Technical Appendix 9.5

Maerl Technical Note

Reference - J0710/24/10/07
April 2025

Falmouth Docks Development
Maerl Technical Note

"Discretionary Advice Service (Charged Advice): Maerl habitat description for the Fal and Helford SAC, and advice on maerl technical note" (Reference: 395023).

Brief

Carcinus Ltd. have been providing Marine Ecological consultancy support to the Falmouth Docks Development project since 2021. This has included the undertaking of two marine ecological surveys (in 2022 and 2023), input to the scoping report for the project and input to the Environmental Statement Marine Ecology chapter assessing the potential impacts and effects of the proposed development on the various marine ecological receptors within the proposed development's zone of influence.

Consultation with Natural England (NE) has been maintained throughout the project to ensure agreement and sign off with the approach to and scope of works undertaken. This has included NE sign off on the scope of marine ecological surveys undertaken in 2023 and NE comment on the receptors and impact pathways scoped into and out of the Environmental Statement.

As per NE advice, this technical note should be read in conjunction with (and as Technical Appendix 9.5 to) Falmouth Docks Development Environmental Statement (ES) Volume 1 Chapter 9: Marine Ecology.

The proposed development is within the Fal & Helford Special Area of Conservation (SAC), which NE identify as being the most important Marine Protected Area (MPA) in England for maerl species. They report that there are large maerl banks situated within the MPA, including at St. Mawes Bank, the Helford river, and out into the wider Falmouth Bay (including Castle Point). Given the importance and sensitivity of this habitat, which is discussed further in this note, a focused approach for viewing and understanding potential direct and indirect impacts on maerl in this area, ahead of formal assessment by the Marine Management Organisation (MMO), had been identified by NE to be beneficial.

The aims of this technical note are to:

- Provide an overview of maerl habitat within the development's site boundary and Zone of Influence (ZOI) which includes the sediment plume area, defined in Study Area below, with some consideration to the habitat distribution over the wider Fal and Helford SAC, from current and historic survey findings;
- Collate information regarding likely impacts of the proposed development on maerl habitat, including live and dead maerl for:
    - Direct impacts;
    - Indirect impacts; and
- Provide areas of works associated with the proposed development mapped against available maerl data, including presence/absence of maerl where areas have not been surveyed (i.e.

between drop-down video (DDV) transects and grab sample locations), through thorough examination of a wide range of physical, chemical and biological datasets.

The report is presented with the following general structure:

- Characterisation of the physical environment within the site boundary (and wider area where data allow) in terms of:
    - Bathymetry (including historic dredging activity);
    - Backscatter;
    - Flow / Tidal data;
    - Shading;
    - Geochemical environment (including both Particle Size Distribution (PSD) and sediment contamination levels); and
    - Ecological environment (broad biotopes and species of note).
- Characterisation of the biological environment for maerl only via:
    - Summary of available historic and current survey data on the distribution of maerl within the site boundary and estimated zone of influence; and
    - Description of areas of maerl in the study area, according to the descriptions of the maerl sub-feature in the Conservation Advice Package created for the SAC.
- Assessment of both direct and indirect impacts associated with the proposed development on maerl habitat, considering known maerl biology and physiology in terms of habitat preferences and sensitivities.

There are a number of different definitions and categorisation systems for maerl habitats, including the Marine Nature Conservation Review (MNCR) Habitat/Biotope (JNCC, 2015) approach, a NatureScot definition (Nature Scot, 2018) and most recently a proposed categorisation system for maerl bed habitats in England (Axelsson, 2023). The Axelsson (2023) approach has been utilised in a number of recent studies of maerl habitats within the area (Jenkin *et al.*, 2023; Envision Marine Ltd, 2024).

Key to these latter categorisation systems has been an assessment of the 2D vs 3D nature of the maerl present in a given area, as 3D habitat complexity is important to the recognised ecological function of maerl habitat. The Envision Marine study in particular noted that the categorisation system was difficult to apply, with survey data not aligning to categorisations within the specified criteria, and recommended it be revised.

During previous discussions with NE pertaining to the handling of available survey data to describe the distribution of maerl habitat within the study area, the suitability and applicability of the classification systems identified in the paragraph above were discussed but not recommended for use by NE. In NE's advice (18 July 2024) requesting this technical note (included as Appendix A of this technical note), they quoted descriptions of maerl habitat type provided in the Fal and Helford SAC's Conservation Advice Package[1]. From the description of maerl beds, as a sub-feature of *Large Shallow*

[1] https://designatedsites.naturalengland.org.uk/ConservationAdvice.aspx?SiteCode=UK0013112&SiteName=Fal%20and%20Helford&SiteNameDisplay=Fal%20and%20Helford%20SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&HasCA=1&NumMarineSeasonality=0&SiteNameDisplay=Fal%20and%20Helford%20SAC#sitemaps

Inlets and Bays and the *Sandbanks which are slightly covered by sea water all the time* qualifying features, the text descriptions shown below have been extracted:

- 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.

As recommended by NE, these descriptions have been used to describe the distribution of maerl habitat across the site, as identified from project specific surveys and available literature. There are, however, no specific criteria for each of these descriptions and they are fairly broad and likely to mask some more fine-scale gradations in the *ecological function* of maerl habitat.

In particular, the feature descriptions indicate that areas of mixed maerl and sediments are comprised of maerl fragments combined with various sediment types including coarse sand, fine sediment, shells and stones. Thus, 'areas of maerl in sediment' may comprise areas that behave functionally like pristine examples of the habitat (due to the complex 3-D structure that maerl thalli create) through to areas of dead and fragmented thalli on sediments. For this reason, additional detail is considered for this descriptor.

The impact assessment presented at the end of this technical note aims to quantify the impact on maerl in terms of the geographical area and temporary/permanent nature of any impacts. This supports the formal impact assessment within ES Volume 1 Chapter 9: Marine Ecology. Both the ES Volume 1 Chapter 9: Marine Ecology and ES Volume 2 Technical Appendix 2.12 Habitat Regulations Assessment discuss impacts on designated sites and sensitive ecological receptors more broadly, but this note provides the focussed discussion of maerl.

Study Area

The proposed development is located near the mouth of the River Penryn, at the southern end of the Fal estuary complex, and includes both marine and terrestrial elements. The total site boundary is 47.2 hectares, of which 41.864 Ha is fully marine and wholly contained within the Fal and Helford SAC, which covers an area of 6,362 Ha (the site boundary is 0.66% of the SAC footprint). The position of the proposed development in the context of the Fal and Helford SAC is presented in Figure 2.

The study area is determined by the extent of the potential impact of the proposed project activities. The study area (Figure 1) for this technical note has been determined by the spatial extent of sediment deposition, as this is considered to be the maximal spatial extent of indirect impacts on maerl habitat within the SAC.

A brief description of maerl habitat found in other areas of the SAC is provided within the Historic Surveys and Data section, for comparative purposes. However, a detailed characterisation of habitats outside the study area have not been provided as no impacts (either direct or indirect) are expected and therefore it falls outside the scope of this document and the requirements in relation to the Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) for the proposed development.

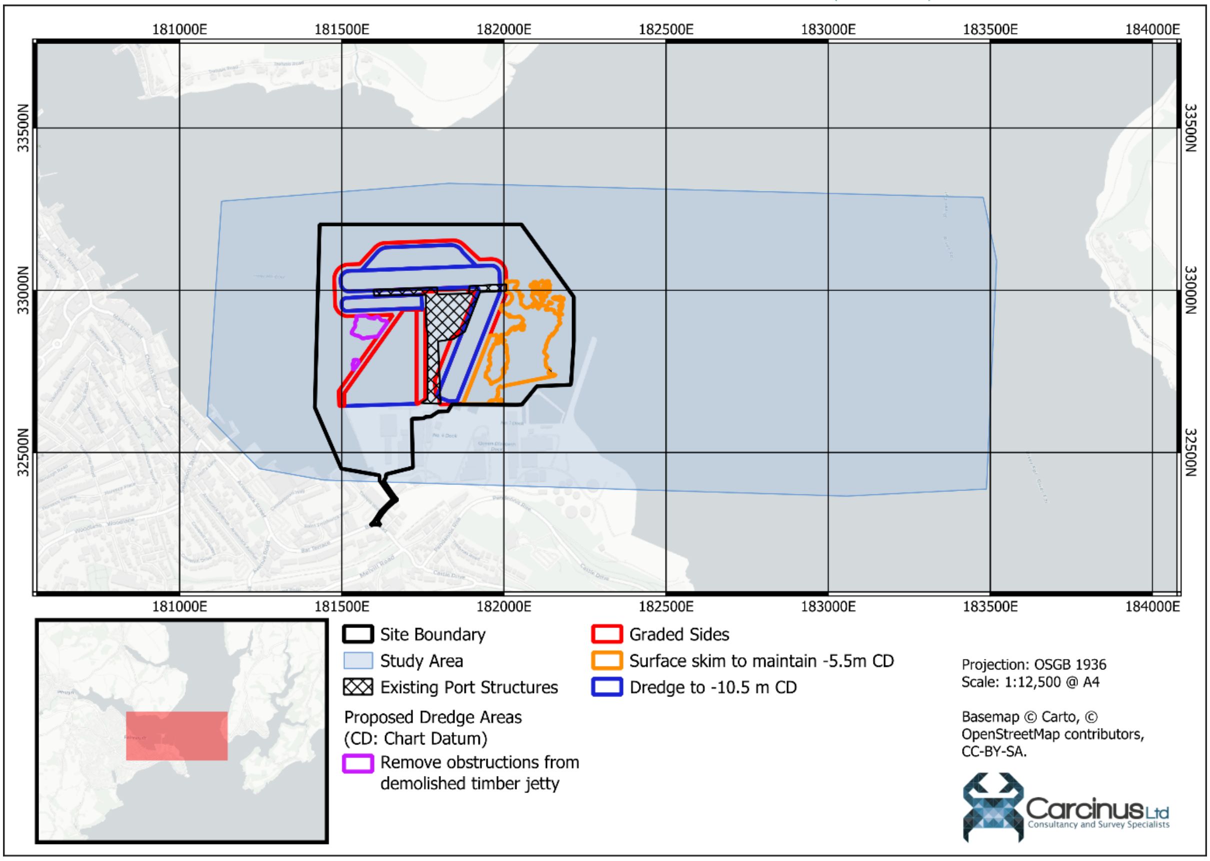


Figure 1 Study area for the assessment of project activities in relation to maerl habitats.

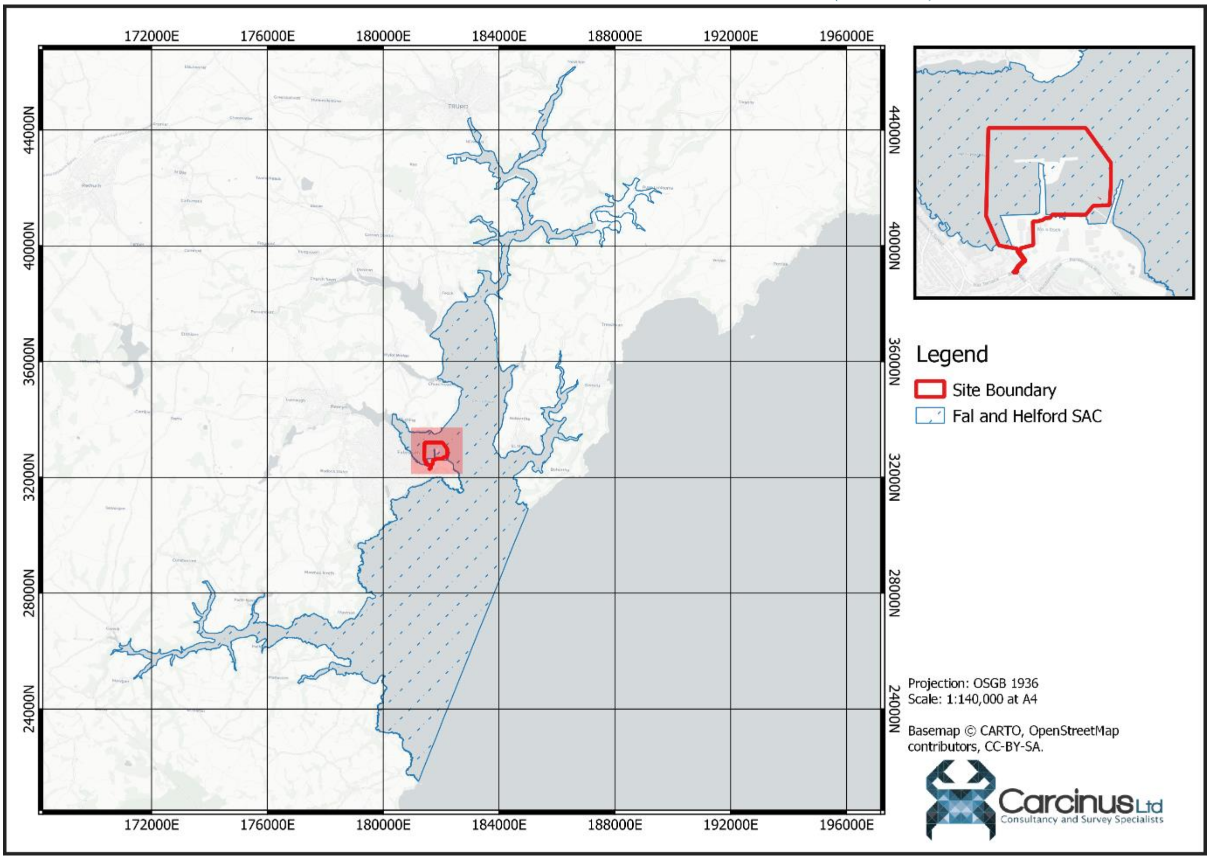


Figure 2 Location of the proposed development in the context of the Fal and Helford SAC.

Current Baseline

Physical environment

Bathymetry (2022)

Bathymetry data from 2022 has been used to describe the area surrounding the main port structure and the general site, and is shown in Figure 3. Some small areas immediately beside the main port structure are 1 – 5 m depth. On the edge and immediately outside of the site boundary in a band like formation, the depth is also 2 - 5 m (this area is the docks entrance channel and has been historically dredged).

The waters immediately inside the site boundary and surrounding waters are 5 – 10 m depth. This also extends out east of the site boundary toward the main channel. There are some small deeper pockets to the west of the main jetty structure and out into the eastern channel, reaching 10 – 15 m depth. The deeper areas to the east form a channel to the south of Carrick Roads, which reaches 30 m.

Summary

As a photosynthetic species, the main requirement for maerl distribution in terms of water depth is availability of light at the seabed. In the relatively turbid waters of northern Europe (within which the study area sits), particularly in relation to the Mediterranean, this turbidity is thought to limit maerl distribution to <32 m (Hall-Spencer, 1998). The waters within the site boundary are therefore within the necessary depth requirement for maerl beds. No recent bathymetric data is available for the wider Fal and Helford SAC.

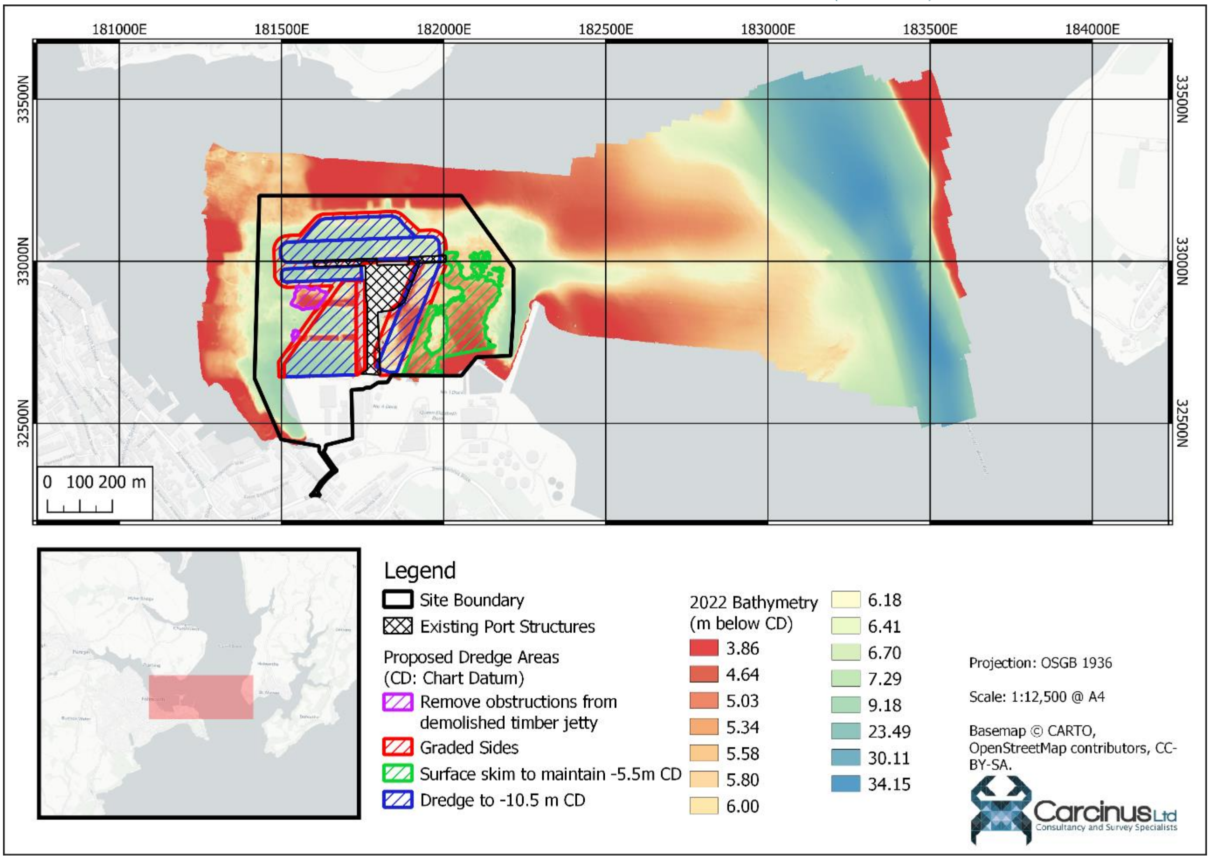


Figure 3 Bathymetric data from the waters surrounding the proposed development location, based on 2022 collected data.

Backscatter (2022)

Multibeam backscatter imagery was collected at the site in 2022 and is presented in Figure 4. The backscatter data was collected by Shoreline Survey Ltd. using an iWBMS Norbit multibeam echo sounder via their proprietary Hypack Survey software. Lighter areas (lower reflectance) typically indicate a softer seabed, such as muds, silts, sands and mixed gravels, and darker areas typically indicate a harder seabed (rock, cobbles, including biogenic reef such as maerl).

