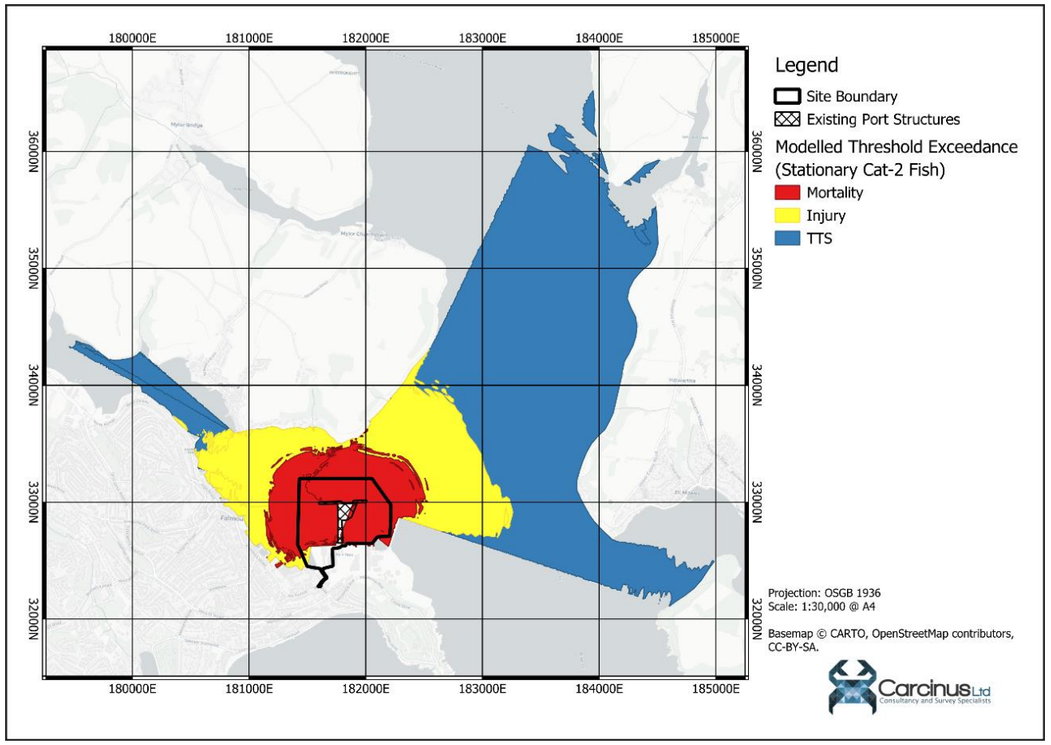

Figure 9.16 Stationary Category 2 noise threshold exceedance as a result of impact piling operations. All three modelled locations overlaid[130].

[124] Oppedal, F., Barrett, L.T., Fraser, T.W., Vågseth, T., Zhang, G., Andersen, O.G., Jacson, L., Dieng, M.A. and Vindas, M.A., 2025. The behavioral and neurobiological response to sound stress in salmon. Brain Behavior and Evolution, 100(1), pp.11-28.
[125] Moore, A., Ives, M., Scott, M. and Bamber, S., 1998. The migratory behaviour of wild sea trout (Salmo trutta L.) smolts in the estuary of the River Conwy, North Wales. Aquaculture, 168(1-4), pp.57-68.
[126] Verhelst, P., Westerberg, H., Coeck, J., Harrison, L., Moens, T., Reubens, J., Van Wichelen, J. and Righton, D., 2023. Tidal and circadian patterns of European eel during their spawning migration in the North Sea and the English Channel. Science of the total environment, 905, p.167341.
[127] Spiga, I., Cheesman, S., Hawkins, A., Perez-Dominguez, R., Roberts, L., Hughes, D., . . . Bentley, M., 2012. Understanding the Scale and Impacts of Anthropogenic Noise upon Fish and Invertebrates in the Marine Environment. SoundWaves Consortium Technical Review, ME5205.
[128] Wale, M., Simpson, S. and Radford, A., 2013. Size dependent physiological responses of shore crabs to single and repeated playback of ship noise. Biology Letters, 2.
[129] Palma, J., Magalhães, M., Correia, M. and Andrade, J.P., 2019. Effects of anthropogenic noise as a source of acoustic stress in wild populations of Hippocampus guttulatus in the Ria Formosa, south Portugal. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *29*(5), pp.751-759.
[130] Percussive piling would occur only in one location at any given time, however, for illustrative purposes this figure overlays the exceedances for impact piling using a soft-start at all three of the modelled locations.

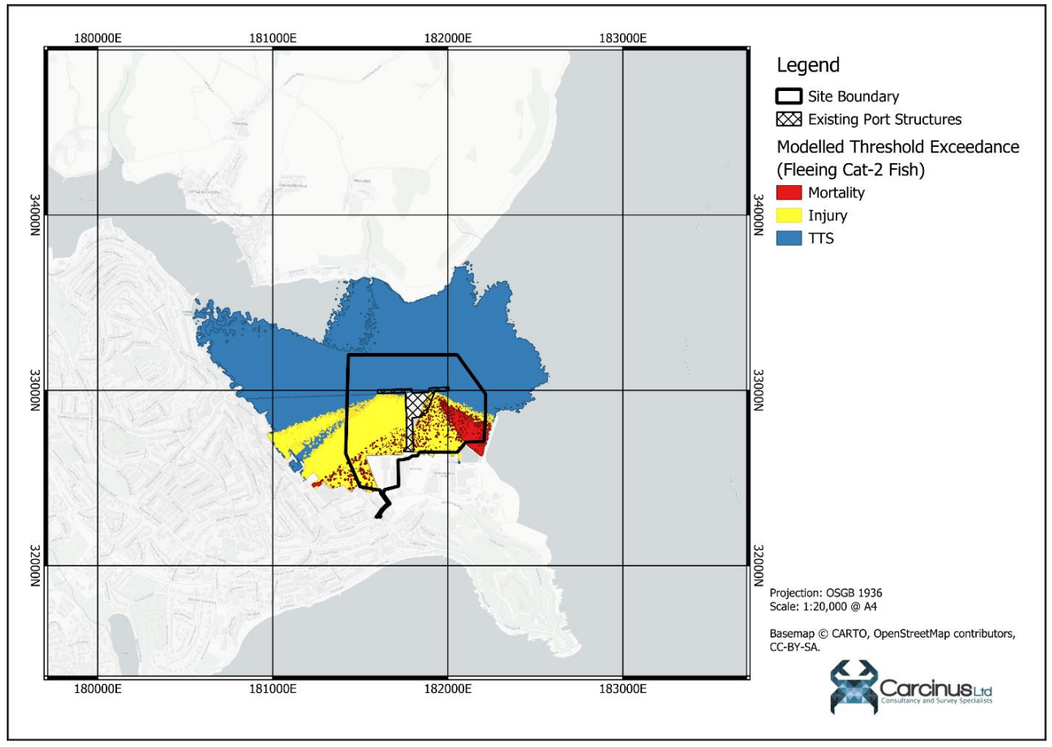

Figure 9.17 Fleeing Category 2 noise threshold exceedance as a result of impact piling operations. All three modelled locations overlaid[130].

Value/Sensitivity of Receptor

9.9.76 The value and sensitivity of the various fish species has been determined from conservation status and professional judgement to give a final classification for the purposes of determining significance of effect as per Table 9.4.

9.9.77 Migratory fish species found within the study area include sea trout and European eel. Both species are listed as species of principal importance in Section 41 of the NERC Act 2006, however, within the study area they are not protected as part of a designated site. Given their low abundance, they are not considered to be important at a national or international level (i.e. only at a local level). Therefore, they have a **low** value within the study area.