The seabed nearest the port structures has a lower return (indicating softer sediment) than seabed farther away. There is also an apparent habitat transition running parallel with the eastern boundary of the site, with sediments east of this point more reflective (harder). No recent backscatter data is available for the wider Fal and Helford SAC. The findings of the 2022 backscatter study are in alignment with the Particle Size Distribution (PSD) data (presented below).

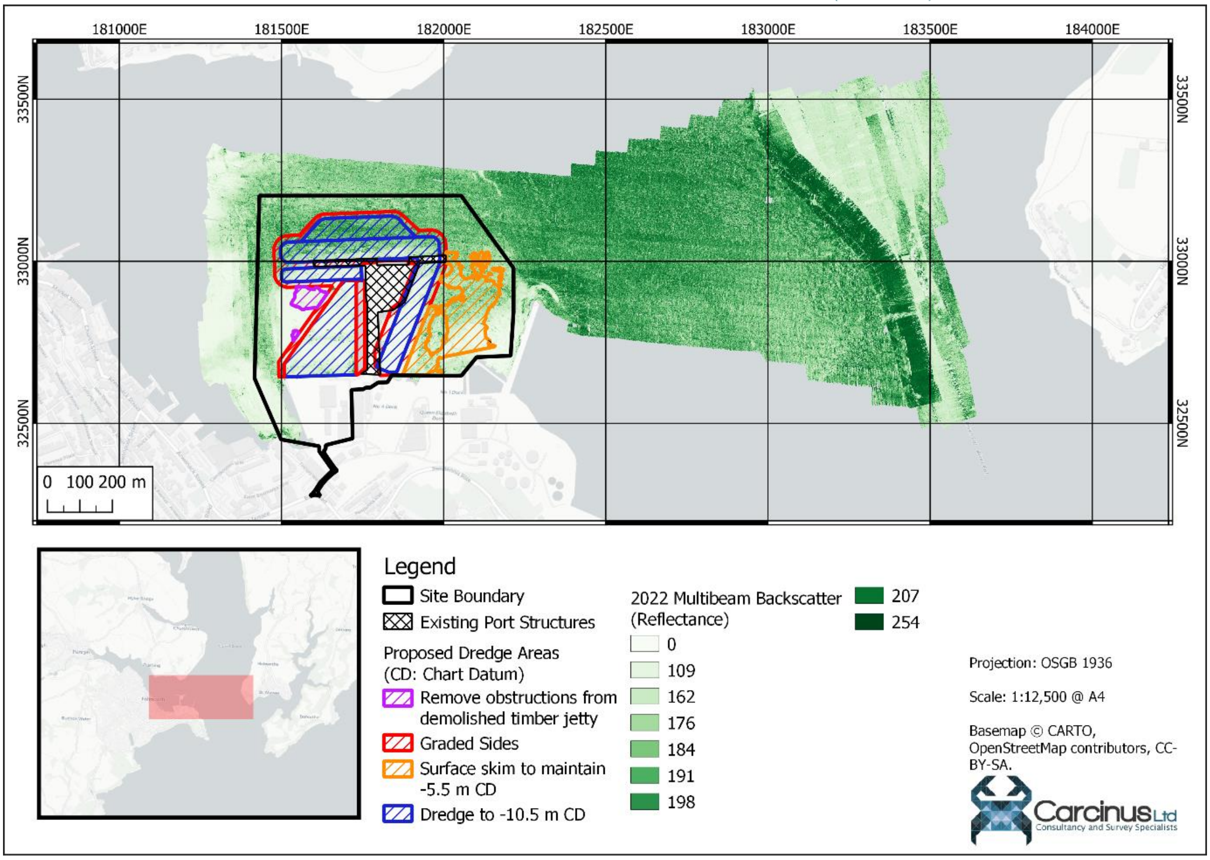


Figure 4 Multibeam backscatter imagery collected at the Port of Falmouth in 2022.

Flow/Tides

Falmouth has a semi-diurnal macrotidal regime, with a mean tidal range during Springs of 4.6 m and a mean tidal range during Neaps of 2.3 m. The incoming tide initially enters the Falmouth Estuary in a northerly direction before flooding westwards up the river Penryn, past the proposed development. The ebbing tide travels in the reverse direction, eastwards down the river Penryn before turning south and out into Falmouth Bay.

Peak currents during spring tides within the site boundary are 0.3 m/s (~0.6 knots), and are strongest north of Queen's wharf. Peak currents during neap tides are much slower, approximately 0.1 m/s (0.19 knots). These peak flows will only occur for ~1-2 hours each tidal cycle, and will only occur once or twice within a two-week spring/neap period. For the majority of the time tidal flows will be slower. Tidal currents within the proposed development site boundary are generally slower than areas of the Fal Estuary known to have a significant aggregation of high quality maerl habitat, such as around St Mawes. Tidal currents in that area are nearer 0.8 m/s (~1.5 knots) during spring tides, more than double the flow rate within the site boundary.

Summary

Maerl beds require sufficient water movement to prevent smothering with silt (Hall-Spencer, 1998) and therefore are restricted to areas of strong tidal current or wave oscillation (Birkett, Maggs and Dring, 1998). The literature varies in terms of minimum tidal currents necessary to support maerl beds, but a conservative estimate suggests that tidal flows should not regularly fall below 0.1 – 0.2 m/s (Perry, Tyler-Walters and Watson, 2024). For the majority of the tidal cycle, tidal flows around the Falmouth Docks are low (generally in the 0.1-0.2 m/s range though up to 0.3 m/s for a short period at peak spring tide), allowing sediment to settle to the seabed in these areas. However, the level of siltation is generally low, in the 1-20 mm annual deposition range (ES Volume 2 Technical Appendix 6.2 Sediment Transport Modelling).

Historic Dredging

Historic dredging activities within the site boundary and surrounding waters are of relevance to this note because of the very slow timescales over which maerl beds grow and recover (1-2 mm/year, if at all), i.e. if an area of growing live maerl was removed in the 20th Century, it is very unlikely that it has recovered to a significant extent through settlement of propagules, if at all. It is possible however, that live maerl thalli could have been washed in by wave action.

A Marine Archaeological Technical Report (ES Volume 2 Technical Appendix 11.1 Marine Archaeological Technical Report) and a Stage 1 & 2 Geoarchaeological Assessment (ES Volume 2 Technical Appendix 11.2 Stage 1 and 2 Marine Geoarchaeological Assessment) have been undertaken for the seabed within the site boundary and should be referred to for further detail. These included an assessment of historic charts and aerial images, as well as analysis of vibrocores specifically undertaken for the proposed development. These show evidence of extensive dredging of the seabed during the 20th century, as well as some earlier dredging during the late 19th century. The bathymetric impact of previous dredging is greatest in the northwest of the site. Previous dredging in the southwestern area has been less destructive.

Falmouth Docks was initially created within a shallow-water tidal basin, and extensive dredging was undertaken. By 1860, a channel 300 ft wide was dredged to connect the docks to the deeper waters of Carrick Roads to the east of the study area. In 1936, there is evidence showing that areas around Queens Wharf and the Northern Wharf were dredged to -5.8 m CD. In 1965, further dredging was undertaken in these same areas to -9.5 m CD and to -7.5 m CD in the navigation channel. Following this phase of dredging, the International Chart (Int 1720 1993) showed that the seabed depth around Queen's Wharf was -6.1 m CD and -5.5 m CD between Queens Wharf and the Northern Wharfs. The depth of the navigation channel was shown to be -5.2 m to -5.8 m CD.

Summary

All of the project's proposed dredge pockets are within areas that have been dredged within the last 100 years. The last confirmed dredging in the approach channel (east of the site boundary) was in 1940. Waters within the site boundary have not been dredged since 1965 (~ 60 years ago). Dredging activities would have removed any naturally seeded, growing maerl bed habitat (as this would have been situated on the surface of any removed material), and it is considered very unlikely that a significant recovery of live maerl bed would have occurred in the intervening period within the docks area. DDV surveys in this area (discussed in 2022 Ecology survey and 2023 Ecology survey sections below) support this conclusion.

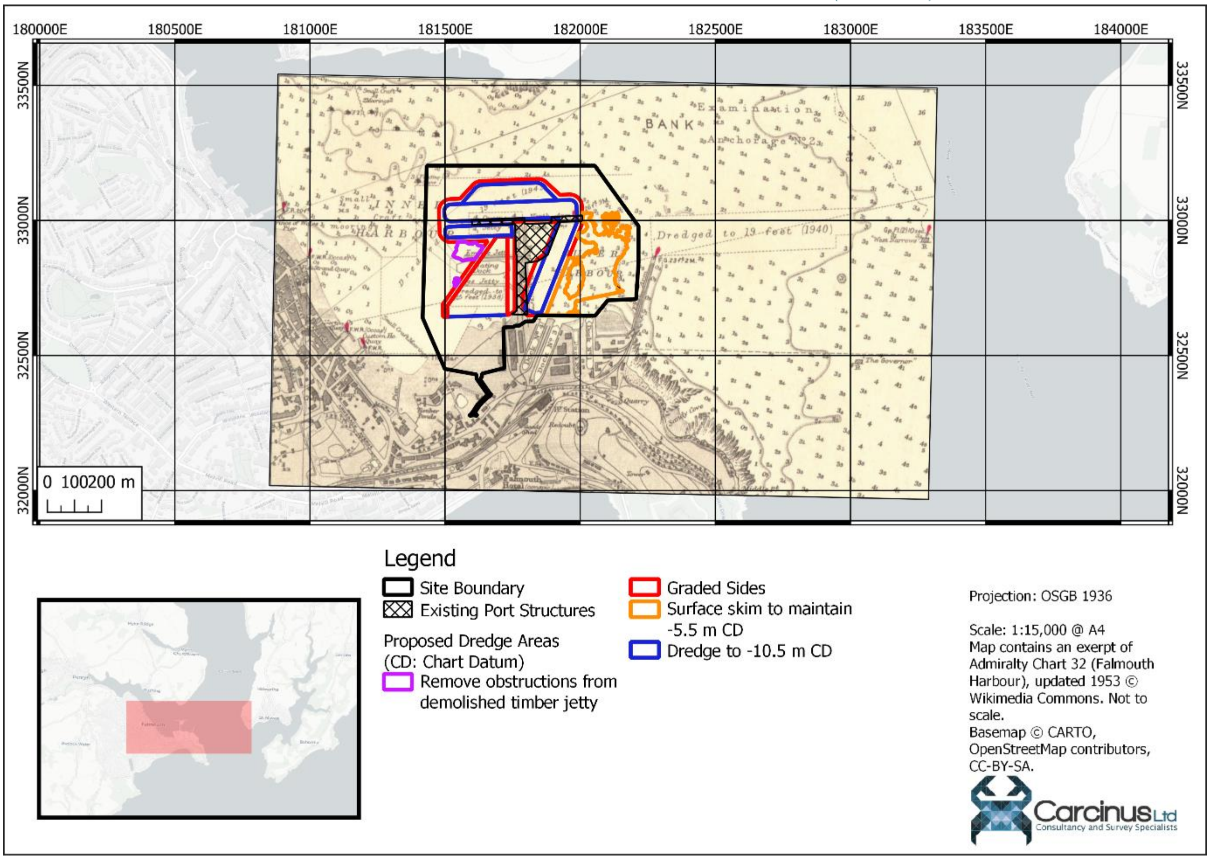


Figure 5 Excerpt Admiralty Chart 32, updated 1953 with dredge pocket overlaid.

Shading

Maerl is a species of algae that requires light to grow. It is intolerant to long-term reductions in light availability (Perry, Tyler-Walters and Watson, 2024). In the northern hemisphere, the sun moves in an arc from east to south to west during the day.

The area to the north of the main jetty structure (Queens Wharf) currently experiences significant shadowing due to the presence of wharf structures. In addition, information obtained from the port in 2023 shows that vessels up to 177 m long and 26.4 m broad were berthed along Queens wharf for 2/3 of the year (8 months). The longest gap with no vessels berthed was between November and December, which coincides with the shortest days and therefore least daylight during the year. The extended presence of berthed vessels causes significant shading throughout most of the year, in addition to that of the wharf structure itself.

Geochemical Environment

Ground Investigations

Geotechnical Engineering Limited undertook a Factual Ground Investigation Report for the Falmouth Docks Development in May 2024 (Report ref: 37977, Geotechnical Engineering Ltd, 2024). Fieldwork was conducted in March 2024 and comprised 21 no. vibrocores.

The nature of the sediments in the first ~1 m below the sedimentary surface (as significant aggregations of maerl thalli are not found below this) have been considered. Whilst the vibrocores (VCs) collected are small in diameter they provide an indication of the presence of maerl thalli within sediments, in addition to providing samples for chemical analysis (see next section). The spatial position of each of the VCs is presented in Figure 6, and the findings of the Ground Investigation are shown in Table 1.

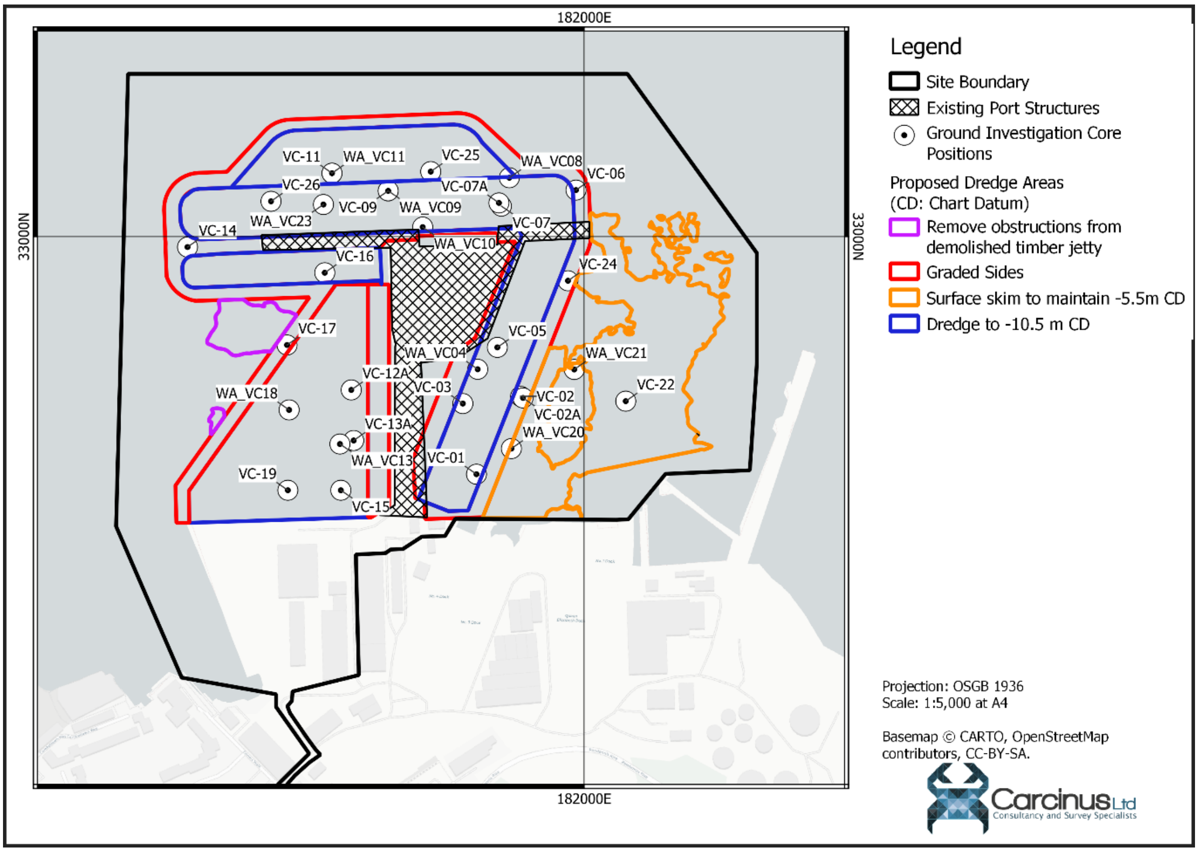


Figure 6 Exploratory hole locations around Falmouth Docks.

Table 1 Vibrocore log data collected around the Falmouth Docks site up to 1.1 m depth. Locations of vibrocores in context of site shown in Figure 6. Descriptions of sediment are verbatim from the geotechnical survey reports, produced by specialist geotechnical / marine archaeological surveyors. Samples where maerl thalli were recorded have been highlighted in blue.

Vibrocore	Sample depth (m below ground level)	Description
	Environmental Vibrocores	
VC-01	0.00-0.10	Very soft black clayey SILT. Faint hydrocarbon and organic odour. 0.35m: Pocket (up to 60x30x40mm) of orangish brown clay.
	1.00-1.10	Soft locally thickly laminated grey CLAY with rare shell fragments (up to 50x30x5mm).
VC-02	0.05-0.15	Very soft greenish grey mottled light bluish grey CLAY. 0.00 - 0.05m: Very soft black slightly gravelly silty clay. Gravel is angular fine and medium slate.

	0.90-1.00	Greenish grey mottled orangish brown very clayey angular fine to coarse slate GRAVEL.
VC-02A	0.00-0.10	Very soft black slightly gravelly clayey SILT with rare shell fragments (up to 85x80x3mm), seaweed stems (up to 140x100x5mm). Faint hydrocarbon odour.
	1.00-1.10	Stiff becoming very stiff orangish brown and light greenish grey gravelly becoming very gravelly CLAY. Gravel is angular to subrounded fine to coarse siltstone and slate.
VC-03	0.00-0.10 1.15-1.25	Very soft black silty CLAY with a local veneer of possible hydrocarbons. Faint hydrocarbon odour.
VC-05	0.00-0.10	Very soft black clayey SILT. Faint hydrocarbon odour. 0.50 - 0.95m: Slightly gravelly. Gravel is angular and subangular fine to coarse coal and clinker.
	1.00-1.10	Dark grey slightly gravelly clayey fine SAND. Gravel is subangular and subrounded fine and medium crystalline.
VC-06	0.00-0.05	Very soft black slightly gravelly silty CLAY. Gravel is angular fine to coarse clinker and slate. Faint hydrocarbon odour(MADE GROUND) Very soft brown clayey SILT.
	1.00-1.10	Firm light greenish grey gravelly CLAY. Gravel is angular fine to coarse slate and crystalline.
VC-07	0.00-0.10	Black and dark greenish grey clayey fine SAND with rare shell fragments (up to 70x43x10mm).
	1.00-1.10	Greenish grey clayey angular fine to coarse slate GRAVEL.
VC-07A	0.00-0.10	Very soft clayey SILT with rare shell fragments (up to 55x45x12mm). Faint hydrocarbon odour. Very soft dark grey mottled greenish grey slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse slate and crystalline.
	1.00-1.10	Stiff light greenish grey gravelly becoming very gravelly CLAY. Gravel is angular fine to coarse slate.
VC-09	0.00-1.00	Very soft black slightly sandy gravelly CLAY with abundant fragments of coral

		(Maerl) (up to 3mm diam). Gravel is angular and subangular fine to coarse possible clinker. Faint hydrocarbon odour (MADE GROUND) Very soft greenish grey CLAY with abundant shell fragments (up to 27x25x15mm). Strong organic odour.
VC-11	0.00-1.00	Very soft greenish grey CLAY with frequent coral (Maerl) fragments (up to 5x3x3mm). Strong organic odour. 0.00 - 0.10m: Black plastic amorphous Peat.
VC-12A	0.00-1.00	Very soft black clayey SILT. Strong hydrocarbon odour.
VC-13A	0.00-0.80	Limited recovery. Recovered as very soft black clayey SILT with a thin veneer of hydrocarbon and rare fragments of rubber (up to 80x50x25mm) and abundant fragments of wood (up to 80x60x35mm). Very strong hydrocarbon odour. (MADE GROUND)
VC-14	0.00-0.10	Very soft black clayey SILT with abundant fragments of coral (Maerl) (up to 10x9x5mm), abundant shell fragments (up to 13x3x2mm). Faint hydrocarbon odour.
	1.00-1.10	Soft grey sandy CLAY with abundant fragments of coral (Maerl), frequent shell fragments (up to 31x26x15mm). Strong organic odour.
VC-15	0.00-0.10	Very soft black slightly gravelly clayey SILT with rare fragments of fabric (up to 100x55x5mm). Gravel is angular medium and coarse clinker. Strong hydrocarbon odour. (MADE GROUND)
	1.00-1.10	Greenish grey and dark bluish grey slightly sandy clayey angular fine to coarse slate GRAVEL.
VC-16	0.00-1.00	Very soft black slightly gravelly clayey SILT with rare fragments of wood (up to 70x18x10mm). Gravel is angular and subangular medium and coarse clinker rarely glass. Strong hydrocarbon odour. (MADE GROUND)
VC-17	0.00-0.10	Very soft black clayey SILT with rare fragments of wood (up to 90x25x15mm) and rare glass. Strong hydrocarbon odour. (MADE GROUND)

	1.00-1.10	Very soft grey slightly sandy silty CLAY with frequent shell fragments (up to 30x20x5mm).
VC-19	0.00-0.10	Very soft black slightly sandy slightly gravelly silty CLAY. Gravel is angular coarse clinker. Faint hydrocarbon odour (MADE GROUND)
	1.00-1.10	Soft greenish grey silty CLAY with frequent shell fragments (up to 13x11x10mm). Strong organic odour.
VC-22	0.00-0.10	Very soft black silty CLAY. Grey and brown fine to coarse SAND and angular fine to coarse slate and quartz GRAVEL.
	1.00-1.10	Greenish grey clayey angular fine to coarse slate and quartz GRAVEL. 0.90 - 1.00m: Orangish brown.
VC-24	0.00-1.00	Very soft black slightly sandy slightly gravelly silty CLAY. Gravel is angular fine to coarse slate. Soft becoming firm orangish brown mottled light grey silty CLAY with rare relict rootlets.
VC-25	0.00-0.10	Very soft greenish grey silty CLAY with abundant fragments of coral (Maerl) (up to 3 mm diam). Strong organic odour.
	1.00-1.10	Very soft greenish grey silty clay with frequent locally abundant shell fragments (up to 35 x 43 x10 mm). Strong organic odour. 0.90m: Very thin bed of greenish grey fine sand with abundant shell fragments (up to 8x3x2mm).
VC-26	0.00-0.10	Very soft black slightly gravelly clayey SILT with frequent shell fragments (up to 30x23x8mm). Gravel is angular coarse clinker. Faint hydrocarbon odour (MADE GROUND)
	1.00-1.10	Very soft greenish grey silty CLAY with abundant shell fragments (up to 30x20x14mm). Strong organic odour.
Archaeological Vibrocores		
WA_VC04	0-0.70	Dark brownish black organic silty CLAY with frequent fine (<3mm) shell fragments. Very wet material (?recent). Gradual lower boundary
	0.7-0.92	Black amorphous silty PEAT with occasional fine organic fragments (Phragmites material) and rare fine shell fragments.

WA_VC08	0-0.08	Dark blackish brown slightly clayey sandy GRAVEL with frequent fine to coarse (4-16mm) shell fragments including bivalves. Specimens > 10 mm are screw shells. Gravel is rare laminae shale and frequent fine gravel-sized coral fragments. Irregular sharp lower boundary.
	0.08-1.70	Light yellowish brown firm slightly silty gravelly CLAY. Gravel is fine to coarse (2-25mm) subangular to angular siltstone. Lower boundary unclear.
WA_VC09	0-0.07	Light greyish brown slightly clayey very shelly medium to coarse SAND. Irregular sharp lower boundary
	0.07-0.28	Dark brownish black soft silty CLAY with a strong organic/hydrocarbon odour and rare shell fragments becoming frequent with depth. No organic fragments. Sharp lower boundary.
	0.28-4.40	Light slightly greenish grey soft silty CLAY with frequent fine to medium (<12mm) with rare coarse (16mm) shell fragments. Sharp lower boundary
WA_VC10	0-0.22	Mid brownish grey gravelly sandy CLAY. Sand is fine. Gravel is fine subangular quartz and siltstone clasts and frequent fine (<4mm) shell fragments. Sharp lower boundary
	0.22-1.85	Light grey firm slightly clayey becoming very clayey SILT with occasional fine to coarse (<16mm) shell fragments including a coarse gravel-sized bivalve at 0.58m. Very shelly at lower boundary between 1.80-1.85m. Sharp lower boundary
WA_VC11	0-0.10	Dark brown sandy CLAY with strong organic smell and few fine coral fragments. Sharp lower boundary
	0.10-4.00	Light greenish grey soft silty CLAY with frequent fine coral fragments and rare thick-walled coarse (<25mm) shell fragments. Becoming rare shell fragments and very silty at 3.00 m.
WA_VC13	0-0.62	ark black slightly gravelly silty CLAY with fine to medium gravel clasts (2-12mm) with strong organic odour. Occasional organic fragments. Very

		wet material. Irregular diffuse lower boundary
	0.62-0.95	Light grey becoming yellowish brown very gravelly CLAY with rare fine shell fragments. Gravel is fine to coarse (2-26 mm) subangular to angular quartz, slate and siltstone clasts. Modern CBM including wire and fabric.
WA_VC18	0-0.13	Black very soft organic silty CLAY with a strong organic odour and occasional fine to medium (<12 mm) shell fragments and rare organic fragments. Sharp lower boundary
	0.13-4.10	Orangish brown becoming bluish grey and strong orange between 1.90-1.94 m firm very silty CLAY. Slightly sandy (fine) in places. Rare fine shell fragments from 2.80 m.
WA_VC21	0-0.97	Light brown mottled bluish grey firm silty CLAY with rare becoming occasional fine to medium (<10 mm) shell fragments with depth. Thin beds of coarse gravel-sized shell between 0.48-0.50 m and 0.69-0.71 m. Rare pockets of soft black silty clay with occasional coral fragments. Rare fine organic fragments between 1.00-1.06 m. Sharp lower boundary
WA_VC23	0-0.20	Dark blackish grey silty CLAY with frequent coral fragments and fine to coarse (<15 mm) shell fragments, predominantly screw shells. Strong organic odour. No organic fragments. Gradual lower boundary
	0.20-5.35	Mid grey slightly sandy very clayey very silty fine SAND with frequent fragmented and whole shells between 0.50-0.68m and occasional fine to medium (2-10 mm) shell fragments throughout. Coarse (c. 70 mm) fragment of wood at 1.9 6m.

Samples VC-01, VC-02, VC-02A, VC-03, and VC-05 were taken from the eastern berth pocket. They consisted of mainly Clay/Silt with some rare gravel. VC-22 was also to the east of the main jetty structure however not as close to the structure itself. This core consisted of similar materials to the 5 cores in this area as well as some sand. VC-24 was taken to the north east of the eastern berth pocket and contained similar materials to those above.

To the north of Queens Wharf, from east to west, samples VC-06, VC-07, VC-07A, VC-25, VC-09, VC-11, and VC-26 were taken. These cores contained a mixture of Clay, Silt, and Sand materials. In the centre of this sampling area, cores were found to contain maerl fragments. VC-09 contained clay with maerl fragments (Plate 1) , VC-11 contained sandy, gravelly clay with a small amount of very small maerl fragments (they cannot be seen in the photograph of this section of core, Plate 2), and VC-25 consisted of silty clay with small fragments of maerl (Plate 3). Maerl fragments north of Queen's Wharf did not exceed 3 mm diameter. VC-14 was taken to the west of the main jetty structure in the north and also contained very soft black clay and silt with fragments of maerl and shell (Plate 4). Maerl fragments within VC-14 were ≤10 mm diameter.

Plate 1 VC_09 from 0 – 2.0 m depth.

Plate 2 VC-11 from 0 - 2.0 m depth.

Plate 3 VC-25 from 0 - 2.0 m depth.

Plate 4 VC-14 from 0 - 2.0 m depth.

The remaining cores were taken from the western berth pocket (VC-16, VC-17, VC-12A, VC-13A, VC-19, and VC-15). These cores contained similar material to those around the docks with a mixture of silt, clay, gravel, and sand. They also contained some wood, rubber, and fabric.

Summary

It can be concluded that none of cores removed and analysed during the Ground Investigation studies would constitute a maerl bed under any of the descriptions given as part of the SAC's conservation advice package, as sediments were predominantly clay, silt and sand in the first 1 m, with no maerl thalli fragments above 10 mm, regularly cited to be the size threshold at which maerl thalli (dead or live) have functional benefits above inorganic gravels (Nature Scot, 2018; Axelsson, 2023) . Additional information as to the nature of the sediments in this area is described in the Ecological Environment section.

Sediment Geochemistry

The vibrocore samples were analysed for heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn), Organotins, Polyaromatic Hydrocarbons (PAH), Total Organic Carbon (TOC), Total Hydrocarbon (THC), Polychlorinated Biphenyls (PCB), Organochlorine Pesticides (OCPs), and Brominated Flame Retardants (PBDEs).

The surface layer (the top 5-10 cm) of core samples north of the Wharf contained heavy metal concentrations frequently above Cefas AL1[2]. In addition, to the north of Queen's wharf, the concentration of Organotins were above AL1 in all locations except one. TBT concentrations (Tributyltin) at two locations were above AL2 (VC-07A & VC-09). The concentrations of most PAHs were above AL1 and total hydrocarbon content was 100 – 740 mg/kg. PCB ICES 7 and Sum of 25 Congeners were above AL1 and AL2 in places. The mean TOC was 1.92%. The results of the sediment geochemistry studies were used to determine the depth of sediment within the proposed dredge pocket unsuitable for disposal at sea (Figure 7). Sediments nearest the wharf structures (south of Queens wharf) were the most contaminated, and assessed to be unsuitable for marine disposal up to 3 m below the sediment surface. Sediments north of Queen's wharf were assessed to be unsuitable for marine disposal up to 0.3 m below the sediment surface.

Additionally, a visual inspection of the core imagery indicates that some cores contain very dark coloured sediment, indicative of an anoxic environment, potentially containing H_2S. Cores with the largest amount of dark sediment were VC01, VC03, VC12, VC16 and VC17, all within the eastern and western berth pockets. The specific concentration of H_2S was not determined in a laboratory during analysis of these cores.

[2]https://assets.publishing.service.gov.uk/media/5a818afae5274a2e87dbe2f7/High_level_review_of_current_UK_action_level_guidance_report__1053_.pdf

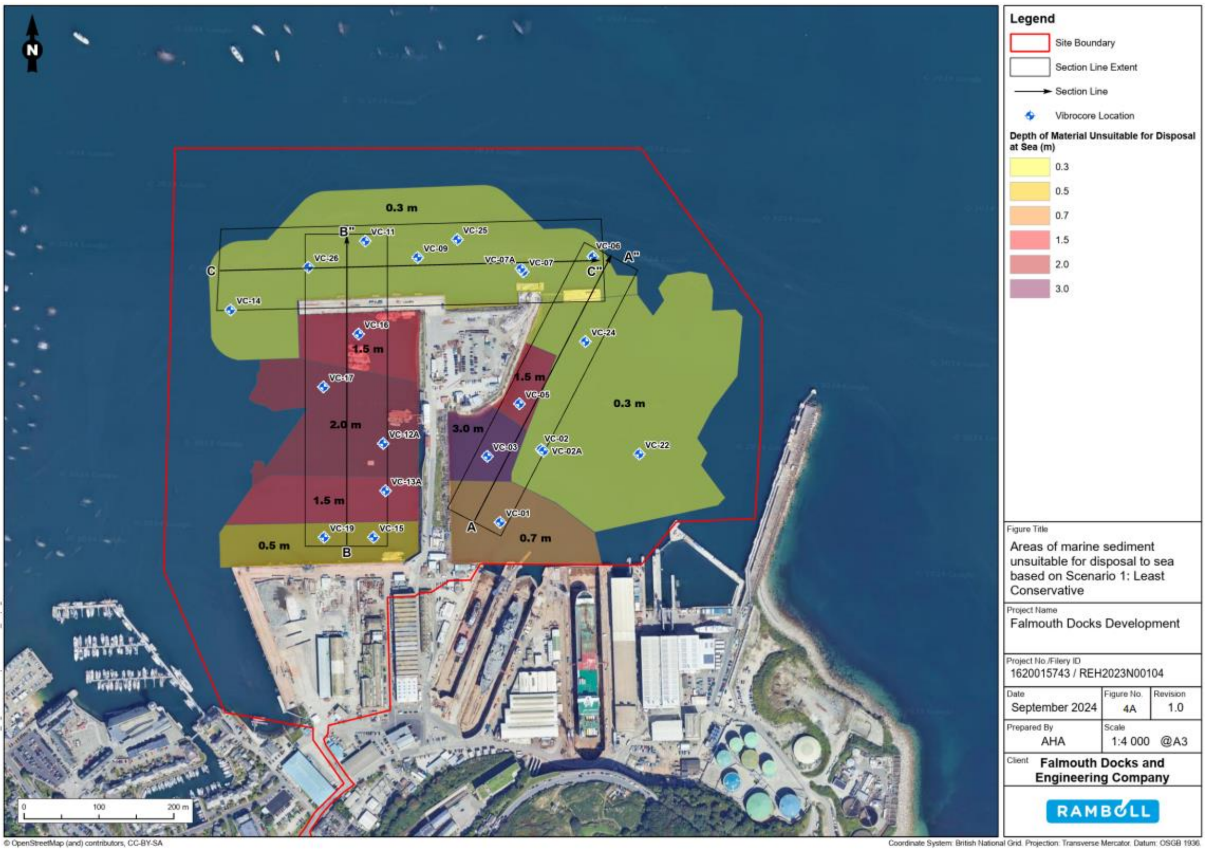


Figure 7 Areas of marine sediment unsuitable for disposal to sea. Extracted from the Ground Investigation Interpretative Report dated September 2024 (ES Volume 2 Technical Appendix 8.3)

Summary

The evidence on the sensitivities of maerl habitat to contamination from hydrocarbons or PAHs is restricted 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 (Perry, Tyler-Walters and Watson, 2024) in relation to acute exposure. If the habitat is sensitive to acute exposure to a chemical, it is reasonable to draw the conclusion that the habitat is unlikely to grow on already contaminated sediments, and so the relatively contaminated nature (unsuitable for marine disposal at depths up to 0.3 – 3 m) of the sediments within the site boundary are very unlikely to be able to support an area of live maerl.

Particle Size Distribution (PSD)

It is recognised that dense aggregations of dead maerl can provide valuable habitat due to the infauna that are able to reside within them, but it is also generally stated that the dead maerl thalli need to be > 1 cm to provide sufficient complexity to qualify as 'dead maerl' and not just 'gravel' (Axelsson, 2023). The surface layer of the vibrocores (top 5-10 cm of the core) were analysed for PSD.

To the north of Queen's Wharf, the mean percentage of the samples that had particle size greater than 8 mm[3] was 2.4 % (the maximum was 4.9 %). VC-09 was excluded from this calculation as it contained a large shell (not maerl). Throughout the rest of the Ground Investigation Survey array, the mean percentage of the sample with particle size greater than 8 mm was 0.8 % (maximum was 2.6%). Again, this excluded large shells/anthropogenic debris which would alter the results.

Day grabs taken during the May 2023 Marine Ecology Survey (ES Volume 2 Technical Appendix 9.3) were also analysed for PSD. The position of these grabs was targeted to the areas immediately surrounding Falmouth Docks (i.e. predominantly within the dredge footprint). The scope for this survey was agreed with NE (agreement received 20/09/2022) and the MMO (ENQ/2022/00146), and it was a condition that no grabs should be collected within areas of live maerl habitat to avoid damaging it. The day grab used typically samples the top 15 cm of sediment. DDV imagery was collected during the same survey campaign, and is used in the summary 2023 Ecology survey to provide information in areas where day grab sampling was not undertaken.