9.9.78 Shellfish species are found throughout the estuary and are commercially important. This means that as a group they are considered to be of medium value. Despite this, they are not considered to be sensitive to underwater noise and so their sensitivity overall, is considered to be **low**. Seahorse are listed under section 9 of the Wildlife and Countryside Act 1981 but are not designated within the estuary. The rare occurrence of this species in Cornwall makes them of regional importance or **medium** value.

Significance of Effect

9.9.79 Demolition operations are considered to have a **low** magnitude of impact on fish, due to the noise only occurring occasionally for short periods of time, allowing fish to return to areas of disturbance once most of the demolition works have been completed. These areas of effect also avoid the upstream migration of both trout and eel in the main channel of the estuary. Given the **low** value of species affected, the overall significance of effect is considered to be **Negligible Adverse** and therefore **not significant**.

9.9.80 Dredging operations are considered to have a **low** magnitude of impact as impact thresholds are not exceeded for either Category 2 or 3 fish. Given the **low** value of fish receptors affected, the overall significance of effect is considered to be **Negligible Adverse** and therefore **not significant**.

9.9.81 Piling operations are considered to have a **medium** magnitude of impact to the migratory fish sea trout and European eel, but a **low** magnitude of impact to shellfish and other sedentary species, such as seahorses. Given the **low** (sea trout, European eel, and shellfish) to **medium** (seahorse) value/sensitivity of the receptors affected (i.e. such as shellfish, which are of medium value but low sensitivity to under water noise), the overall significance of effect resulting from impact pile driving, using soft-start procedures, will be **Negligible** to **Minor Adverse** and therefore **not significant**.

Marine Mammal Communities

<u>Habitat Removal and Disturbance</u>

Description of Impact

9.9.82 See Paragraph 9.9.3 point 0.

Magnitude of Impact

9.9.83 The total area of lost foraging habitat is very small and unlikely to represent a significant foraging habitat for marine mammals, given the existing and ongoing dock operations, which are likely to deter marine mammals away. Marine mammals frequently show wide foraging ranges and high mobility, and the magnitude of impact as a result of habitat loss resulting from the construction of the new wharf structures and removal of marine sediment will be **low**.

Value/Sensitivity of Receptor

9.9.84 Given the importance of marine mammals and the protection afforded them by national and international legislation, their nature conservation value is considered to be **high**.

Significance of Effect

9.9.85 Given the low magnitude of impact, the overall effect on marine mammals as a result of habitat loss and disturbance during the demolition and construction stage will be **Minor Adverse** and therefore **not significant**.

<u>Elevated Suspended Sediment Concentrations</u>

Description of Impact

9.9.86 See Paragraph 9.9.3 point 0.

Magnitude of Impact

9.9.87 Timeseries modelling of increases in SSC caused by dredging operations indicates that whilst temporary spikes of SSC can be high (in the region of 200 mg/l above baseline), the average increase across the sediment plume is within natural variability of the system, and the spikes are very transitory. SSC concentrations fall to baseline levels within a few hours of dredging activities commencing. Dredging operations are scheduled to take approximately 20 weeks at the Western Wharf, 18 weeks at the Northern Wharf (including Queen's Wharf extension) and 20 weeks at the FLOW Deck. Despite the fact that there would therefore be a daily spike in SSC during that time, the restriction of dredging to flood tide only (minus 1.75 hrs) greatly minimises the spatial extent of this plume, and it is expected to be within natural variation.

9.9.88 Dolphins are often recorded in Falmouth Bay but only occasional sightings of these species are recorded in the Fal Estuary (predominantly common dolphins *D. delphis*). Both species are recorded in the study area throughout the year, although densities of common dolphin inshore increases in winter months, compared to bottlenose dolphins where greater numbers are expected in the summer. Harbour porpoise *P. Phocoena* are also recorded throughout the year but have rarely been sighted in the estuary. Cetaceans such as harbour porpoise have been observed foraging in high turbidity environments[131][132]. It is unlikely that increased turbidity and murky water associated with increased SSC will adversely

[131] C. Pierpoint, 'Harbour Porpoise (*Phocoena Phocoena*) Foraging Strategy at a High Energy, near-Shore Site in South-West Wales, UK', *Journal of the Marine Biological Association of the United Kingdom* 88, no. 6 (September 2008): 1167–73, https://doi.org/10.1017/S0025315408000507.

[132] F Marubini et al., 'Habitat Preferences and Interannual Variability in Occurrence of the Harbour Porpoise Phocoena Phocoena off Northwest Scotland', *Marine Ecology Progress Series* 381 (17 April 2009): 297–310, https://doi.org/10.3354/meps07893.

impact marine mammal foraging ability. Although these conditions may compromise visual ability, marine mammals are able to use other senses to navigate their surroundings and the high mobility means they can avoid areas of high SSC. Given the very low number of marine mammals likely to be in close proximity of the proposed development, the small area where SSC will increase and the short and temporary nature of this release, the magnitude of impact is considered to be **low**.

Value/Sensitivity of Receptor

9.9.89 Given the importance of marine mammals and the protection afforded them by national and international legislation, their nature conservation value is considered to be **high**.

Significance of Effect

9.9.90 Given the **low** magnitude of impact, the overall effect on marine mammals as a result of elevated suspended sediment concentrations during the demolition and construction stage will be **Minor Adverse** and therefore **not significant**.

Underwater Noise and Vibration

Description of Impact

9.9.91 See Paragraph 9.9.3 point 0.

Magnitude of Impact

9.9.92 The key guidance document for understanding impacts from anthropogenic sound on marine mammals was Southall *et al*. (2007)[133]. Since the publication of this important book the research has been updated into widely accepted industry guidance giving sound level criteria for potential impacts of underwater sound, published by the National Oceanic and Atmospheric Administration (NOAA) in 2018[134] and updated as final in October 2024[135]. The updated 2024 NOAA guidelines have not been used in this instance as these have not yet been accepted by the JNCC. The thresholds for TTS and PTS provided in the 2018 report are for the most part, considered more precautionary, although any differences are relatively minor and are not considered likely to result in a change to impact assessment outcomes.

9.9.93 Southall *et al.* 2019[136] carried out a review of the weightings and thresholds in 2019 and recommended an update to naming conventions to better reflect hearing ranges. The naming conventions in Southall *et al*. (2019) have been used throughout this assessment. Table 9.15 presents the estimated functional hearing bandwidth for each of the marine mammal hearing groups proposed in Southall *et al.* 2019.

Table 9.15 Marine mammal hearing groups and generalised hearing ranges, adapted from NOAA, 2018[137] and Southall *et al.* 2019[136].

Hearing group	Mammals represented	Generalised hearing range (Hz)	
		Lower Limit	Upper Limit
Low-frequency cetaceans (LF)	Baleen whales	7	35,000
High-frequency cetaceans (HF)	Dolphins, toothed whales, beaked whales, bottlenose whales	150	160,000
Very high-frequency cetaceans (VHF)	True porpoises	275	160,000
Phocid pinnipeds (PW)	True seals	50	86,000

9.9.94 Building on the hearing ranges presented above, the NOAA guidelines also provide impact criteria based on SPL_{peak} using unweighted broadband values for both TTS and PTS thresholds (where PTS is calculated as 6 dB greater than TTS for each mammal hearing group). Impact thresholds for impulsive sounds are presented in Table 9.16 and those for continuous sounds are presented in Table 9.17. For impulsive sounds, both SPL_{peak} and SEL_{cum} are considered, and the worst-case (i.e. lowest value) is used in the assessment.

Table 9.16 Weighted impact criteria for marine mammal injury from impulsive sounds, adapted from NOAA, 2018[137] and Southall *et al*. 2019[136].

Hearing Group	TTS Threshold		PTS Threshold	
	SPL_{peak} (dB re 1 µPa)	SEL_{cum} (dB re 1 µPa²s)	SPL_{peak} (dB re 1 µPa)	SEL_{cum} (dB re 1 µPa²s)
LF Cetaceans	213	168	219	183
HF Cetaceans	224	170	230	185
VHF Cetaceans	196	140	202	155
PW in water	212	170	218	185

Table 9.17 Weighted impact criteria for marine mammal injury from continuous sounds, adapted from NOAA, 2018[137] and Southall *et al*. 2019[136].

Hearing group	TTS Threshold SEL_{cum} (dB re 1 µPa²s)	PTS Threshold SEL_{cum} (dB re 1 µPa²s)
LF Cetaceans	179	199
HF Cetaceans	178	198
VHF Cetaceans	153	173
PW in water	181	2021

9.9.95 In addition to injurious effects, anthropogenic sound has been observed to cause behavioural disturbance of marine mammals. Behavioural responses are much harder to adequately quantify as responses are variable and context dependent. The Southall *et al.* 2019[136] guidance uses a ranking system to assess the severity of the behavioural responses of marine mammals from 0 (no response) to 9 (outright panic, stranding events etc.). The more severe the response, the lower the amount of time the animals will tolerate the noise before they could be negatively impacted.

9.9.96 The behavioural response data presented in the Southall guidance is generally based on seismic air gun noise, which is concentrated below a frequency of ~ 1 kHz. The guidance identifies that low frequency cetaceans respond significantly to sounds above ~140 re 1 µPa (rms). Pile driving noise covers a broader frequency range and so the energy at lower frequencies will be less for the same broadband SPL. Data for pinnipeds, mid-frequency or high-frequency cetaceans is more limited and so a precautionary approach in determining sensitivities is used for EIA purposes. A threshold of 140 dB re 1 µPa (rms) is adopted to indicate the onset of low-level marine mammal disturbance effects for all mammal groups in response to impulsive sound. The threshold for higher level disturbance has been taken to be 160 dB re 1 µPa (rms) for impulsive sound. For continuous sounds (drilling, dredging, vessel noise) a lower threshold of 120 dB re 1 µPa has been used, based on a level at which low-frequency cetaceans have been observed to exhibit behavioural responses.

9.9.97 Anthropogenic noise and vibration would be generated during the demolition and construction stage of the proposed development from the following:

[133] Southall, B.L. et al., 2007. 'Marine Mammal Noise-Exposure Criteria: Initial Scientific Recommendations', *Bioacoustics* 17, no. 1–3 (1 January 2008): 273–75, https://doi.org/10.1080/09524622.2008.9753846.
[134] NOAA, '2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing : Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts', NOAA Technical Memorandum NMFS-OPR (National Oceanic and Atmospheric Association, 2018), https://staging-noaa.cdc.gov/view/noaa/17892.
[135] National Marine Fisheries Service. 2024. Update to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0): Underwater and InAir Criteria for Onset of Auditory Injury and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-71, 182 p.
[136] Southall, B.L. et al.. 2019. /Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects', *Aquatic Mammals* 45, no. 2 (11 March 2019): 125–232, https://doi.org/10.1578/AM.45.2.2019.125.
[137] NOAA, '2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing : Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts'.

- Demolition of the existing Northern Arm;
- Capital dredging for the new berths using a backhoe dredger to increase below-keel water depth adjacent to the docks; and
- Pile driving (piling) to install the new wharf structures.

9.9.98 Drawing on Chapter 5: Demolition and Construction and the underwater noise modelling report (Technical Appendix 7.1), Table 9.18 describes the magnitude of the impact from each of the three noise-generating activities on marine mammal receptors. The underwater noise modelling report has modelled noise propagation based on four locations and separate noise propagation models have been generated for each. Table 9.18 describes the area of impact for each of the different marine mammal hearing groups described in Table 9.15. A distinct magnitude of impact is given for each group.

Table 9.18 Magnitude of impact justification for the various noise-generating activities associated with the demolition and construction stage.

Attribute	Description
Demolition	
Source Level	Various demolition activities/methodologies will be required to remove the existing Northern Arm. The Underwater Noise Modelling report has identified that the loudest of these will be the use of a hydraulic hammer to break up any underwater structure that remains after cutting and block removal has been completed. The SEL source level for this activity has been taken to be 192 dB re 1µPA² (assumed to be used at 5 strikes per second) for up to 1 hr in any 24 hr period.
Timing/Duration	This activity would be short-term and temporary. Chapter 5: Demolition and Construction states that demolition of the Northern Arm is estimated to take 12 weeks, with a hydraulic hammer in use for only 1 hr without pause within a 24 hr period. Demolition would not occur overnight.

Table 9.18 Magnitude of impact justification for the various noise-generating activities associated with the demolition and construction stage.

Area of Impact	The table below shows the predicted distances to different impact thresholds for different marine mammal hearing groups arising from demolition of the Northern Arm.

	TTS	PTS
LF cetaceans (SEL_{cum})	3,000 m	400 m
HF cetaceans (SEL_{cum})	400 m*	0 m
VHF cetaceans (SEL_{cum})	3,800 m	1,700 m
Pinnipeds (SEL_{cum})	2,400 m	400 m*
LF cetaceans (SPL_{peak})	4 m	2 m
HF cetaceans (SPL_{peak})	1 m	0 m
VHF cetaceans (SPL_{peak})	40 m	20 m
Pinnipeds (SPL_{peak})	4 m	2 m

*Threshold exceedance would only occur for animals between the noise source and the shoreline, where fleeing is restricted.

PTS (based on SEL_{cum}) in phocids was predicted to occur within 400 m and was generally restricted to between the noise source and the eastern breakwater, although for VHF cetaceans the PTS area extended across the majority of the width of the estuary (Figure 9.18). PTS is not predicted for HF cetaceans.

TTS in HF cetaceans is confined to within the noise source and the eastern breakwater, with a predicted distance of 400 m. For all other cetacean hearing groups and pinnipeds, TTS extends across the width of the Fal Estuary, with a maximum distance of 3,800 m for VHF cetaceans (extending further upstream into the river Fal). However, the eastern breakwater acts as a barrier to sound, reducing the propagation of sound towards the mouth of the estuary.

On the basis of the SPL_{rms} threshold of 160 dB 1e 1 µPa there is predicted to be instantaneous behavioural disturbance to marine mammals within 1 km of the noise source and low level disturbance across the estuary.

Table 9.18 Magnitude of impact justification for the various noise-generating activities associated with the demolition and construction stage.

Magnitude of Impact	Dolphins are sometimes recorded in Falmouth Bay but only intermittent and occasional sightings of these species are recorded in the Fal Estuary (predominantly common dolphins *D. delphis*). These species are HF cetaceans for which PTS and TTS is unlikely to extend beyond the eastern breakwater. Harbour porpoise *P. Phocoena* are seen throughout the year in the study area but have rarely been sighted in the estuary itself. This species is a VHF cetacean for which PTS and TTS occur across the width of the Fal Estuary. This is also true of pinnipeds, for which grey seals are occasionally seen in the estuary. During the demolition of the existing wharf, these species are likely to avoid the estuary, favouring the Falmouth Bay where cetaceans and pinnipeds are more regularly sighted. If any marine mammals are present upstream of the works, there is a potential that the sound from the demolition works could act as a barrier to their movements back out of the estuary. However, the use of the hydraulic hammer is only predicted for 1 hr over a 24 hr period, allowing marine mammals to move freely within the estuary again, once the works have stopped. In the absence of a soft-start when using the hydraulic hammer (as well as other measures provided within the JNCC 2010[138] guidance for minimising disturbance to marine mammals), there is the potential for PTS and TTS to occur in marine mammals close to the demolition works. However, given the number of individuals that are sighted within the estuary and the very short duration of the demolition works, this is considered unlikely, with most individuals likely to avoid the area or move away. On this basis, the magnitude of this impact on cetaceans and pinnipeds is considered to be **medium**.
Dredging	
Source Level	A backhoe dredger will be used for the capital dredging, to reduce the sediment mobilisation caused during dredging. The noise propagation modelling has used a worst-case SPL_{rms} sound source level of 175 dB re1µPa, generated continuously for up to 24 hrs/day. In practice, some of the dredging activity noise generated could be quieter, and dredging would occur on an adjusted flood tide only to minimise potential impacts on locally protected maerl habitats (and therefore not 24 hours per day). Accordingly, the effects assessed are a worst-case scenario as the 24-hour exposure modelled is significantly higher than will occur.