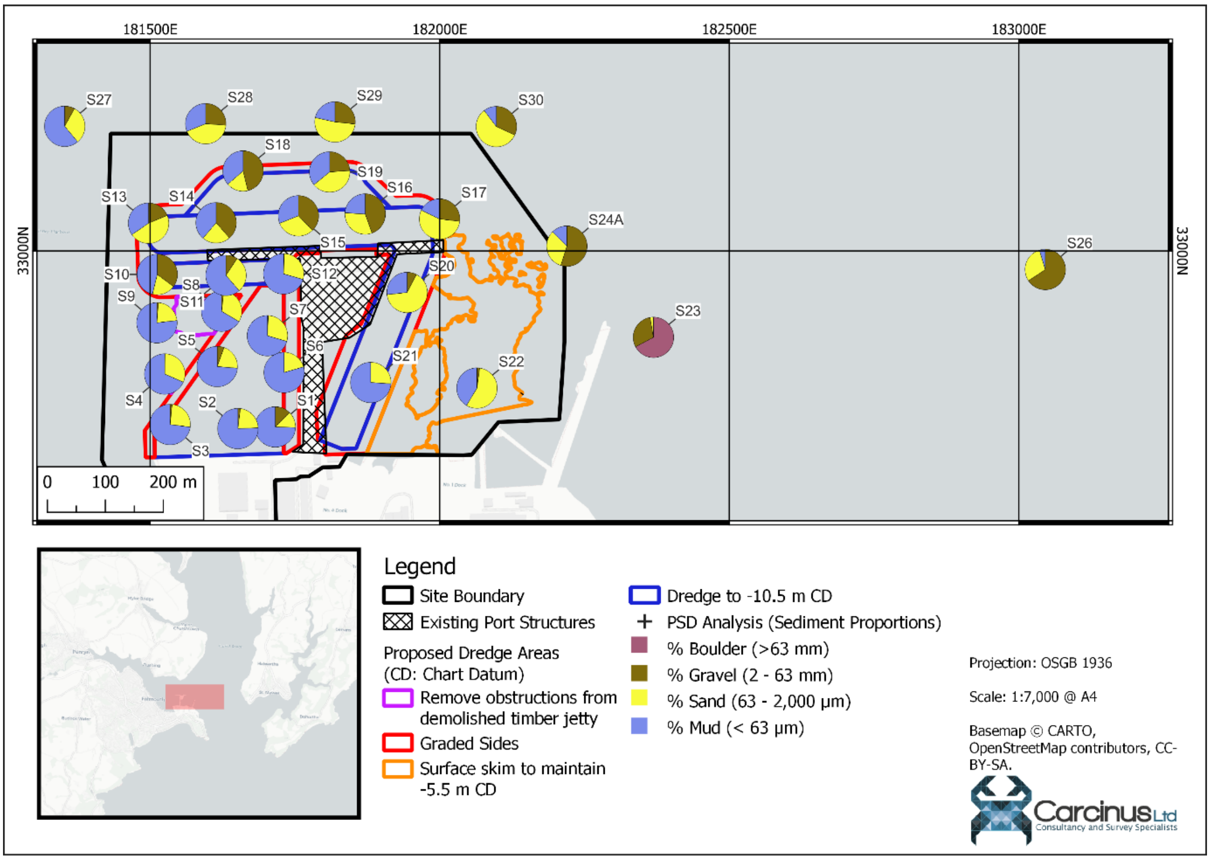


Figure 8 Location of grab samples and proportion of sediment in each day grab comprising of Boulder, Gravel,

Amongst all grab samples, the mean percentage of each sample with particle size greater than 8 mm was 7.5%. Sample S23 contained one large boulder (and 93% of this sample was therefore >8 mm), and when this station is excluded the mean percentage >8 mm was 4.45 %. Amongst those grabs immediately north of the wharf (S13 – S19; S27-30), the mean percentage of each sample with particle size greater than 8 mm was 3.7 % (max 13.7 % at S13). Images of the grabs were captured and analysed (and are presented in Appendix D of the 2023 Survey Report (ES Volume 2 Technical

[3] Note – proportion above 8 mm diameter is quoted as 8 mm is the nearest half-phi interval to 1 cm, the threshold for maerl thalli.

Appendix 9.3)), and these indicated that particles > 8 mm were mainly shells and cobbles. All dead maerl fragments in this area were < 1 cm.

In the day grab samples around the rest of the wharf structure (S1 – S12; S20-S21 & S24A and excluding S13-19; S27-30), the mean percentage of the sample with particles greater than 8 mm was 3.2% (max 28.3% at S10). Sample S23 was excluded from this calculation 67.2% of this sample was a boulder (particle >63 mm).

Summary

Overall, the majority of samples were dominated by fine sand and mud sediments. This aligns with the results of the Ground Investigation. Imagery of day grabs from the 2023 Marine Ecology survey suggests that materials > 8 mm mainly comprised shells, pebbles, and anthropogenic materials. The vibrocore log (ES Volume 2 Technical Appendix 8.1 Factual Ground Investigation Report) also states that the maerl fragments observed were small (< 1 cm), and mostly below 3 mm in length.

When the PSD results from the Ground Investigation and marine ecological studies are considered in combination, it can be concluded that the sediments around the existing port structure are consistent in their physical characteristics. There is a small percentage of sediments >8 mm, there is a notable proportion of fine sediments (<63 µm), and none of the sediments constitute maerl beds, due to the lack of a significant sediment proportion > 8 mm.

Ecological Environment

Historic Surveys and Data

Maerl beds within the Fal and Helford SAC have been subject to a number of studies throughout the last few decades. The following paragraphs briefly summarise the various studies undertaken, broken down into studies localised to the Helford River and the Fal estuary.

Helford River

Maerl was first recorded in the Helford estuary by Rostron (1987). They described between 40-80 % cover of live maerl (*L. corallioides*) at 3 m below chart datum (within the study area considered in this technical note depths range from 1 – 10 m below chart datum), but did not make an estimate of the extent of the bed.

In 2012, the Helford Marine Conservation Group (in collaboration with Plymouth University) conducted a boat-based survey of the seabed on the outer part of the Helford Estuary using a Remote Operated Vehicle (ROV) (Seasearch, 2012). Maerl was found at the point where the estuary narrows near Bosahan Point. A second dive survey was conducted, finding that the maerl extended several hundred metres along the seabed in a strip from east to west.

Further surveys in 2012 mapped the bed in greater detail and studied the associated fauna and flora, including some surveys with a particular focus on worms and seaweeds. The maerl in the Helford was found to be composed mainly of 80% live *L. corallioides*, in shallow water approximately 4 m below chart datum. It was observed to support a wide range of other seaweed species including some BAP species, native oysters *Ostrea edulis*, and *Edwardsia timida* (timid burrowing anemone).

The Helford bed, according to Bunker (2012) was approximately 2.2 Ha (+/- 0.5 ha), and the length of the bed from east to west was 430 m by 100 m north to south. The widest part of the bed was closest to the estuary. In 2022, the Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA) conducted a Drop-Down Video (DDV) Maerl Habitat survey (Jenkin *et al.*, 2023). The aim of the survey was to get a better understanding of the types of maerl in the SAC, and in the Helford estuary maerl was confirmed however the area extent was not mapped.

Fal Estuary

Maerl beds in the Fal estuary, in particular those at St Mawes Bank, have been subject to a number of surveys since their first discovery. These have been both diving surveys (e.g. Seasearch, 2012) and DDV camera surveys (Jenkin *et al.*, 2023), as well as some coring studies (e.g. Royal Haskoning, 2004). A brief description of the location of study is presented in the following paragraphs.

In 2004, Falmouth Harbour Commissioners (FHC) commissioned a marine ecological study to understand the effects of maerl extraction (Royal Haskoning, 2004). This study was focussed on the Carrick Roads area of the Fal (east of the proposed development's site boundary) and attempted to quantify the depth of maerl present. 23 cores were taken over 150 ha of survey area. The deepest maerl was found in the south of the study area, near the mouth of the Fal Estuary between Pendennis Point and St Anthony Lighthouse, as well as in the north within Carrick Roads. None of the survey points were within the proposed development site boundary, and the closest sampling location (300 m from the north-eastern edge of the site boundary) had no maerl present.

In 2008, FHC and the Falmouth Docks and Engineering Company commissioned Royal Haskoning to undertake a marine ecological study to inform the baseline of the marine ecology sections of the EIA for the Falmouth Cruise Project (Axelsson et al., 2008[4]). This study covered 11 transects and collected 20 sediment cores over an area of 160 Ha. This included two cores and transects within the current proposed development's site boundary, just to the north of Queens Wharf. These stations (CS01 and CS02) were found to have occasional or absent maerl respectively. This study also undertook cores and transects to the south-east of the Eastern Breakwater finding an area dominated by coarse gravels and sands characterised by kelps and red algae with varied patches of dead and live maerl. For transect BT-1 closest to the breakwater, there were loose fragments of dead maerl present but occasional transitioning to maerl fragments in peaks in sediment waves created by water movement. Moving further southeast there were patches of live maerl observed.

The study does not report absolute percentage covers but rather describes the abundance according to the DAFOR system, which unlike the similar SACFOR scale, does not have a strict definition (Sutherland, 2006). Live maerl was frequently 'rare' or 'occasional' across the survey array. Dead maerl was more common, generally recorded as 'abundant' or 'dominant'. The study did not comment on the general pattern of maerl across the study area, nor did it differentiate between the different categories of maerl habitat identified. It is considered likely that the distribution of different benthic biotopes across the survey array are broadly similar now, to that identified during the Carcinus Ltd. studies (described in the next section) although the survey areas are not identical.

In 2014, Natural England published a report on the maerl beds in the Fal & Helford SAC, and were able to produce comparisons between the extent of maerl in 2013 to 2002 (Allen *et al.*, 2014). This study was informed by a drop-down video and diver survey, undertaken in 2013. Diving operations were restricted to the St Mawes area (~ 2 km east of the proposed development's site boundary and outside of the zone of influence) and within the Helford River. Drop-down video transects were undertaken over a wider area, extending from the Carrick Roads area out into Falmouth Bay and

[4] Axelsson M., Bamber, R., Dewey S., Duke S. and Hollies, R. (2008). Falmouth Cruise Project EIA - Marine Ecological Survey. 15th January 2008.

within the Helford River. The study involved the collection of 100 camera drops over an area of ~4,000 Ha and 15 diver surveys over ~120 ha, with significant interpolation of data between survey locations. Live maerl was confirmed at St. Mawes, and the extent of the bed was reported to have not changed since 2002.

Deep deposits of dead maerl have previously been found in Carrick Roads and in the wider Falmouth Bay area, potentially showing that live maerl formerly covered a much wider area (Birkett, Maggs and Dring, 1998). Hoskins (2014) reported dense aggregations of live maerl off St Mawes, ~2 km away on the opposite side of the Fal estuary to the Falmouth Docks. Also present in this area were areas of seagrass, as well as clean/silty fine sand and mixed sediments.

Sheehan *et al.* (2015) sampled approximately 10 ha of predominantly dead maerl beds in Falmouth harbour to the east of the port structures and in the subtidal channel of the Fal estuary, close to (but not within) the proposed development's site boundary. The survey was not designed to characterise the nature of the benthic habitat, but the site description provided in the paper notes that the maerl in this area was dead maerl rather than live.

More recently, in 2022 C-IFCA undertook a drop-down video (DDV) survey of the Fal and Helford SAC (Jenkin *et al.*, 2023). This study covered a total of 25 transects over an area of ~3,000 Ha, with one transect off St Mawes (east of the study area, outside the modelled sediment deposition area for the proposed development), one in the Helford River and the majority located throughout Falmouth Bay. The study reported high quality maerl habitat off St Mawes and South of Pendennis point. Scattered areas of dead maerl were recorded throughout Falmouth Bay, often seen in 'waves' where the sediment is mobile. The study reported reductions in live maerl cover in areas shallower than 5 m.

2022 Ecology survey

In May 2022, Carcinus Ltd were contracted to conduct an initial DDV survey in the vicinity of the Port of Falmouth and approach channels. The objectives of this survey were to summarise the benthic habitats of the area with specific reference the distribution of maerl habitats in the vicinity of the proposed development. This survey was also undertaken with a view to informing the design of a more detailed multidisciplinary marine ecological study (see 2023 survey discussion below). The survey methodology was chosen as a method of surveying benthic habitats known to be highly sensitive to physical disturbance and abrasion.

A total of 24 transects were completed in and around the port structure, and out in the channel to the east (approximately 130 Ha total study area). Biotopes were assigned to each of the transects following the methodology set out in Parry (2019). Figure 9 presents a summary of the location of each transect and the biotope assigned to each one.

The scope of this survey was chosen when the Falmouth Docks project was in very early planning stages (i.e. before capital dredge areas had been confirmed) and the survey extent was approximately in line with the bathymetric and backscatter surveys undertaken in 2022 (see Physical environment), and transect paths were chosen to cover habitat boundaries visible in the backscatter data (and to provide representative coverage where no boundaries were visible). The outputs were used to inform the design of the project, including the approach to dredging methods to avoid impacts. This has resulted in several iterations of the dredging approach which significantly restricts dredge window and utilise water movements to minimise sediment dispersion and thereby minimise impacts outside the main dock area.

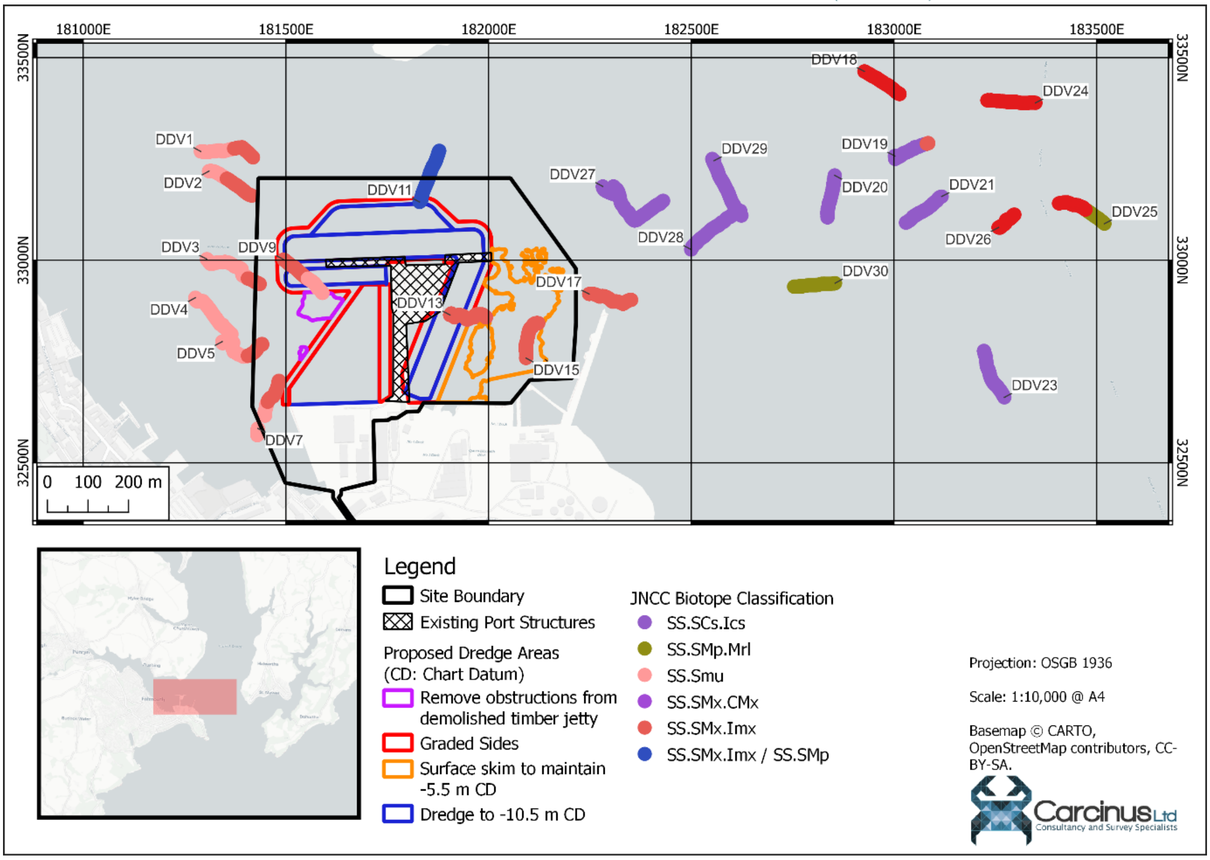


Figure 9 Biotopes along DDV transects surveyed within the Port of Falmouth and vicinity (Carcinus Ltd, 2022).

Transects studied around the wharf structures consisted of generally *Sublittoral Cohesive Mud and Sandy Mud* communities or *Infralittoral Mixed Sediment* (with some areas of *Sublittoral Macrophyte Dominated Sediment*). Transects to the east of the site boundary were generally coarse sediment, infralittoral nearer to the Port of Falmouth and circalittoral farther away (owing to greater water depths in this area).

Dead maerl was found in 11 of the 24 transects, and live maerl in 6 (Figure 10). DDV30 was characterised as **Maerl beds** biotope along its entire length, and was the only transect to be characterised as this habitat type. It is challenging to accurately measure the size of dead maerl thalli identified during DDV surveys, but generally the fragments identified were small (likely less than 10 mm) and sparse.

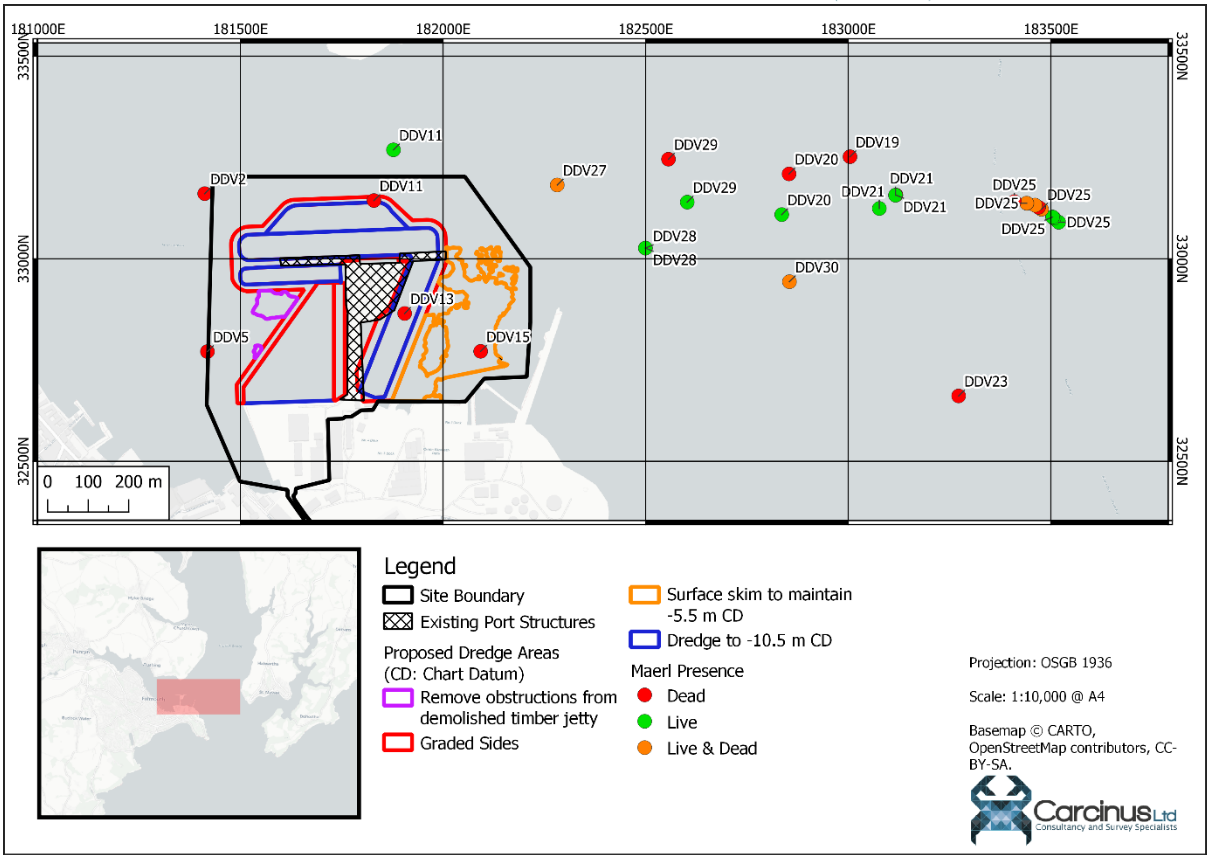


Figure 10 Locations of dead and live maerl along DDV transects in the May 2022 survey (Carcinus Ltd., 2024).

2023 Ecology survey

In May 2023, Carcinus Ltd were contracted to conduct multidisciplinary marine ecological surveys relating to the proposed redevelopment of the Port of Falmouth, Cornwall (Carcinus Ltd., 2024). These surveys were commissioned to enable a characterisation of the site and potential zone of impact resulting from the proposed development, required as part of the process of gaining consent for the proposed development. The approach to and scope of these surveys was agreed with Natural England via the Discretionary Advice Service (DAS) and outputs used to inform the dredge design process.

The data from these surveys have been used to inform the baseline of ES Chapter 9: Marine Ecology. It should be noted, whilst these surveys have been able to characterise some areas of maerl in the vicinity of the proposed development, they were not commissioned specifically to characterise maerl habitat across the wider Fal & Helford SAC. Survey operations covered approximately 114 Ha around Queen's Wharf, Western Wharf, Northern Wharf, and the water extending to the east. This survey did not reach the deep water channel of St. Mawes, nor north into Carrick Roads, where maerl is known to be present (see Fal Estuary) but is outside the project's predicted ZOI of this study.

A total of 15 no. DDV transects and 5 no. targeted camera drops were surveyed over ~60 Ha and biotopes assigned following Parry (2019) (Figure 11). A total of 29 Day Grabs (0.1 m^2) were also collected across the sampling array, subsampled for PSD and analysed for infauna at 0.5 mm and 1.0 mm size classes. In addition, hard structures around the port were surveyed by ROV.

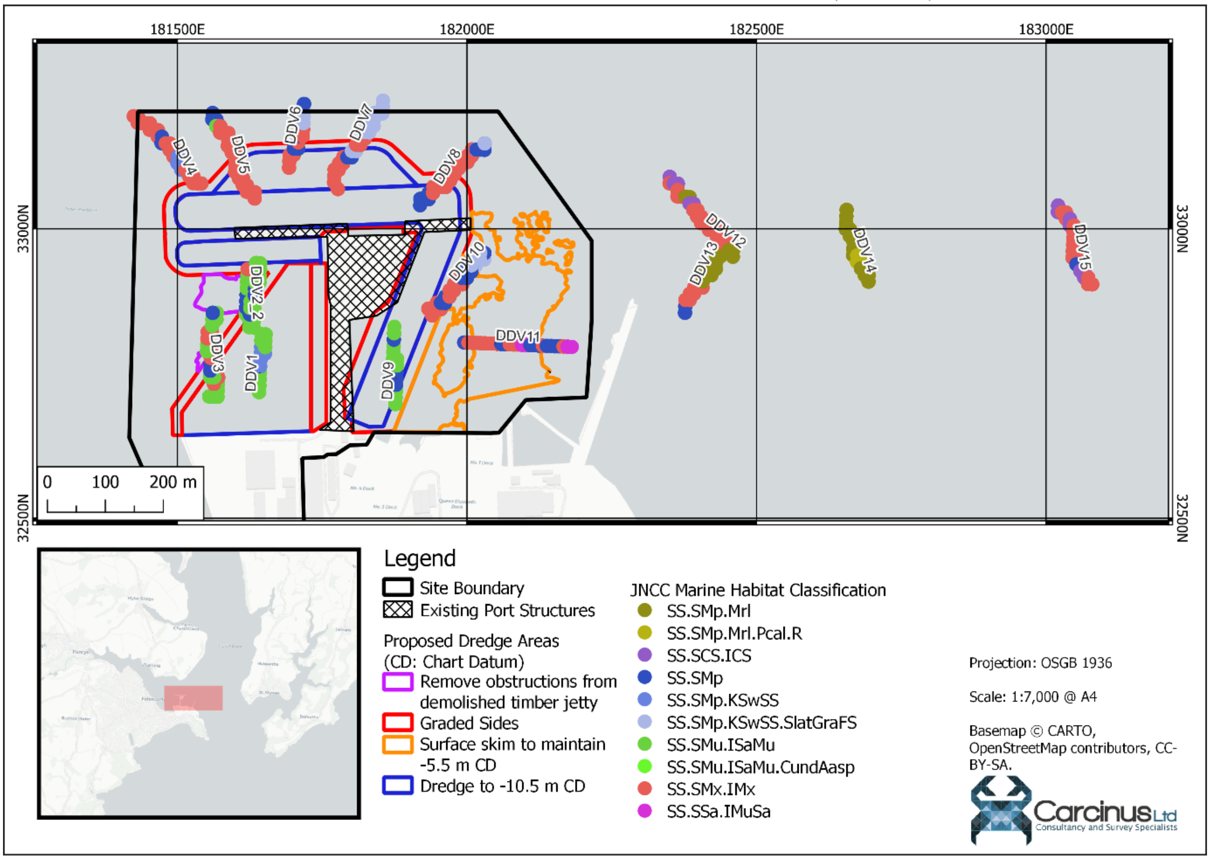


Figure 11 Habitat complexes along DDV transects surveyed within the study area (Source: Carcinus Ltd., 2024).

The Outer Channel to the east is the only place where live maerl was recorded during the survey undertaken in 2023. **Maerl beds** and ***Phymatolithon calcareum* maerl beds in infralittoral clean gravel or coarse sand** biotopes and habitat complexes were recorded along DDV12, DDV13, and DDV14. DDV14 was entirely live maerl habitat.

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** was identified in the northern parts of DDV6, DDV7 and DDV8.

Epifauna and flora visible in the DDV imagery were identified and enumerated using the SACFOR scale. Maerl bed biotopes are strongly associated with a variety of epifaunal species such as *Asterias rubens*, as well as providing habitat for burrowing bivalves and interstitial invertebrates that include suspension feeding polychaetes and echinoderms. None of the key characterising epifauna of the maerl biotope ((JNCC, 2022) were identified in transects north of Queens Wharf (DDV4 – 8).

The survey report, written prior to receiving NE advice note of July 2024, categorised sites surveyed to have either no maerl whatsoever, dead maerl gravels / fragments with a 2D structure, or 3D maerl bed with either only dead or both live and dead maerl thalli (Figure 12).

Transects closest to the main port jetty contained no maerl habitat (DDV1, DDV2, DDV9, DDV10, DDV11). A small area on transect DDV3 had an image with 5-10% cover of small, dead maerl gravel. Sparse dead maerl was also seen to the north of the development (DDV4-DDV8), however this was 2D in structure with the thalli < 1 cm. To the east, DDV12-15 showed varying levels of dead and live maerl cover, with DDV14 consisting of up to 100% cover of interspersed live maerl overlying dead maerl across the whole transect.

Transects north of Queen's wharf contained varying amounts of dead maerl, although this was generally patchy with no extensive areas of high % cover (Figure 13). No DDV transects extended all the way to the existing wharf structure as there were vessels berthed on the northern side at the time of the survey. It is considered that habitats between the DDV transects and the wharf are very similar to those surveyed (and the habitat areas delineated in the Maerl Habitat Distribution section have assumed this). Previous surveys, e.g. the 2008 survey works, found limited maerl presence to the north of Queen's Wharf.

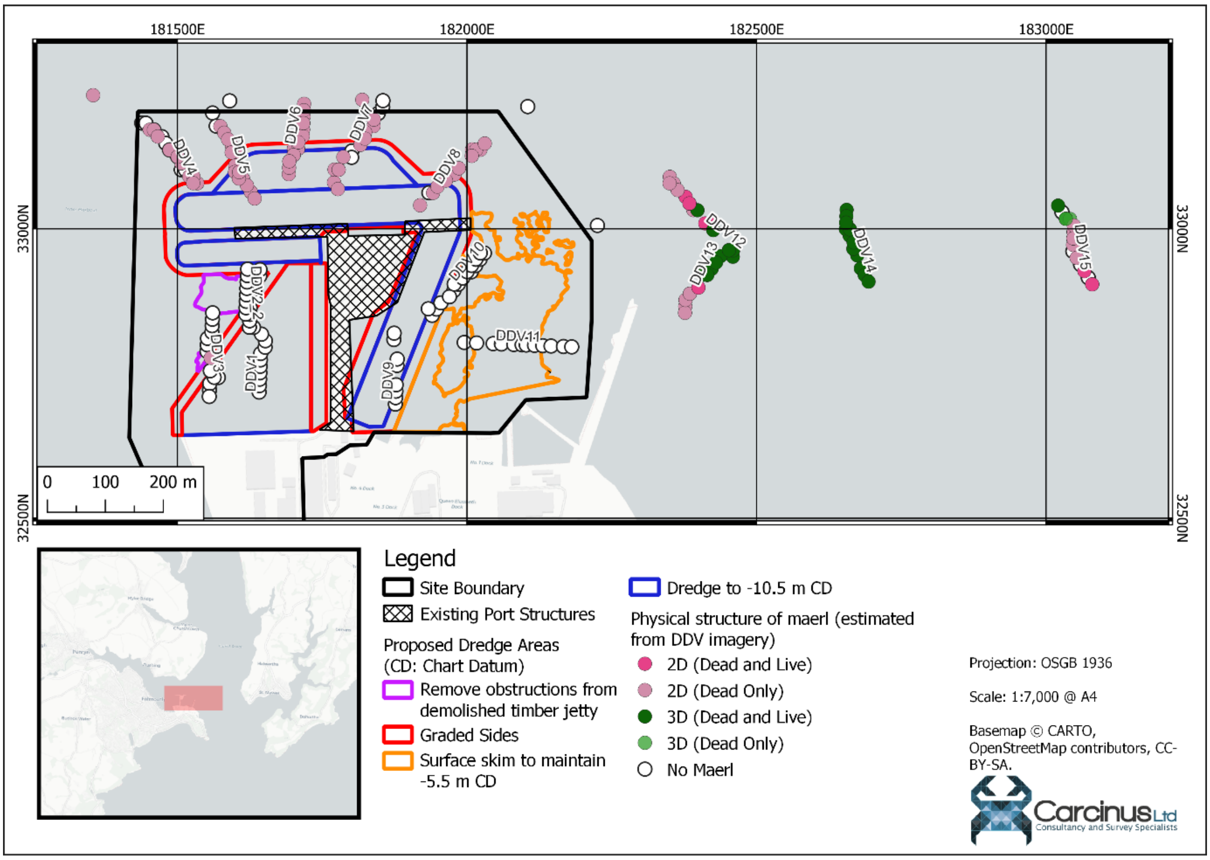


Figure 12 Estimated 3D/2D structure of identified areas of maerl within the vicinity of the Port of Falmouth (Source: Carcinus Ltd., 2024).

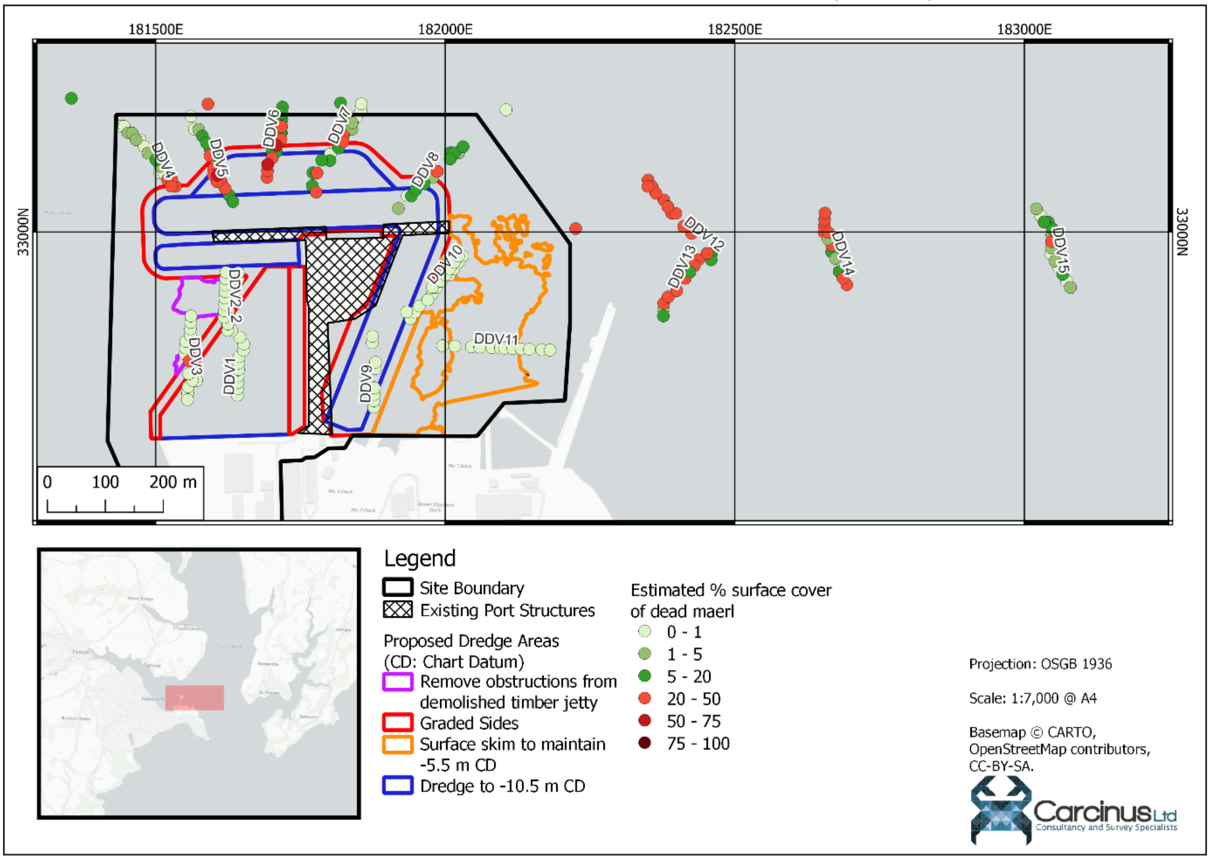


Figure 13 Estimated % surface cover of dead maerl in the vicinity of the proposed development.

Particle Size Distribution data was analysed (see Particle Size Distribution section above), and a photograph of both the as-collected sample, and the sample post sieving over a 0.5 mm mesh, was taken. These photographs are reproduced from the survey report in Appendix II. None of the grab samples had any evidence of either live maerl or dead maerl with thalli >1 cm (Table 2).

Table 2 Whole and sieved (0.5 mm mesh) samples collected north of Queen's wharf during survey operations in May 2023.

Station	Whole Sample	Sieved Sample
S13		

Station	Whole Sample	Sieved Sample
S14		
S15		
S16		
S17		
S18		

Station	Whole Sample	Sieved Sample
S19		
S27		
S28		
S29		
S30		

The infauna within day grab samples was identified and enumerated and the community composition for >1.0 mm and 0.5 mm – 1.0 mm size fractions analysed. Hierarchical cluster analysis was performed on the data, and the spatial distribution of the clustering (Figure 14 & Figure 15) indicated that for both size fractions the faunal community in the east of the survey array (i.e Stations S24A, S23 and S26) were distinct from the faunal community around the existing wharf structures. Grab samples around the wharf structures contained more mud-dominated sediments and were associated with *Galathowenia oculata* and *Melinna palmata*, whereas stations in the east of the array were correlated with increased abundance of *Glycera lapidum* and Eusyllinae worms.

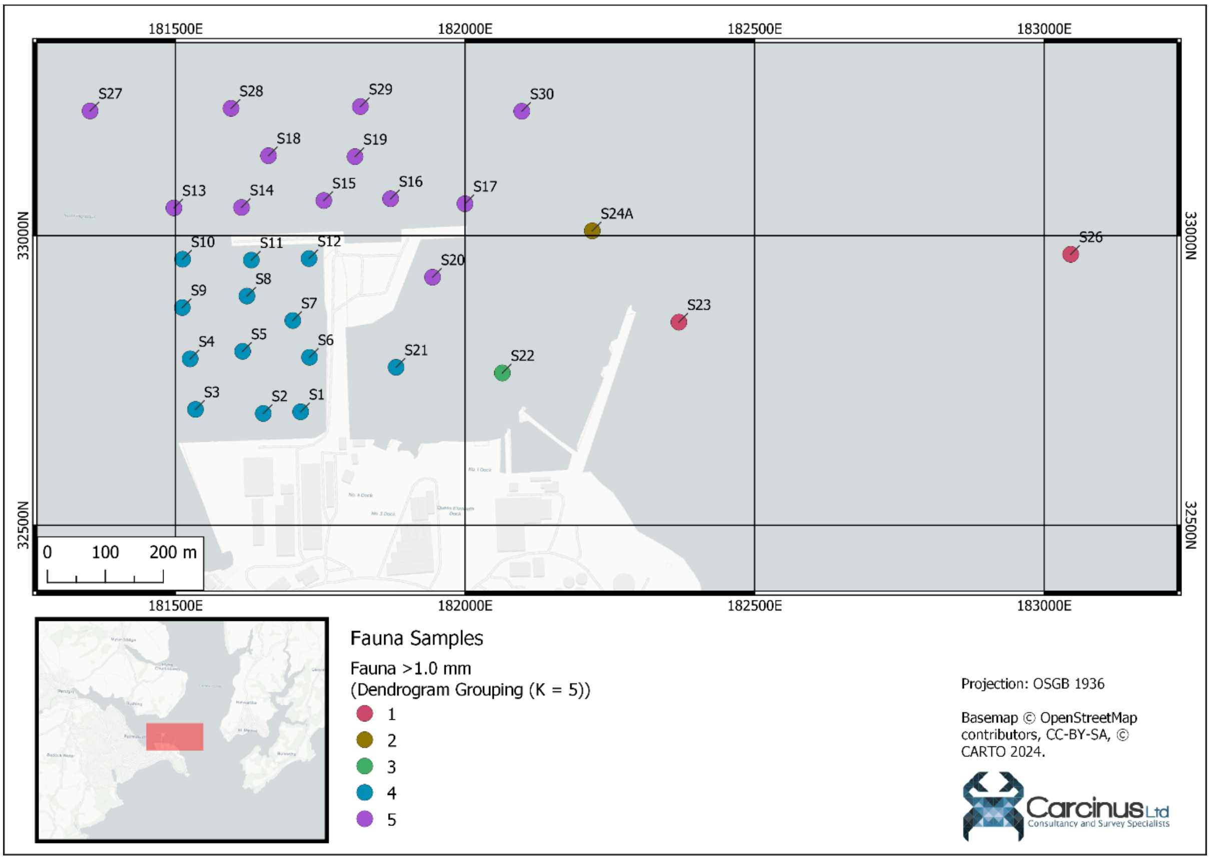


Figure 14 Results of hierarchical cluster analysis performed on the >1.0 mm faunal community.