Table 9.18 Magnitude of impact justification for the various noise-generating activities associated with the demolition and construction stage.

Timing/Duration	This impact would be short-term and temporary. The estimated duration of dredging operations in each area of the site is as follows: • Western Wharf: 20 weeks; • Northern Wharf & Queen's Wharf: 18 weeks; and • FLOW Deck: 20 weeks Dredging activities will be restricted to flood tide (-1.75 hrs) to minimise the potential for sediment dispersion. This has the secondary benefit of meaning that there will be at least 12 hours per day where no dredging activities occur. As shown in Chapter 5: Demolition and Construction, dredging of one area of the site and piling in another area of the site could occur concurrently. In this event, the non-impulsive noise generated by dredging would be masked by the impulsive sound generated by piling. Accordingly, the underwater noise modelling for percussive piling described below remains a worst-case.
Area of Impact	The underwater sound from dredging was modelled and found to not exceed PTS thresholds for any marine mammal. The TTS threshold for very high frequency and low frequency cetaceans was met at a distance of 460 m from source, but only for animals between the Falmouth Docks and the Eastern Breakwater (Figure 9.19). No threshold exceedance is predicted for either high frequency cetaceans or phocids.
Magnitude of Impact	The activity is short term and temporary. Baseline noise levels within the main shipping channel were calculated to have an annual mean SPL above 120 dB re 1µPa, and the modelled disturbance as a result of dredging will be similar to the medium sized vessel noise disturbance (of the order of 1 km from the noise source). Given the existing vessel disturbance near to the wharf, it is unlikely that marine mammals would be within the area of TTS close to the proposed development and would be disturbed by vessel movements prior to the dredging commencing. The magnitude of this impact is considered to be **low** as sound levels would not increase significantly above baseline.
Pile Driving	
Source Level	The piles proposed to be used as part of the proposed development are up to 1.32 m in diameter and will initially be installed by vibro-piling to reduce noise generation, but it is assumed that impact piling (with a hammer energy of 300 kJ) will be used to drive the piles to target depth. The source level from this activity is modelled at 210 re $1\mu Pa^2$, assuming 3% sound conversion efficiency (the proportion of the hammer energy that is converted to sound energy). The duration of this activity is taken to be 4 hrs within 24 hrs (with a strike rate of 0.67 strikes per second). This is based on an assumption that two piles could be installed per day, each with approximately 6 hr total installation time of which 4 hrs is percussive piling. A soft-start procedure shall take place, whereby the initial sound source level is increased over 20 minutes to the maximum value. This has been included as an embedded mitigation measure for marine mammals, as part of the JNCC 2010 guidance for minimising the effects of impact piling.

[138] JNCC. 2010. Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise. August 2010. Online. Available from: https://hub.jncc.gov.uk/assets/31662b6a-19ed-4918-9fab-8fbcff752046

Table 9.18 Magnitude of impact justification for the various noise-generating activities associated with the demolition and construction stage.

Timing/Duration	This impact is considered to be short term and temporary. Duration of piling works for the construction of the various wharfs is estimated as follows: • Western Wharf: 16 weeks; • Northern Wharf: 9 weeks; • Queen's Wharf extension: 5 weeks; and • FLOW Deck: 20 weeks. Only one piling rig will be operated at a time. Demolition and piling would not occur concurrently. There will be downtime whilst the piling rig moves to the next pile location. No piling will occur overnight. Up to 4 hours of percussive piling would occur per day.
Area of Impact	Figure 9.20 shows the maximum modelled distance to impact threshold for impact piling using a soft-start, for the different marine mammal hearing groups. Percussive piling would occur only in one location at any given time, however, for illustrative purposes Figure 9.20 overlays the exceedances for impact piling using a soft-start at all three of the modelled locations (Locations 2 (northern-most point on Western Wharf), 3 (Queen's Wharf) and 4 (FLOW Deck)), to show the maximum modelled distance to impact threshold. Refer to Technical Appendix 7.1 for all model outputs. The table below shows the worst-case (greatest) predicted distances to the impact thresholds for different marine mammal hearing groups arising from impact piling with a soft-start, based on the model outputs for all three modelled locations.

	TTS	PTS
LF cetaceans (SEL_{cum})	3,600 m	2,000 m
HF cetaceans (SEL_{cum})	1,300 m	650 m*
VHF cetaceans (SEL_{cum})	4,100 m	2,000 m
Pinnipeds (SEL_{cum})	3,100 m	1,100 m
LF cetaceans (SPL_{peak})	130 m	120 m
HF cetaceans (SPL_{peak})	30 m	20 m
VHF cetaceans (SPL_{peak})	1,300 m	630 m
Pinnipeds (SPL_{peak})	170 m	120 m

*Threshold exceedance occurs only for animals between the noise source and the shoreline, where fleeing is restricted

Predicted PTS and TTS in HF Cetaceans is shown to be limited by the eastern breakwater, which acts as a barrier to sound propagation within the estuary. Although TTS extends further to the west, it is mostly restricted close to the proposed development red line boundary (Figure 9.20).

For VHF cetaceans and pinnipeds, predicted TTS extends across the Fal Estuary, reaching the other side of the main channel, during impact piling with soft-start at modelled Locations 2 and 3. For VHF cetaceans, PTS is also predicted across the width of the estuary during impact piling with soft-start at modelled Locations 2 and 3. Impact piling with soft-start at Location 4 is predicted to lead to threshold exceedances for pinnipeds and VHF cetaceans to the west of the Dock structure only, not extending eastwards to the main Fal estuary.

There is also the potential for a low and higher level of behavioural disturbance within 2.5 km of the noise source. Higher level of behavioural disturbance is predicted within 1 km of the noise source. This is based on an instantaneous SPL_{rms} threshold.

Table 9.18 Magnitude of impact justification for the various noise-generating activities associated with the demolition and construction stage.

Magnitude of Impact	There are only intermittent and occasional sightings of dolphins recorded in the Fal Estuary (predominantly common dolphins *D. delphis*). These species are HF cetaceans for which predicted PTS and TTS from the impact piling is unlikely to extend beyond the eastern breakwater. Harbour porpoise *P. Phocoena* are rarely sighted within the estuary for which sightings within the estuary are limited or absent. Although there is potential for the impact piling to result in PTS to this species across the width of the estuary, it is considered unlikely that they would be present during these works. Grey seal have also been reported in the estuary, which would be at risk from TTS across the width of the estuary. However, due to their fast mobility, they are expected to move away and avoid any areas of high sound intensity. During the proposed impact piling, these species are likely to avoid the estuary, favouring the Falmouth Bay where cetaceans and pinnipeds are more regularly sighted. If any marine mammals are present upstream of the works, there is a potential that the sound from the impact piling could act as a barrier to their movements back out of the estuary. However, the pile driver will only be used for 4 hrs over a 24 hr period (with downtime between piles), allowing marine mammals to move freely within the estuary again, once the works have stopped. There is potential for PTS and TTS to occur in marine mammals close to the impact piling works. It is considered unlikely that marine mammals will be present in the estuary during the works given their rare and occasional sightings in this location. However, there still remains a risk of injury to these species if they were present close to the works. On this basis, the magnitude of this impact on cetaceans and pinnipeds is considered to be **medium**.

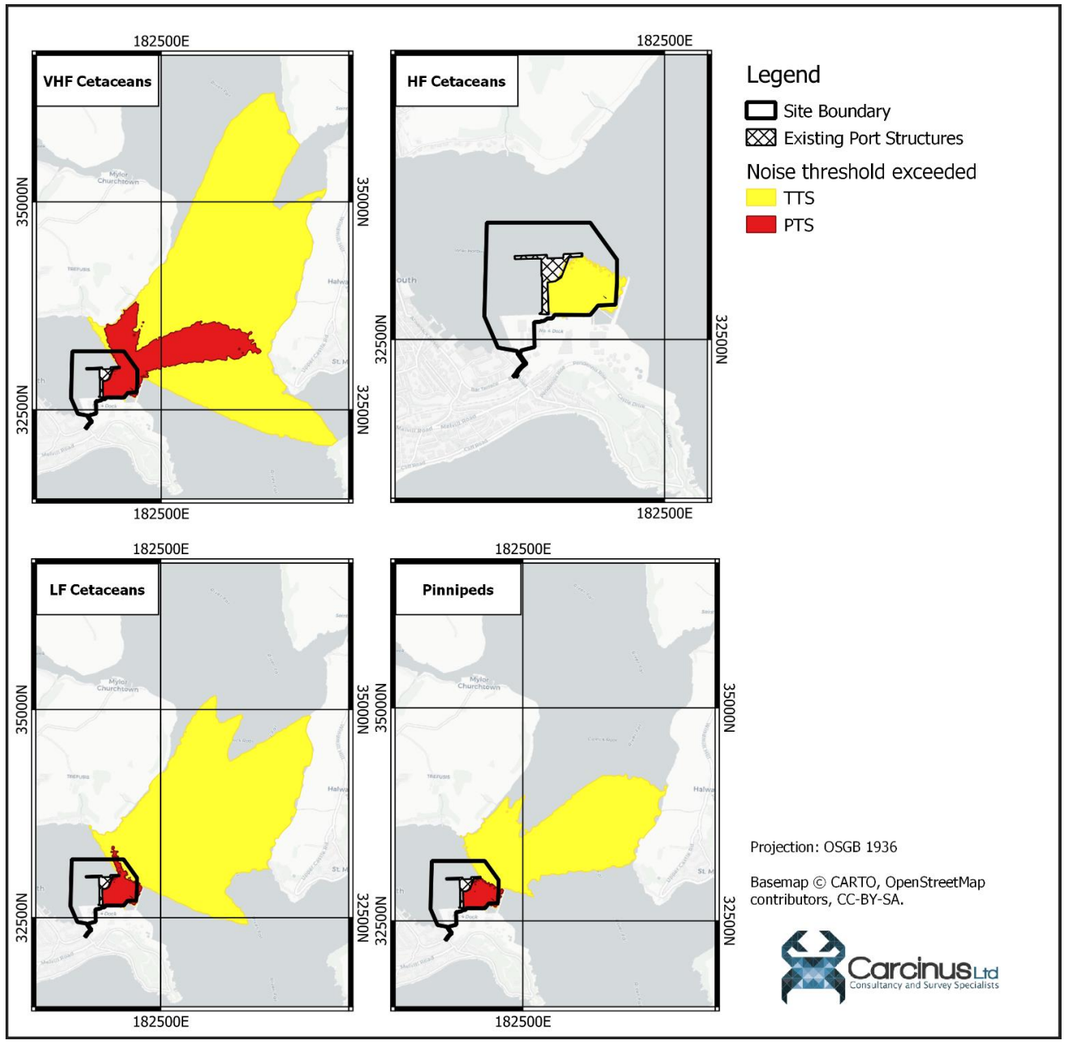

Figure 9.18 Noise threshold exceedance for different marine mammal groups as a result of demolition of the Northern Arm.

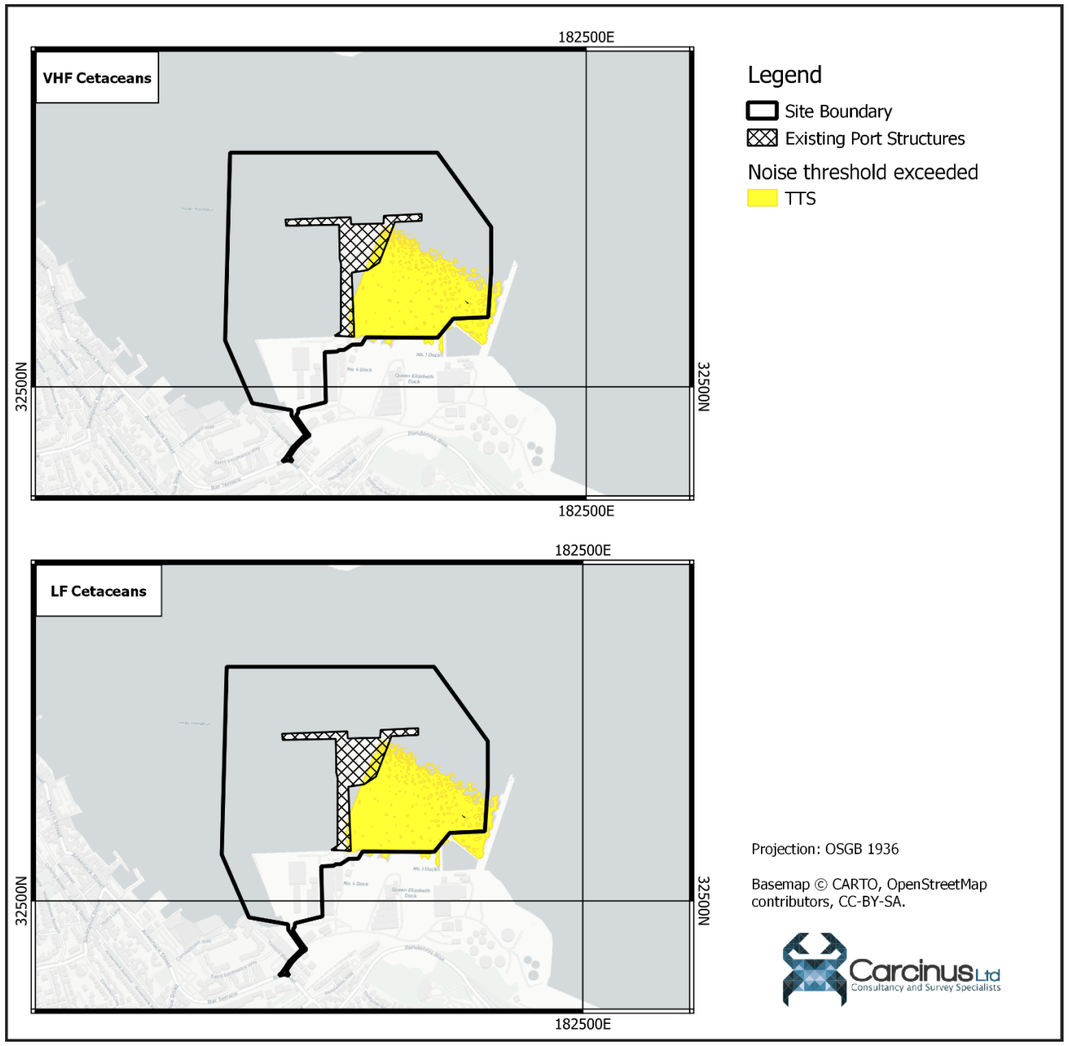

Figure 9.19 Noise threshold exceedance for different marine mammal groups as a result of dredging.