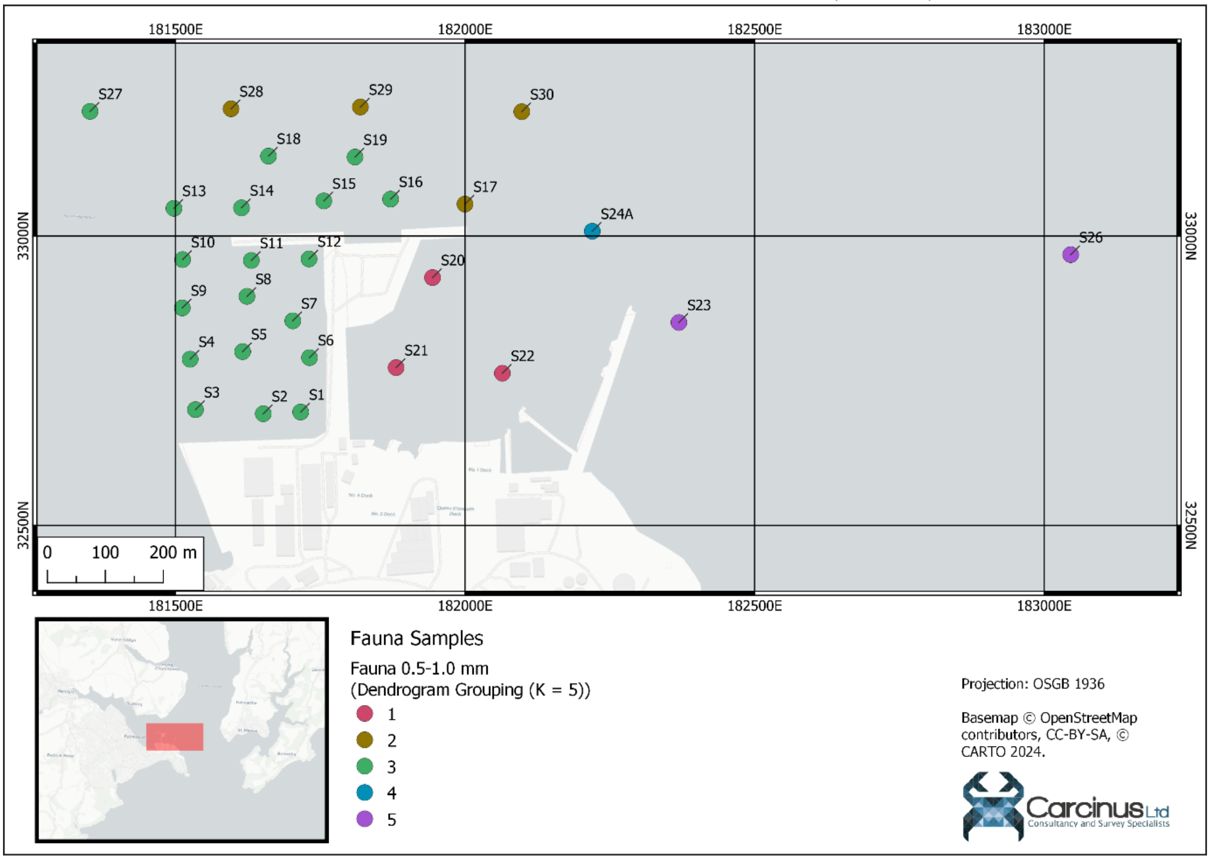


Figure 15 Results of hierarchical cluster analysis carried out on the 0.5 – 1.0 mm faunal community.

Ecology Surveys Summary

Data from the two surveys indicate that the only significant aggregations of live maerl was found to the east of the site boundary. A veneer of dead maerl gravel was found to the north of Queens Wharf, although the maerl gravel areas were patchy, interspersed with areas of mud-dominated sediment. The thalli in this area were small (<1 cm).

Infauna community composition data from the benthic grabbing survey indicated a differentiation in the faunal community in the areas around the existing port structures compared to those in the east of the study area. Grab samples around the wharf structures contained more mud-dominated sediments and were associated with *Galathowenia oculata* and *Melinna palmata*, whereas stations in the east of the array were correlated with increased abundance of *Glycera lapidum* and Eusyllinae worms.

Maerl Habitat Distribution

There are four Annex I habitats that are a primary reason for selection of the Fal and Helford as an SAC[5]. Of particular importance to this assessment and technical note is *Sandbanks which are slightly covered by seawater all the time* (1110). The sheltered nature of the site, its low tidal range, and the wide range of seabed substrates results in one of the richest examples of sandbanks in the UK.

A key sub-feature of this Annex I habitat within the SAC is maerl. Maerl is a free-living calcified red seaweed which forms beds of irregularly branched nodules. There are two species of maerl within

[5] https://sac.jncc.gov.uk/site/UK0013112

the UK: *Phymatolithon calcareum* and *Lithothamnion corrallioides*. Both are listed on the UK Biodiversity Action Plan.

The living maerl can sit on top of layers of dead maerl, building up over time (centuries to millennia) to form large beds. Maerl is a type of 'coralline' algae which means it deposits lime in its cell walls as it grows, therefore creating a hard brittle skeleton. It is extremely fragile and slow-growing (1-2 mm/year), and there are areas of maerl in the Fal and Helford SAC up to 4000 years old (Bosence and Wilson, 2003).

Maerl is typically found at water depths between 0 – 20 m, where photosynthesis can occur, on sand, mud, or gravel substrate. The areas in which it grows usually have low wave action, but a moderate to high water flow. Maerl beds are highly variable, and can consist of a thin layer of live maerl on top of varying thickness layers of dead maerl. In addition, it can also occur as a layer of live maerl on silty or variable substratum.

Maerl beds do not just incorporate live maerl, as some areas of dense dead maerl can form habitats thought to be of similar or equal importance due to their structural complexity and ability to support associated benthic communities (Perry, Tyler-Walters and Watson, 2024). Live maerl accumulates in areas of suitable conditions through settlement of propagules, as well as being washed in through wave and tidal circulation.

In the NE technical advice note that recommended the production of this technical note, they referenced the maerl sub-feature description within the Conservation Advice package for the Fal and Helford SAC which describes maerl beds within the designated site as encompassing:

- 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.

There are however, no details in the conservation package that clearly defines what these descriptions are, which is problematic for the 'maerl in sediment' descriptor in particular, which can include a range of maerl habitat conditions. Drawing on the findings of studies undertaken by Carcinus for ecology and other relevant technical assessments undertaken as part of the EIA (including GI, remote sensing surveys etc., principally designed to inform the EIA for this project), as well as other historic data on maerl distribution within the Fal and Helford SAC (described above), we have synthesised the information to provide an estimate of the distribution of each maerl category within the study area.

Pristine live maerl beds with up to 100% live maerl coverage

Based on the data summarised as part of this study, there are no examples of this habitat type within the site boundary or estimated sediment plume area (e.g. Figure 21). The nearest example is off St Mawes, approximately 2 km east of the study area, an area well known for the quality of its maerl bed.

Extensive areas of dead maerl with little to no live maerl

Based on the data summarised as part of this study, there were no examples of this habitat type seen within the site boundary or estimated sediment plume area. Data from the 2022 C-IFCA study

(Jenkin *et al.*, 2023) indicate that good examples of this habitat type are found outside of the Fal Estuary within Falmouth Bay.

Extensive areas of dead and crushed maerl

Based on the data summarised as part of this study, there are no examples of this habitat type within the site boundary or estimated sediment plume area. Data from the 2022 C-IFCA study (Jenkin *et al.*, 2023) indicate that good examples of this habitat type are found outside of the Fal Estuary within Falmouth Bay.

Living maerl overlying dead maerl

DDV surveys conducted by Carcinus in 2022 and 2023 identified areas of live maerl east of the site boundary. Whilst surface coverage of live maerl was occasionally high (up to 65% cover (Figure 16)), it was always accompanied by significant dead maerl coverage. The area has therefore been categorised as this habitat type rather than 'pristine live maerl'. DDV transects undertaken in this area in 2022 and 2023 were the only ones assigned the 'Maerl Beds' biotope.

There is insufficient information available to determine the point at which this area of habitat transitions to the pristine live maerl bed, known to be present off St Mawes, but the habitat type has been estimated to extend approximately 1 km from the site boundary towards St Mawes. The western extent of the habitat type is considered to align with the transition from more reflective to less reflective substrate seen in the backscatter data (Figure 17). The habitat transitions on both its northern and southern boundaries to 'areas of maerl in sediment'.

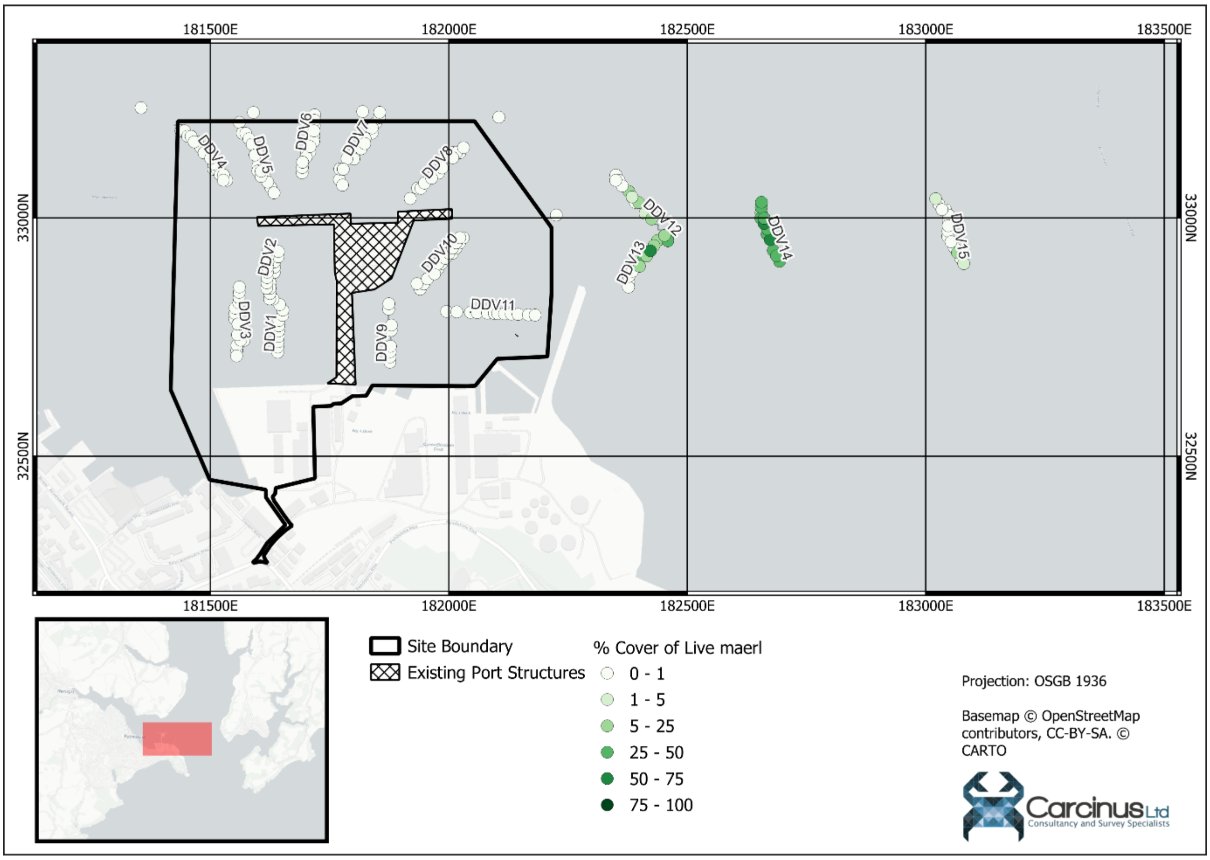


Figure 16 Estimated % surface cover of live maerl in the vicinity of the proposed development

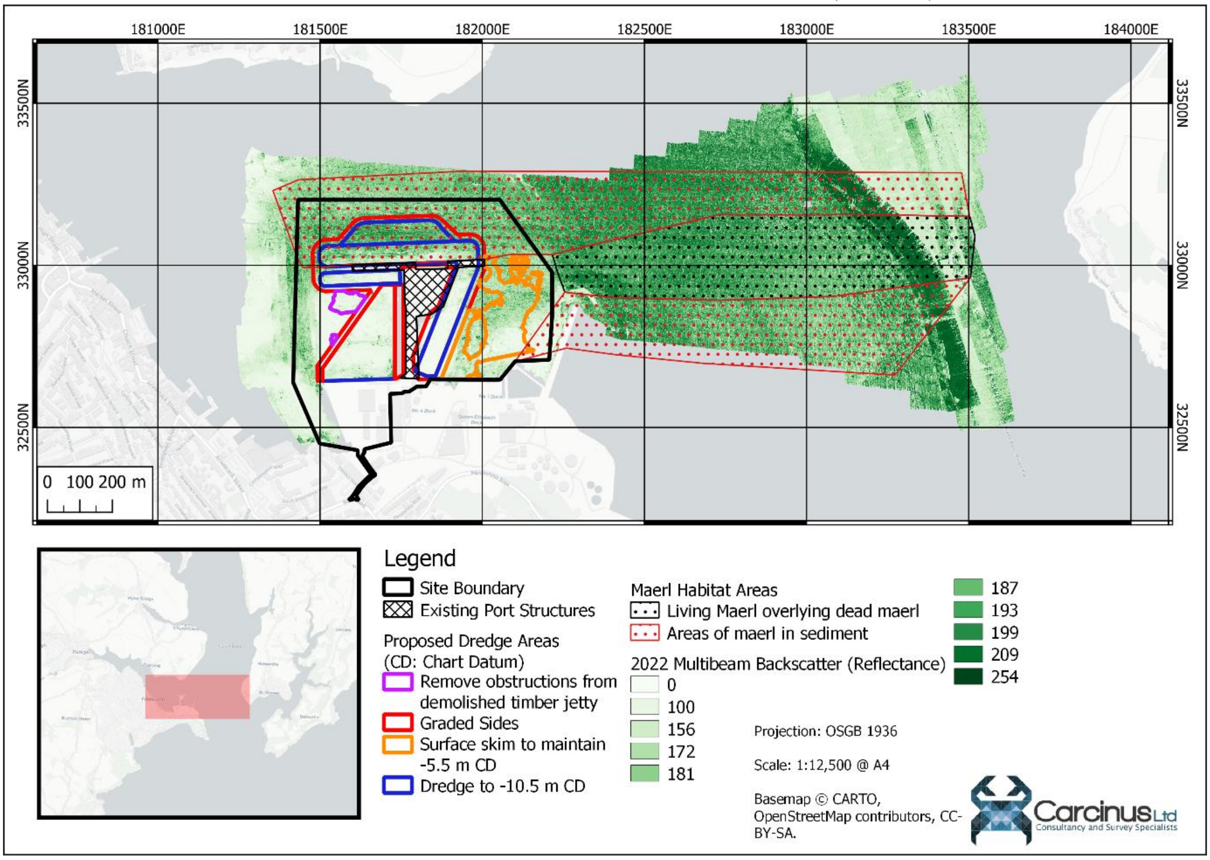


Figure 17 Areas of maerl habitat in relation to backscatter imagery from 2022.

Areas of maerl in sediment

This habitat description is broad, and likely includes a gradient in the ecological functioning of maerl-containing habitats, from dense aggregations of large (>1 cm) dead maerl thalli that provide a 3D habitat and sufficient interstitial space for the burrowing infauna that characterise maerl beds (Perry, Tyler-Walters and Watson, 2024) to areas of mixed or muddy sediment with only small maerl thalli that would not provide sufficient interstitial space to support as many species. Mixed or muddy sediments interspersed with dead maerl gravel within sediments and occasional accumulations of maerl gravel on the sediment surface would behave functionally as mixed sediments rather than as maerl beds.

The majority of maerl bed habitat within the study area considered as part of this technical report has been classified as the ‘maerl in sediment’ habitat type. Two DDV transects (DDV12 and DDV13) span the border of this habitat type and living maerl overlying dead maerl, giving a clear indication of the transition point. The southern instance of this habitat type is where Sheehan *et al.* (2015) collected their samples, as well as some areas identified in the 2013 NE study to contain dead maerl overlying other substrates. Up to 60% surface cover of dead maerl was recorded in DDV transects surveyed north of Queen’s Wharf (Figure 13), and whilst it is difficult to accurately measure maerl thalli from DDV imagery, supplementary information collected as part of the ecological sediment grabbing campaign (PSD data, whole and sieved grab imagery) and the ground investigation campaign (PSD data & core imagery) suggest that maerl thalli in this area are small (<1 cm) with patchy surface coverage.

Biotopes (the physical nature of the habitat) in these areas were classed as **Infralittoral Mixed Sediment** and sediment samples were classed as being 'Gravelly Muddy Sand' according to Folk (1954). Plate 5 and Plate 6 show a still from the southern end of DDV7 and images of the grab sample collected S15. These locations are close together (~20 m) and show that whilst the percentage cover of dead maerl is high, it is appropriate to class this habitat as 'areas of maerl in sediment' as the maerl coverage is patchy, with small (<1 cm) thalli and the structure 2D in nature.