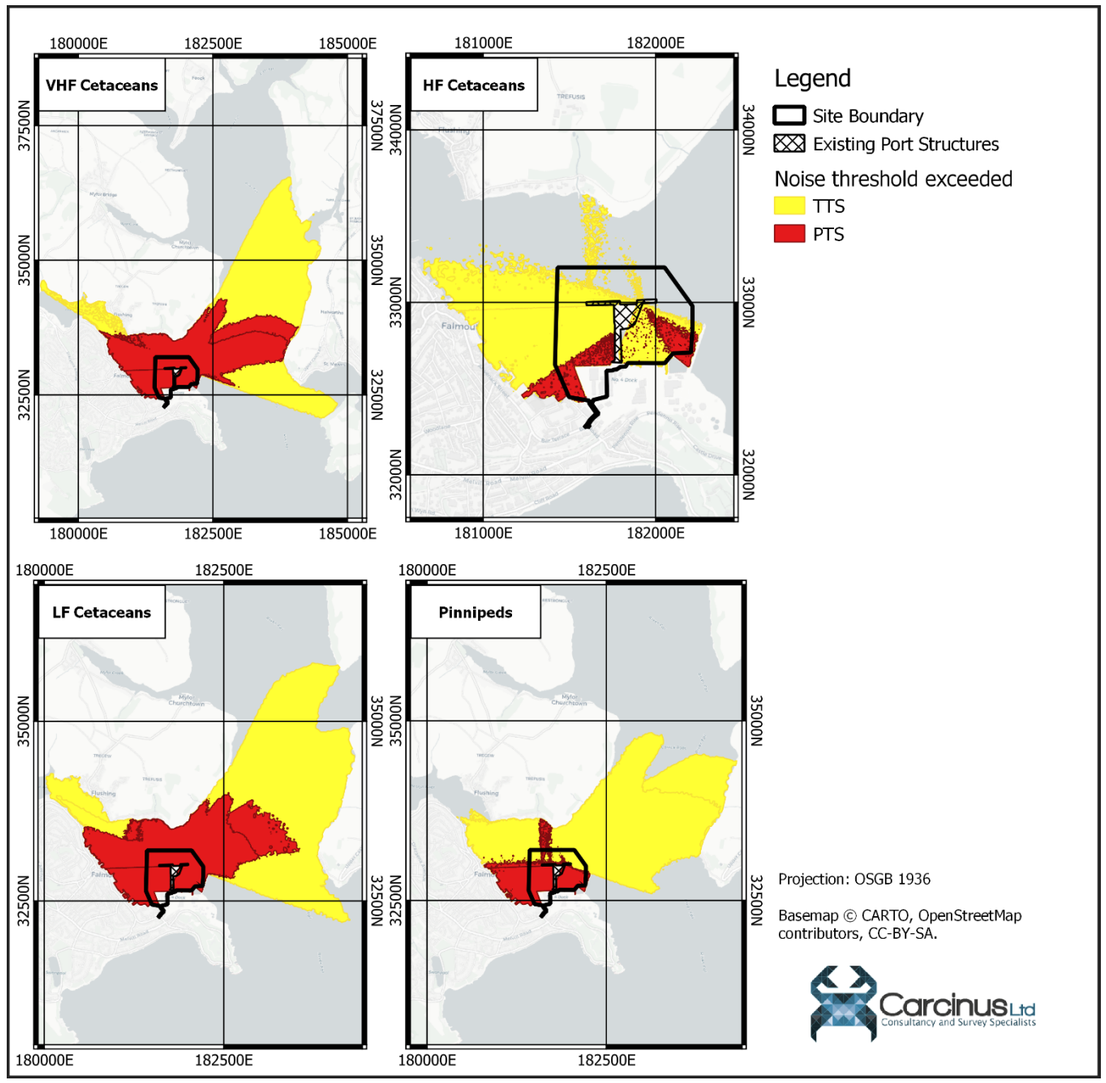

Figure 9.20 Noise threshold exceedance for different marine mammal groups as a result of impact piling. Results for Locations 2, 3 and 4 are overlaid[139].

Value/Importance of Receptor

9.9.99 The main marine mammal species observed within the study area are bottlenosed dolphin *T. truncatus*, common dolphin *D. delphis*, harbour porpoise *P. phocoena* and grey seal *H. grypus*. However, the presence of these species in the vicinity of the proposed development is infrequent and generally in low density. Large cetaceans, such as whales and orca, are occasionally spotted off the coast of Falmouth but these are considered to be vagrants or occasional visitors and are not considered further within this assessment.

9.9.100 Both dolphin species fall into the High Frequency Cetacean group, harbour porpoise are in the Very High Frequency Cetacean group and grey seals are in the Phocids in water group. All three groups of marine mammals have a high nature conservation value as they are protected under various national and international legislation. Their nature conservation value is considered to be **high**.

9.9.101 There are no low frequency cetaceans regularly present within the area of impact for noise generating activities and therefore this group are scoped out of further assessment.

Significance of Effect

9.9.102 The impact magnitude of dredging operations is considered to be **low** for all cetacean and pinniped groups as the generated sound will be within baseline levels at the site. The receptor has a **high** nature conservation value and therefore the overall significance of effect is **Minor Adverse** and therefore **not significant**.

9.9.103 The impact magnitude of demolition and impact piling on cetaceans and pinnipeds is considered to **medium**. Based on these receptors being of **high** conservation value, the overall significance of effect of these activities is therefore **Moderate Adverse** and **significant**, in the absence of any additional mitigation.

Vessel Strike

Description of Impact

9.9.104 During the construction and demolition stage of the proposed development, vessels would be required, such as for the dredging operations, use of barges, and other workboats. This would see an increase in the number of vessels used around Falmouth Docks and close to the proposed development, which could lead to injury/mortality of marine mammals using the waters in the vicinity of the site.

Magnitude of Impact

9.9.105 The number of marine vessels required during the demolition and construction stage is very small. This would not represent a significant increase in vessel traffic within the study area, particularly given the higher number of existing vessel movements between Falmouth Docks. Furthermore, the vessels would likely be travelling significantly under the imposed speed limits of 6 knots and so would be slow moving. The magnitude of impact of the movement of marine vessels to and from the site is considered **low**, given that the vessel traffic would not significantly increase beyond baseline levels.

Value/Sensitivity of Receptor

9.9.106 The nature conservation value of marine mammals is high, given the importance of the group and the protection afforded to them by international and national legislation. However, all species of marine mammal known to be present semi-regularly within the study area (bottle-nose dolphin, common dolphin, harbour porpoise and grey seal) are highly mobile and would be able to move away from slow moving vessels. Marine vessels are likely to travel at significantly below the maximum vessel speed limit of the Fal Estuary (6 knots), and therefore the highly mobile marine mammals would be able to avoid the vessels. The sensitivity of marine mammals to vessel strike is therefore low, and the overall value/sensitivity of this receptor is **medium**.

Significance of Effect

9.9.107 Given the **low** magnitude of impact and **medium** value/sensitivity of the receptor, the overall effect of vessel strike on marine mammals would be **Minor Adverse** and therefore **not significant**.

Operational Effects

9.9.108 The potential impacts and likely effects on marine ecological receptors during the operational development would be as follows:

- Propellor wash and scour from the presence of additional vessels resulting in disturbance to benthic habitats;
- Additional shading and overshadowing of subtidal habitats resulting from presence of additional port structures;

[139] Percussive piling would occur only in one location at any given time, however, for illustrative purposes this figure overlays the exceedances for impact piling using a soft-start at all three of the modelled locations.

- Sediment dispersion and deposition from ad hoc maintenance dredging, as required, to maintain sufficient depth, mostly within the eastern berth pocket;
- Vessel strike causing injury to marine mammals; and
- Disturbance as a result of underwater noise and vibration from the presence of additional vessels.

Benthic Ecological Receptors

Propellor scour and wash

Description of Impact

9.9.109 The proposed development would see a small increase in the numbers of vessels using Falmouth Docks (see Chapter 4: Proposed Development Description for detail). This has the potential to cause disturbance to subtidal habitats through propeller scour and wash. However, the movement of marine vessels to and from Falmouth Docks once the development is operational would not represent a significant increase to the vessel traffic already moving to and from the docks.

Magnitude of Impact

9.9.110 The extent of habitat loss and scour would vary with the speed that the marine vessels are moving at and the water depth beneath the vessel. A study of the extent of wash and scour created by commercial vehicles in Australia found that waves generated by commercial vessels were of a similar magnitude to naturally generated waves[140]. The authors also found that the erosion was about half the rate of natural tidal circulation.

9.9.111 Given the small increase in vessel numbers in the context of the existing dock operations, the magnitude of impact is considered to be **low**.

Value/Sensitivity of Receptor

9.9.112 Benthic habitats within the dredge footprint immediately post construction have a low nature conservation value. The presence of algae, including subtidal kelps, within the proposed dredge pocket suggests that this habitat type is insensitive to the current wash/scour regime at the site. Algae are expected to recover in a relatively short period of time (<1-2 years), and the value/sensitivity of the re-colonised habitat would also be **low**.

Significance of Effect

9.9.113 Given the low magnitude of effect and low value/sensitivity of the receptor, the overall effect of scour caused by additional vessels would be **Negligible Adverse** and therefore **not significant**.

Additional Shading and Overshadowing of Subtidal Habitats

Description of Impact

9.9.114 The proposed development would see the following new structures constructed:

- The new approximately 348 m long Western Wharf would form a continuous deck surface with the Northern Wharf, and land between the existing causeway and Western Wharf would be reclaimed as quayside;
- The suspended deck Northern Wharf structure would be constructed in the existing 90 m gap between Queen's Wharf and the Northern Arm;
- Queen's Wharf would be extended 50 m westwards; and
- A 290 m deck (the 'FLOW Deck') would be constructed to facilitate a FLOW device.

9.9.115 In total, the proposed development would increase the area of suspended deck and wharf structures from 11,644 m^2 to 26,133 m^2 (a total increase of 14,489 m^2), providing a total of 810 m of additional quayside length. In addition to the new wharf space, vessels will berth alongside the wharves for varying lengths of time. In 2023, vessels were berthed to the northern side of Queen's Wharf for 8 months of the calendar year. The presence of these new wharf structures and vessels would create additional overshadowing and shading of the benthic habitats beneath.

Magnitude of Impact

9.9.116 Substrates beneath the new wharf structures would essentially be permanently shaded and substrates to the east, north and west would be shaded to differing extents during the day and seasonally. Much of this area is new or extended intertidal revetment rather than subtidal substrate (with the exception of the Queen's Wharf extension). The worst-case scenario would occur during early mornings/late evenings in winter months, as the sun is typically lowest in the sky.

9.9.117 The site boundary already contains various wharf structures that create shading of the seabed to a degree. Given the localised nature of the footprint shading in the context of the regional Fal Estuary, overshadowing would be highly localised to the wharf area. Despite the fact it would occur daily throughout the lifespan of the proposed development, overshadowing would be transient and move with the sun path across the day. The magnitude of impact is therefore considered to be **low**.

Value/Sensitivity of Receptor

9.9.118 Benthic habitats within the dredge footprint immediately post construction will have a low nature conservation value and so any change in the light regime will not have an effect. The presence of algae, including subtidal kelps within the proposed dredge pocket suggests that this habitat type is insensitive to the current overshadowing regime at the site and some new algae growth may occur. Most are expected to recover in a relatively short period of time (<1-2 years), and the value/sensitivity of the re-colonised habitat would also be **low**.

Significance of Effect

9.9.119 Given the low magnitude of effect and low value/sensitivity of the receptor, the overall effect of shading caused by new wharf structures and additional vessels would be **Negligible Adverse** and therefore **not significant**.

Sediment effects from maintenance dredging

Description of Impact

9.9.120 Limited maintenance dredging is proposed. The anticipated volume of maintenance dredging is estimated to be up to approximately 8,000 m^3 every five years (and accordingly, up to approximately 16,000 m^3 every 10 years), as required, mostly within the eastern berth pocket. The extent and intensity of maintenance dredging is small as natural deposition within the site boundary is low and dredge depths are expected to be fairly stable. This would be undertaken in line with the requirements of the marine licence, with proposed disposal at the Falmouth Bay Disposal site.

Magnitude of Impact

9.9.121 The requirement for maintenance dredging is expected to be minimal, both in terms of the area potentially affected in the context of the site boundary (mostly within the eastern berth pocket) and the volume of removed sediment (up to 16,000 m^3 every 10 years in comparison to the 643,000 m^3 total proposed to be removed during the capital dredge). The level and extent of maintenance dredging will be small and infrequent, and the subsequent dispersion and deposition of sediments expected to remain within the site boundary. The maintenance dredging would target local sediments that would infill, and therefore there is considered to be low potential for mobilisation and transport of contaminants during maintenance dredge campaigns.

9.9.122 The magnitude of impact is therefore considered to be **low**.

Value/Sensitivity of Receptor

9.9.123 Benthic habitats within the dredge footprint immediately post-construction have a low nature conservation value. Algal communities may develop in the dredge pockets and recover in a relatively short period of time (<1-2 years). The value/sensitivity of the re-colonised habitat would also be **low**.

Significance of Effect

9.9.124 Given the low magnitude of effect and low value/sensitivity of the receptor, the overall effect of maintenance dredging would be **Negligible Adverse** and therefore **not significant**.

[140] AMOG Consulting, 'Assessment of Waves and Propeller Wash Associated with Shipping.', 2010.

Marine Mammals

Vessel Strike

Description of Impact

9.9.125 As described above, the operational development would see a marginal increase in the number of vessels moving to and from Falmouth Docks, which could lead to injury/mortality of marine mammals using the waters in the vicinity of the site.

Magnitude of Impact

9.9.126 The movement of marine vessels to and from Falmouth Docks once the development is operational would not represent a significant increase to the vessel traffic already moving to and from the docks, and the vessels would likely be travelling significantly under the imposed speed limits of 6 knots. Whilst vessel traffic would occur at all times of day and at all times of year, the impact of a single animal colliding with a single vessel is direct, short-term and may be temporary or permanent (depending on whether mortality occurs). The magnitude of impact of the movement of marine vessels to and from the site is considered **low**, given that the vessel traffic to and from the wharf would not significantly increase the extant vessel traffic level in the area.

Value/Sensitivity of Receptor

9.9.127 The nature conservation value of marine mammals is high, given the importance of the group and the protection afforded to them by international and national legislation. However, all species of marine mammal known to be present occasionally and in low density within the Fal Estuary (e.g. common dolphin and grey seal) are highly mobile. Marine vessels are likely to travel at significantly below the maximum vessel speed limit of the Fal Estuary (6 knots), and therefore the highly mobile marine mammals would be able to avoid the vessels. The sensitivity of marine mammals to vessel strike is therefore low, and the overall value/sensitivity of this receptor is **medium**.

Significance of Effect

9.9.128 Given the **low** magnitude of impact and **medium** value/sensitivity of the receptor, the overall effect of vessel strike on marine mammals would be **Minor Adverse** and therefore **not significant**.

Underwater noise and vibration (increased vessel movements)

Description of Impact

9.9.129 As described above, the operational development would see a marginal increase in the number of vessels moving to and from Falmouth Docks, which could lead to disturbance to marine mammals using the waters in the vicinity of the site.