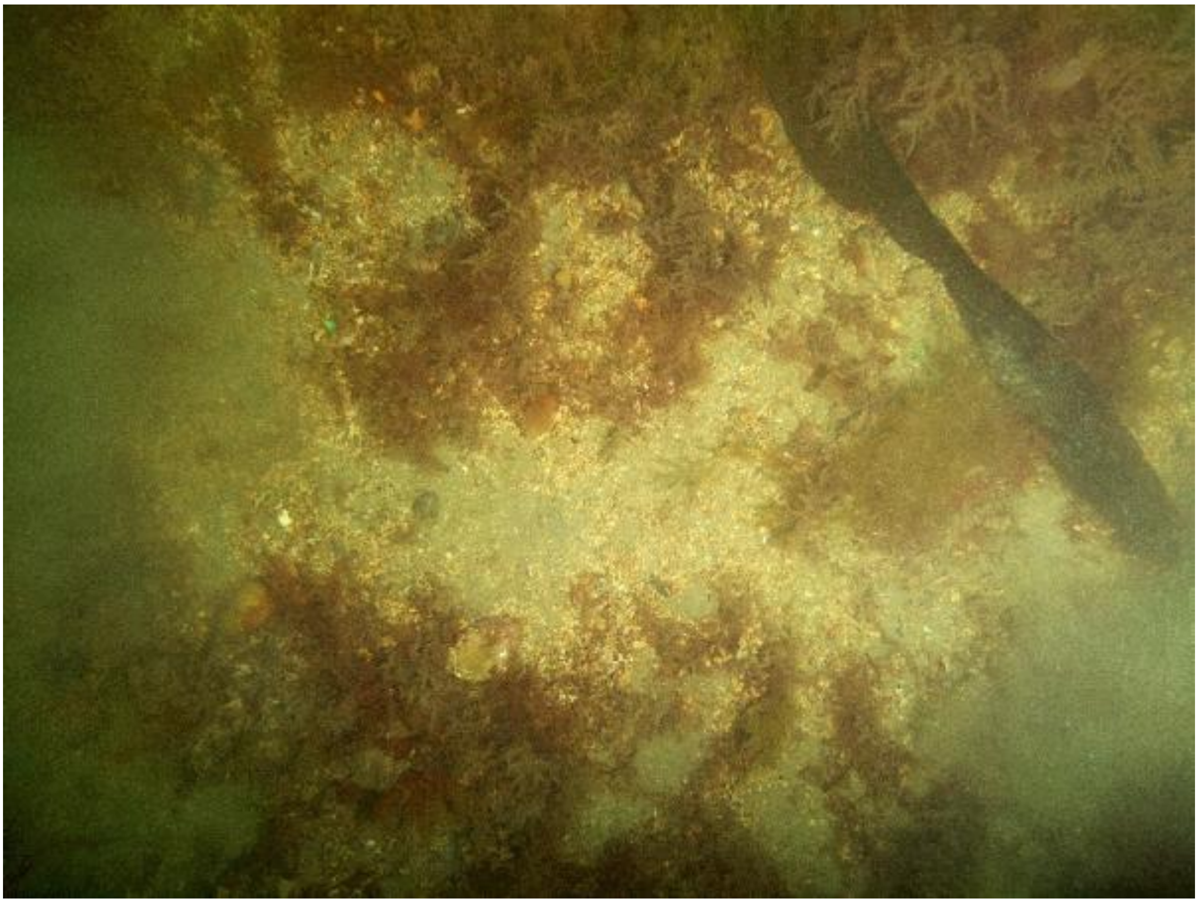


Plate 5 Still from the southern end of DDV7 – very close to grab station S15 (Plate 6).

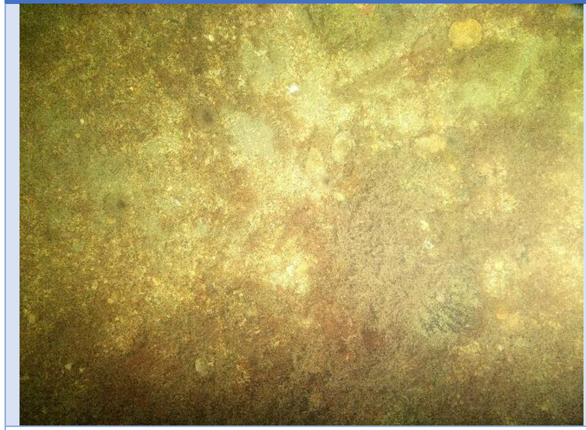
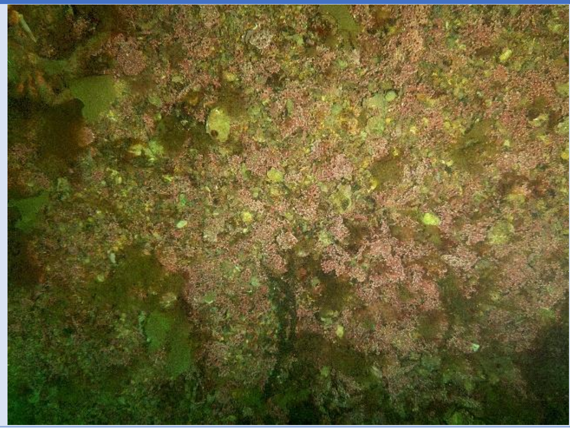
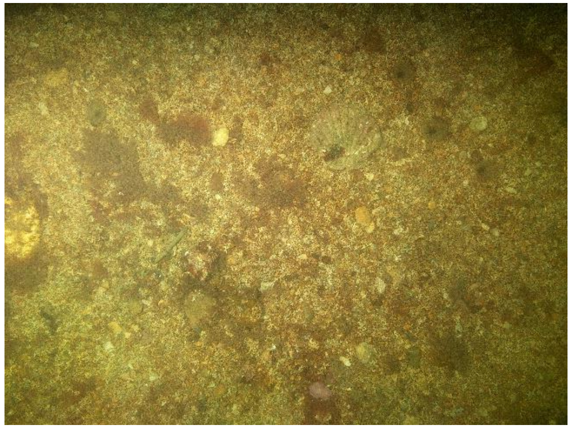
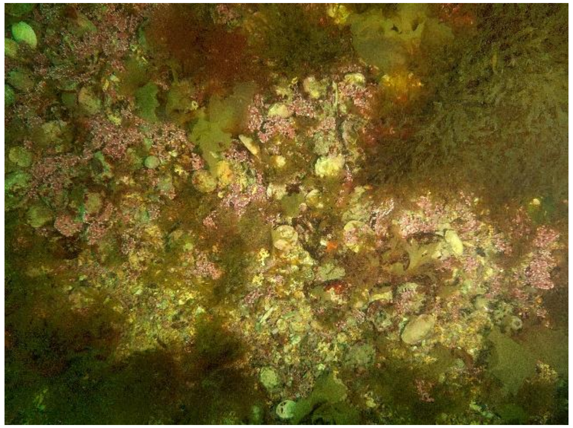
Plate 6 Whole sample and sieved sample from S15 – within the area defined as 'Areas of Maerl in Sediment'.

The area of substrate north of Queen's Wharf and within the proposed dredge pocket would not be classed as maerl bed under either the SNH criteria (Nature Scot, 2018) or JNCC Biotope Description

(JNCC, 2015). Plate 7 illustrates the patchy nature of maerl along another transect in this area, DDV5, with three sequential images having vastly different % of dead maerl gravel. It is therefore not appropriate to classify this area of habitat as "*extensive areas of dead and crushed maerl*". Table 3 illustrates the significant differences between the "areas of maerl in sediment" found north of Queen's Wharf and the live maerl habitats present within the Fal and Helford SAC.

Plate 7 Stills from DDV5.

Table 3 Indicative images of varying types of maerl-containing habitats within the Fal Estuary

"Areas of Maerl in Sediment" (Images from transects DDV 5 & 6, within site boundary)	"Live Maerl overlying dead maerl" (Images from transects DDV 12 & 14, 185 m and 450 m east of the site boundary respectively)	"Pristine live maerl" within Fal and Helford SAC (such as that off St Mawes, ~2 km from the site boundary). Reproduced from Allen et al., (2014)
		
		
Note – images have been compressed to reduce overall file size. Original images are of high resolution.		

Summary of Baseline

The depth profile of the study area is appropriate to support maerl habitat (which can grow in up to 32 m water depth in the semi-turbid waters of the north east Atlantic). Backscatter imagery from 2022 suggests that substrates immediately surrounding the existing wharf structures have a lower return (indicating softer sediment) than seabed farther away. There is also an apparent habitat transition running parallel with the eastern boundary of the site boundary, where habitats east of this point are more reflective (harder). Tidal flow data suggests that waterflows within the site boundary are too slow to prevent the natural deposition of fine sediment, inhibiting the potential for growth of live maerl. Furthermore, historic dredging data show that the waters within the site boundary were dredged in 1965, meaning that any live maerl habitat is unlikely to have recovered to a significant extent.

Sediment chemistry information collected as part of the Ground Investigation studies has indicated that the surface layer (the top 5-10 cm) of core samples north of the Queen's contained heavy metal concentrations frequently above Cefas AL1[6]. In addition, to the north of Queen's wharf, the concentration of Organotins were above AL1 in all locations except one. TBT concentrations (Tributyltin) at two locations were above AL2. The concentrations of most PAHs were above AL1 and total hydrocarbon content was 100 – 740 mg/kg. PCB ICES 7 and Sum of 25 Congeners were above AL1 and AL2 in places. Particle Size Distribution information indicates that across the various sediment samples analysed, the mean percentage of each sample >8 mm was less than 5%. Imagery collected from the various grab samples collected north of Queen's Wharf (Table 2) show the high silt content, indicating that sediments in this area would not functionally behave in a similar fashion to dense aggregations of dead maerl gravels as the interstitial volume of the sediments would be greatly reduced.

Considered in combination, the physical and chemical data from the site suggests that the sediments within the site boundary are not likely to support high-quality maerl bed. Information gathered during grabbing operations in 2023 indicates that the sediments north of Queen's Wharf are a fine/mixed sediment matrix with small, dead fragments of maerl thalli. These sediments are functionally more similar to mixed sediments rather than maerl beds, as they lack the interstitial spaces necessary to facilitate the high biodiversity associated with dense maerl beds with a three-dimensional structure.

Drop-down video data from 2022 and 2023 suggests that there are some areas of dead maerl gravels within the site boundary (restricted to waters north of Queens' Wharf), but as discussed in the previous paragraphs Particle Size Distribution data and images of vibrocores suggests that any coverage is restricted to the surface layer, with all maerl thalli <1 cm. Live maerl starts to be recorded to the east of the site, near to the habitat transition visible in the backscatter data. The SAC conservation package describes maerl within the Fal as:

- Pristine live maerl 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

[6]https://assets.publishing.service.gov.uk/media/5a818afae5274a2e87dbe2f7/High_level_review_of_current_UK_action_level_guidance_report__1053_.pdf

- areas of maerl in sediment.

Categorisation of maerl habitats within the study have been based (following direction from NE) on the descriptions above.

It can be concluded that the site and study area does not contain 'pristine live maerl with up to 100% live maerl coverage', 'extensive areas of dead maerl with little to no live maerl' or 'extensive areas of dead and crushed maerl'.

The areas of live maerl recorded to the east of Falmouth Docks still had a significant coverage of dead maerl. This habitat type was therefore recorded as 'living maerl overlying dead maerl'. It was bounded on its northern and southern boundary by 'areas of maerl in sediment', considered to extend to within the site boundary. The coverage of dead maerl in the areas surveyed was too sparse and patchy to be categorised as either 'extensive areas of dead maerl with little to no live maerl' or 'extensive areas of dead and crushed maerl'.

Impact Assessment

Direct impacts as a result of the proposed development would be the removal of sediments (as a result of dredging and the new wharf infrastructure). Indirect impacts as a result of the proposed development would be deposition of fine sediments mobilised during dredging operations (smothering). Indirect impacts would therefore occur over a wider area than direct impacts as tidal circulation would carry suspended fine sediments. Sediment plume modelling has been undertaken to predict the maximal spatial extent of sediment deposition as a result of the proposed dredging operations. The dredging method, which shall use a lidded bucket for time restricted operations (dredging on an adjusted flood tide), is an embedded project design measure to minimise impacts. The dredging method is detailed in ES Chapter 5 Demolition and Construction Description.

Direct Impacts

Habitat Loss

The direct impact on maerl habitat that would arise from the proposed development is direct removal of habitat as part of proposed dredging operations. Figure 18 presents the areas of proposed dredging in relation to the site boundary and identified areas of maerl habitat.

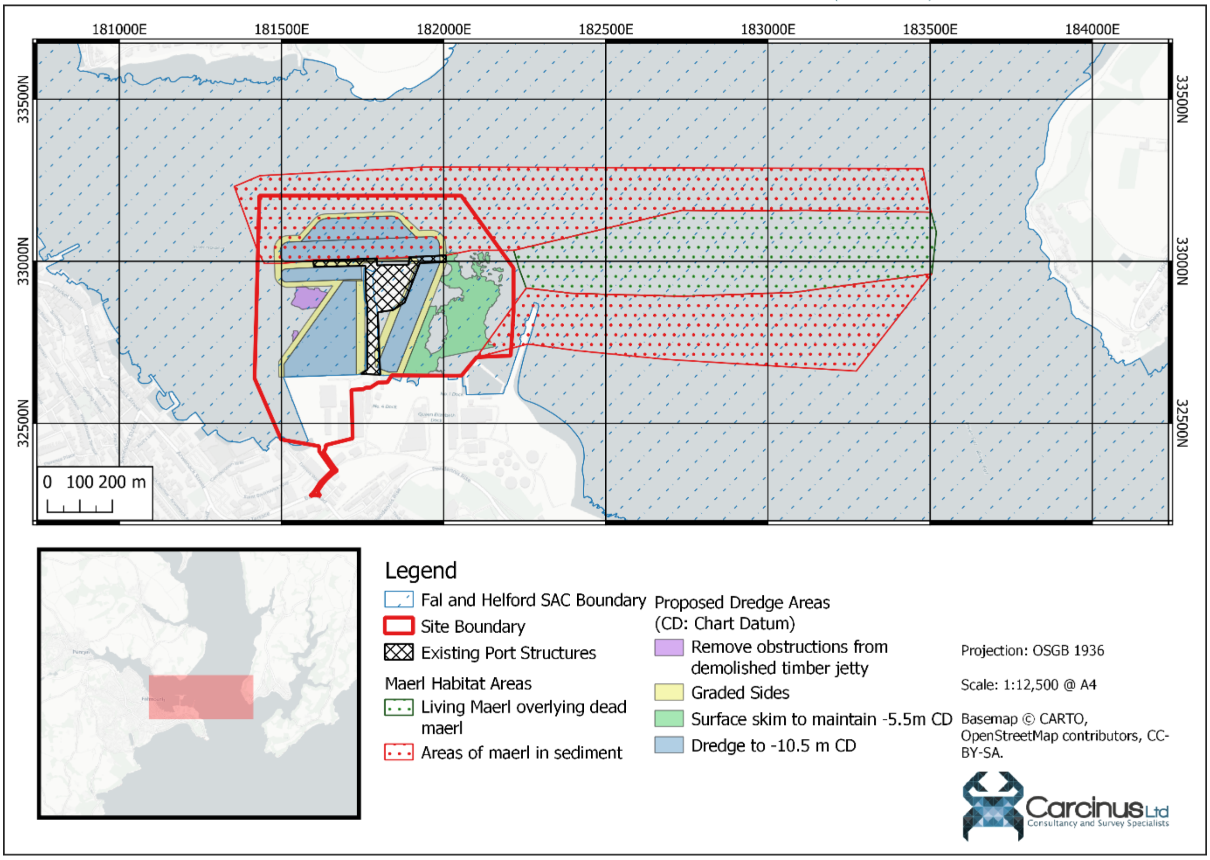


Figure 18 Proposed dredge areas in relation to areas of maerl habitat in the study area.

No dredging will take place in any areas identified as 'live maerl overlying dead maerl'. The area of 'maerl in sediment' identified as being within the dredge footprint is approximately 6.1 ha. The substrate in this dredge area consists of small aggregations of dead maerl veneer interspersed with areas of mixed/muddy sediments. It is also relatively contaminated (the top 0.3 m is unsuitable for disposal at sea) and whilst mapped as 'maerl in sediment' it will not functionally behave as a maerl habitat. Bathymetric data from 2022 suggests that water depths in this area are between -6 and -7.5 m CD, meaning that between 3 and 4.5 m depth of sediment would be removed. The total volume of removed sediment would be approximately 201,500 m^3. This constitutes a permanent loss of this habitat. However, additional soft sediments, gravels and dead maerl fragments are likely to accumulate over time through natural circulation and deposition.

The loss of sediment from within the dredge footprint is not considered to remove any maerl habitat type that has the ecological functioning protected by the Fal and Helford SAC, on the basis of the environmental conditions and the seabed conditions observed. It is also considered that the environmental conditions within the dredge footprint are not appropriate to support the establishment or growth of live maerl due to a number of factors. This includes sediment contamination, low tidal currents allowing higher levels of siltation/smothering than experienced outside the harbour and lower light levels as much of the area is semi-permanently overshadowed by vessels berthed at the port. The Sediment Transport Modelling Report (ES Volume 2 Technical Appendix 6.2) states that the proposed development would result in a marginal increase in annual sediment deposition, at 3,800 m^3/year within the port operational area (increased from 3,560 m^3/year). Within the western berth pocket this equates to ~6.9 mm/year, within the eastern berth pocket this is 13.1 mm/year and north of Queens Wharf this is 8.7 mm/year (an increase of 0.5 mm, 1.3 mm and 0.6 mm/year respectively). The seabed habitats and sediments observed within the dredge pockets were found to contain small, dead fragments of maerl thalli within a matrix of sediment rather than aggregations of maerl (live or dead) that create the habitat complexity and associated species diversity of the type that is a designating feature of the SAC. It is considered likely that over time gravels and dead maerl fragments have accumulated through natural transport and deposition and habitat removal by dredging in this area is not removing maerl bed habitat.

Indirect Impacts

There are three potential indirect impacts on maerl bed habitats within the Fal and Helford SAC arising from the proposed development, all of which relate to the mobilisation of sediment during dredging operations:

- A reduction in incident light levels at the seabed caused by an increase in suspended sediment concentrations (SSC, turbidity);
- Deposition of mobilised sediments away from the dredging locations; and
- Mobilisation and deposition of contaminated sediments away from the dredge footprint.

Based on the proposed dredging operations, HR Wallingford modelled the sediment dispersal from within the three dredge locations, the Western Berth pocket, the Eastern Berth pocket and north of Queen's Wharf (ES Volume 2 Technical Appendix 6.3 Sediment Plume Modelling Report), over a two-week spring/neap tidal cycle. The grid size used in the modelling is 25 m x 25 m (625 m^2). Assessments are limited to areas outside the dredge pocket as those within the dredge pocket are assessed in the direct impacts section.

Increased Suspended Sediment Concentrations (SSC)

Long term increases in SSCs reduce the amount of light at the seabed available for photosynthesis. This is likely to be particularly significant for photosynthetic species living near their maximum depth limit, which is thought to be ~32 m for maerl in northern European waters (Hall-Spencer, 1998).

The dredging operations that would take place as part of the proposed development would cause a temporary spike in suspended sediment concentrations. HR Wallingford modelled the likely patterns of suspended sediment increase that would occur over a two-week Spring/Neap tidal cycle and estimated the mean, and maximum, SSC increase predicted to occur. The mean increase in SSC in each dredge area is shown in Figure 19 and the maximum increase over that two week period is shown in Figure 20. Timeseries modelling of the changes in SSC indicate that the maximum increases are very short lived, a matter of a few hours, and SSC would return to baseline within a few hours of operations ceasing.