Magnitude of Impact

9.9.130 The movement of marine vessels to and from Falmouth Docks once the development is operational would not represent a significant increase to the vessel traffic already moving to and from the docks, and the vessels would likely be travelling significantly under the imposed speed limits of 6 knots. As described in Chapter 7: Underwater Noise and Technical Appendix 7.1 Underwater Noise, the amount of additional time per year that animals may be disturbed within the deeper areas of the estuary is 15 hrs per year, in addition to the extant level of approximately 50-60 hours per year (for passenger and cargo vessels). The magnitude of impact of the movement of marine vessels to and from the site, also considering the current background level, is considered very **low**, given that the vessel traffic to and from the wharf would not significantly increase the extant vessel traffic level in the area.

Value/Sensitivity of Receptor

9.9.131 The nature conservation value of marine mammals is high, given the importance of the group and the protection afforded to them by international and national legislation. However, all species of marine mammal known to be present only occasionally and in low density within the Fal Estuary (e.g. common dolphin and grey seal) are highly mobile. Marine vessels are likely to travel at significantly below the maximum vessel speed limit of the Fal Estuary (6 knots). The sensitivity of marine mammals to underwater noise and vibration is therefore low, and the overall value/sensitivity of this receptor is **medium**.

Significance of Effect

9.9.132 Given the **low** magnitude of impact and **medium** value/sensitivity of the receptor, the overall effect of vessel strike on marine mammals would be **Minor Adverse** and therefore **not significant**.

9.10 Additional Mitigation

Demolition and Construction Stage

9.10.1 **Significant** effects on cetaceans and pinnipeds were predicted as a result of demolition of the Northern Arm using a hydraulic hammer and the proposed impact piling with soft-start.

9.10.2 To reduce this effect to not significant, the JNCC, 2010 guidelines[141] to minimise the risk of injury to marine mammals from impact piling will be adopted (for both demolition activities requiring hydraulic hammer and impact piling activities). This will include the use of a marine mammal observer (MMOb) to ensure no marine mammals are within the vicinity of the proposed development prior to commencing these activities, and a soft-start procedure, whereby the initial sound source level is increased over 20 minutes to the maximum value. The MMOb will be positioned to ensure the possible movement of any animals upstream into the Fal can be observed.

Operational Stage

9.10.3 There are **no significant** effects on marine ecological receptors as a result of the operational stage and therefore additional mitigation is not required.

9.11 Enhancement Measures

9.11.1 No enhancement measures are proposed or required in respect of marine ecological receptors.

9.12 Demolition and Construction Residual Effects

9.12.1 The use of these additional mitigation measures (soft-start and MMOb for demolition with the hydraulic hammer, and MMOb for impact piling with soft-start) reduces the magnitude of impact from use of the impact piles and hydraulic hammer to **low**, bringing the overall significance of effect to **Minor Adverse** and **not significant**. With additional mitigation in place, the residual demolition and construction effects would be **Minor Adverse** and therefore **not significant**.

9.13 Operational Residual Effects

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

9.14 Summary of Significant Effects

9.14.1 Table 9.19 provides a tabulated summary of the outcomes of the marine ecology assessment of the proposed development. It reports on the likely significant effects with respect to marine ecological receptors associated with the demolition and construction and operational stages of the proposed development.

[141] JNCC. 2010. Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise. August 2010. Online. Available from: https://hub.jncc.gov.uk/assets/31662b6a-19ed-4918-9fab-8fbcff752046

Table 9.19: Summary of Marine Ecological 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								
Benthic Ecological Communities – all receptors	Habitat Removal and Disturbance	Negligible / Adverse / Not Significant	N/A	Negligible / Adverse / Not Significant	Direct	Permanent	Irreversible	Long-term
	Elevated Suspended Sediment Concentrations	Negligible to Minor / Adverse / Not Significant	N/A	Negligible to Minor / Adverse / Not Significant	Indirect	Temporary	Reversible	Short-term
	Suspended Sediment Deposition	Negligible to Minor / Adverse / Not Significant	N/A	Negligible to Minor / Adverse / Not Significant	Indirect	Permanent	Irreversible	Medium-term
	Mobilisation and deposition of contaminated sediments	Minor / Adverse / Not Significant	N/A	Minor / Adverse / Not Significant	Indirect	Permanent	Irreversible	Medium-term
	Introduction and/or spread of marine invasive non-native species	Minor / Adverse / Not Significant	N/A	Minor / Adverse / Not Significant	Indirect	Permanent	Irreversible	Long-term
Fish and Shellfish Communities – all receptors	Habitat Removal and Disturbance	Negligible / Adverse / Not Significant	N/A	Negligible / Adverse / Not Significant	Direct	Permanent	Irreversible	Long-term
	Elevated Suspended Sediment Concentrations	Negligible / Adverse / Not Significant	N/A	Negligible / Adverse / Not Significant	Indirect	Temporary	Reversible	Short-term
	Suspended Sediment Deposition	Negligible / Adverse / Not Significant	N/A	Negligible / Adverse / Not Significant	Indirect	Permanent	Irreversible	Medium-term
	Underwater Noise and Vibration (Dredging, Demolition with Hydraulic Hammer, Impact Piling with Soft-Start)	Negligible to Minor / Adverse / Not Significant	N/A	Negligible to Minor / Adverse / Not Significant	Direct	Temporary	Reversible	Short-term
Marine Mammals – all groups	Habitat Removal and Disturbance	Minor / Adverse / Not Significant	N/A	Minor / Adverse / Not Significant	Direct	Permanent	Irreversible	Long-term
	Elevated Suspended Sediment Concentrations	Minor / Adverse / Not Significant	N/A	Minor / Adverse / Not Significant	Indirect	Temporary	Reversible	Short-term

Table 9.19: Summary of Marine Ecological Effects

	Underwater Noise and Vibration (Demolition with Hydraulic Hammer)	Moderate / Adverse / **Significant**	Use of the JNCC, 2010 guidelines, including the deployment of Marine Mammal Observer (MMOb) and soft-start for all use of a hydraulic hammer.	Minor / Adverse / Not Significant	Direct	Temporary	Reversible	Short-term
	Underwater Noise and Vibration (Dredging)	Minor / Adverse / Not Significant	N/A	Minor / Adverse / Not Significant	Direct	Temporary	Reversible	Short-term
	Underwater Noise and Vibration (Impact Piling with Soft-Start)	Moderate / Adverse / **Significant**	Use of the JNCC, 2010 guidelines, including the deployment of Marine Mammal Observer (MMOb).	Minor / Adverse / Not Significant	Direct	Temporary	Reversible	Short-term
	Vessel Strike	Minor / Adverse / Not Significant	N/A	Minor / Adverse / Not Significant	Direct	Permanent	Reversible / Irreversible	Long-term
Operational Development								
Benthic Ecological Communities – all receptors	Propellor Scour and Wash	Negligible / Adverse / Not Significant	N/A	Negligible / Adverse / Not Significant	Direct	Permanent	Irreversible	Long-term
	Overshadowing	Negligible / Adverse / Not Significant	N/A	Negligible / Adverse / Not Significant	Direct	Permanent	Reversible	Long-term
	Sediment Effects from Maintenance Dredging	Negligible / Adverse / Not Significant	N/A	Negligible / Adverse / Not Significant	Direct	Permanent	Reversible / Irreversible	Medium-term
Marine Mammals – all groups	Vessel strike	Minor / Adverse / Not Significant	N/A	Minor / Adverse / Not Significant	Direct	Permanent	Reversible / Irreversible	Long-term
	Underwater Noise and Vibration (increased vessel movements)	Minor / Adverse / Not Significant	N/A	Minor / 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

9.15 Cumulative Effects

Intra-Project Effects

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

Inter-Project Effects

9.15.2 No development projects have been identified as likely to have inter-project cumulative effects.