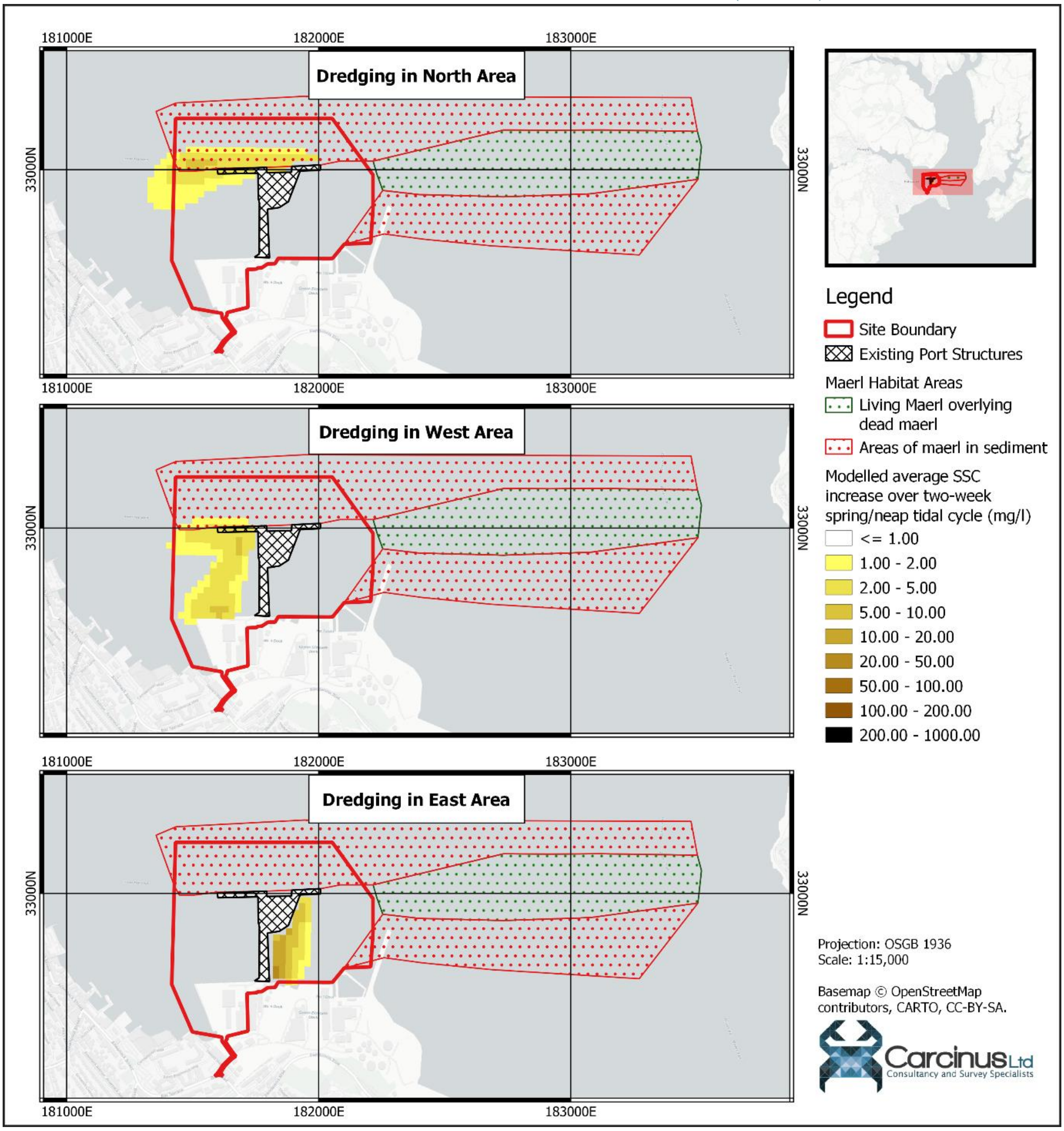


Figure 19 Mean increase in suspended sediment concentrations resulting from proposed dredging operations in each of the three areas.

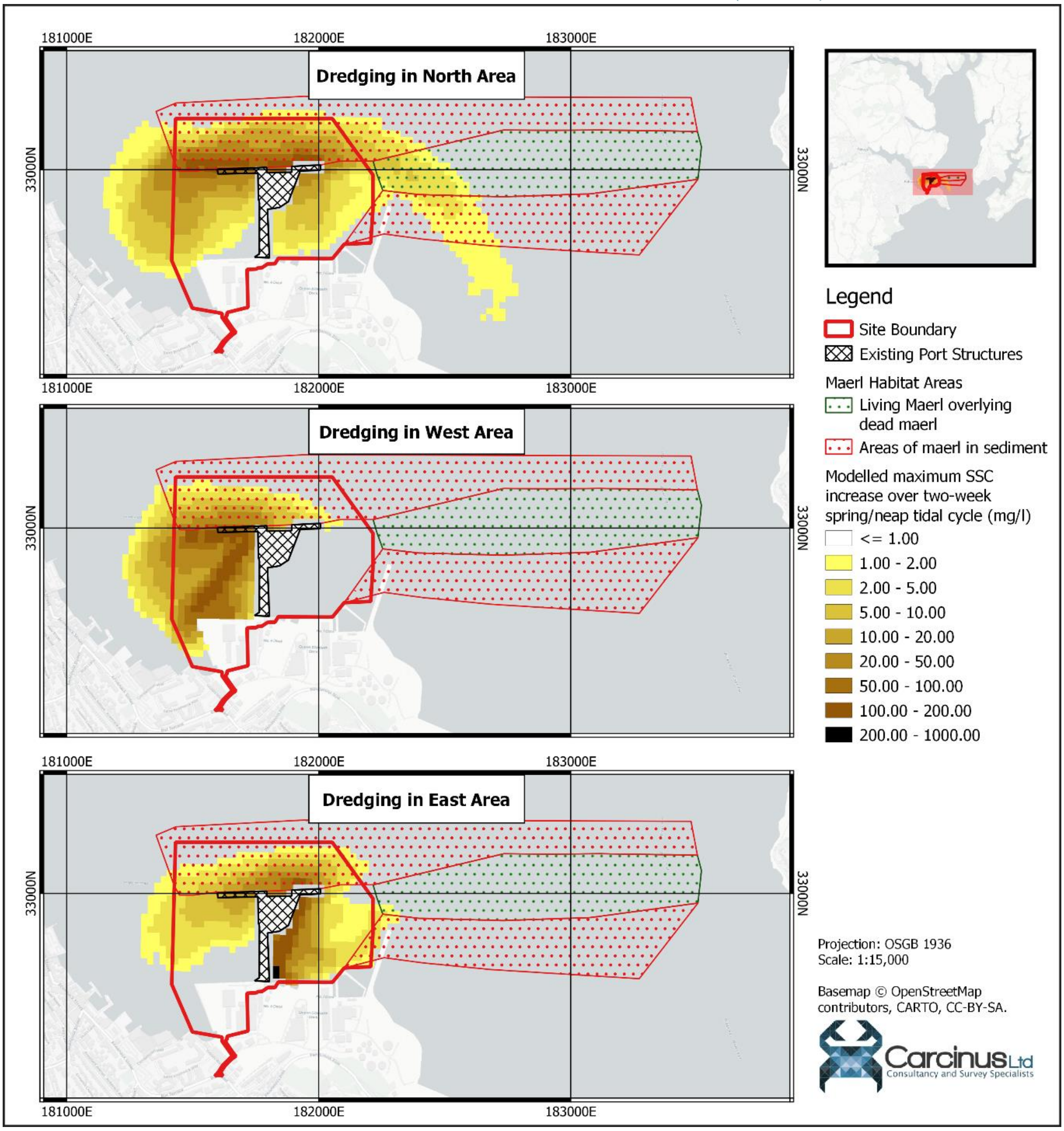


Figure 20 Maximum increase in suspended sediment concentrations resulting from proposed dredging operations in each of the three areas.

Table 4 summarises the modelled worst-case scenarios in terms of increases to SSC as a result of proposed dredging across the areas of defined maerl habitat. The average increase in SSC over each of the two maerl habitat types identified is very low, not exceeding 0.1 mg/l over the two-week modelling period. The maximum increase in SSC in any single grid square occurs as a result of dredging activity north of Queen's wharf, and the peak SSC increase also occurs in this location. The maximum SSC increase is predicted to occur just outside the proposed dredge pocket. Outside the site boundary and within areas of live maerl overlying dead maerl, SSC increases are much lower. The average SSC increase in this area is 0.0055 mg/l and the short-lived peak is only 5.78 mg/l. The average increases are much lower than the peak increases because the SSC levels are very short lived, returning to baseline within a few hours of the peak occurring.

Table 4 Summary of increases to suspended sediment concentrations within the defined areas of maerl habitat as a result of proposed dredging operations.

Dredge Area	Average mean SSC increase over mapped habitat area (mg/l)	Highest average SSC increase (mg/l within single 25 m x 25 m square)
Live maerl overlying dead maerl		
North of Queen's	0.0055	0.076
Eastern Berths	0.00062	0.036
Western Berths	0.00084	0.012
Areas of maerl in sediment		
North of Queen's	0.076	4.25
Eastern Berths	0.0028	0.10
Western Berths	0.0084	1.12

Timeseries data presented within the Sediment Plume Modelling Report (ES Volume 2 Technical Appendix 6.3) show that the peaks in suspended sediment concentrations occur daily with dredging operations, but return to baseline levels within a few hours of dredging operations finishing each day. There is also variation with tides, such that the maximum values determined only occur on certain tides, not on every day of dredging. There would, therefore, be no long-term increase[7] in SSC within the site boundary or area of impact.

Mean increases in SSC at an area of live maerl south east of the eastern breakwater (position based on historic data from 2008 survey) is predicted to be <0.01 mg/l. Mean increases in SSC in locations live maerl was observed during 2023 are predicted to be <0.01 mg/l.

Naturally occurring weather events such as floods, large tides or severe storms can increase SSC concentrations to levels above those caused by dredging (Parr *et al.*, 1998), and the duration of SSC increase can be longer as a result of natural events compared to dredging. 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. It is therefore considered highly likely that the very short term increase in SSC is within the natural variability of this system.

Maerl beds are reported to have *medium* sensitivity to long term (>1 year) increases in SSC[8] (Tyler-Walters *et al.*, 2023). There is considered to be little overall impact on the areas of maerl habitat within the study area as a result of temporary increases in SSC as a result of proposed dredging. 'Areas of maerl in sediment' and 'living maerl overlying dead maerl' have been identified within the study area. The effect on both types of maerl habitats would be short term and temporary in nature, and SSC concentrations likely to be within natural variation of the system.

[7] 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).
[8] Defined as being sufficient to cause a change in one rank on the Water Framework Directive scale.

Sediment deposition

A related impact from the proposed development could be smothering. Dredging operations (shown in Figure 18) would mobilise sediments into the water column, which would then be dispersed away from the dredging site by natural water circulation (tides etc.) before being redeposited on the seabed in a different area. This type of sediment deposition is referred to as being 'light' within the Marine Evidence based Sensitivity Assessment (MarESA) list of pressures[9] (Tyler-Walters *et al.*, 2023), as it results from the settling out of silt/sediments suspended in the water column (as opposed to direct deposition such as at a disposal site).

HR Wallingford modelled the likely patterns of sediment deposition that would occur over a two-week Spring/Neap tidal cycle, and estimated the depth of additional sediment deposition that would occur, and have extrapolated this to estimate the deposition that would occur at the end of the entire dredging campaign. The extent of sediment deposition based on modelling dredging in each of the three areas, as well as a model aggregating the dredging in all three areas, is shown in Figure 21.

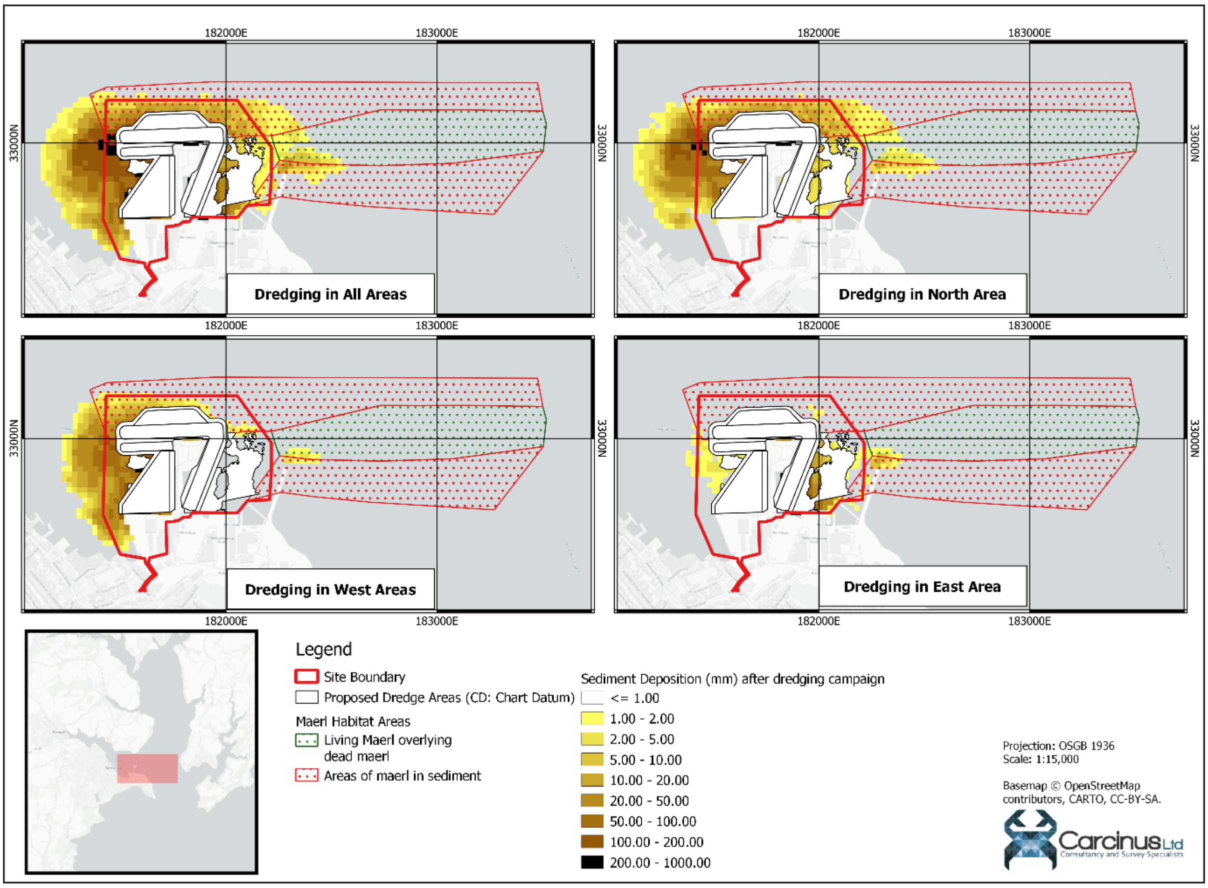


Figure 21 Sediment deposition (mm) at the end of the entire dredging campaign as a result of proposed dredging operations.

[9] The MarESA list of pressures are themselves defined based on the pressure definitions developed by the OSPAR Intercessional Correspondence Group on Cumulative Effects (ICG-C) – Amended 25th March 2011 (https://data.jncc.gov.uk/data/1e136107-1396-4c67-b755-dc9f43bf3bb1/20110328-ICG-C-Pressures-list-v4.pdf)

Sediment deposition is predicted to be greater in mapped 'areas of maerl in sediment' than areas of 'live maerl overlying dead maerl'. The mean sediment deposition across 'areas of maerl in sediment' is predicted to be 2.72 mm as a result of dredging in all areas. Within areas of 'live maerl overlying dead maerl' the mean deposition is predicted to be only 0.42 mm.

The maximum deposition within any single 25 m x 25 m grid square is predicted to be 233 mm (based on aggregating the deposition from dredging in all three areas). This is predicted to occur at a position just outside the proposed dredge pocket, near the western extent of Queen's Wharf, in an area characterised by sediments with maerl fragments only. Sample S13 from the May 2023 marine ecology survey was collected near to this location, and the proportion of fine sediment (<63 µm) was approximately 35%, with ~46% sand (63 µm – 2 mm) and <20% gravel (2 – 63 mm). The maximum deposition in an area of functional maerl habitat (i.e. living maerl overlying dead maerl) is 18.4 mm, with a small patch of higher deposition approximately 60 m from the tip of the eastern breakwater (Figure 21).

The data presented above does not account for natural redeposition of fine sediments that will occur following natural mobilisation events such as severe storms. The Sediment Transport Modelling Report (ES Volume 2 Technical Appendix 6.2) states the proposed development would result in a marginal increase in annual sediment deposition, resulting in a total of 5-10 mm deposition per year within the port operational area. In many areas, deposition of dredged material is unlikely to exceed natural deposition patterns within the system. PSD data gathered through ecological studies in May 2023 showed that all but two of the samples (S23 and S26) contained >10% fine sediments (<63 µm) and so sediment deposition arising from proposed dredging activities would be unlikely to significantly alter the particle size distribution of these sediments. Deposition outside the immediate project area would be in line with the natural ecological variability of the system and would not affect the function of the maerl subfeature of the Fal and Helford SAC.

Remobilisation & deposition of contaminated sediments

The GI sediment chemistry investigations showed that the surface layer of the majority of samples had concentrations of heavy metals, organotins and PCBs above Cefas AL1 and AL2 levels in places within the dredge pockets. There lies the potential for sediment bound contaminants to be remobilised and deposited elsewhere. The modelling undertaken by HR Wallingford has assumed that 29-34% of sediment volume is contaminated.

Additionally, a visual inspection of the core imagery indicates that some cores contain very dark coloured sediment, indicative of an anoxic environment and potentially containing H_2S. The concentration of this substance within sediments has not been determined in a laboratory but there is the potential for mobilisation and deposition of this compound. Whilst it is noted that live maerl has been identified as being sensitive to hydrogen sulphide (Wilson *et al.*, 2004), sediment plume modelling indicates that there is very little deposition on areas of live maerl (<0.5 mm).

All dredging activity is proposed to be undertaken with a closed-lidded bucket. The use of a close-lidded bucket minimises the release of fine sediments during dredging operations. During remobilisation of sediments, some sediment bound contamination will partition from the sediment-bound phase to the aqueous phase, further diluting and dispersing 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. All dredging operations are proposed to be undertaken by a 10 m^3 lidded bucket, appropriate for collecting contaminated sediments. As with the non-contaminated sediments, the data presented above does not account for natural redisposition of fine sediments that will occur following natural mobilisation events such as severe storms. In many areas, deposition of dredged material is unlikely to exceed natural deposition events, and much of the deposition is predicted to occur near to the existing wharf structures, which are known to be already contaminated. Very little deposition will occur in areas of 'live maerl overlying dead maerl'.

Conclusion

This technical note has presented a characterisation of the substrates surrounding Falmouth Docks and the predicted zone of influence arising from the proposed development, particularly in terms of the distribution of maerl. The impact pathways of concern in relation to maerl habitats are:

- Habitat removal and disturbance;
- Increased suspended sediment concentration;
- Sediment deposition; and
- Remobilisation and deposition of contaminated sediments.

The full impact assessments for these pathway are found in ES Volume 1 Chapter 9 Marine Ecology.

The full impact assessment for these pathways in relation to potential adverse effects on the site integrity of the Fal and Helford SAC are found in ES Volume 2 Technical Appendix 2.12 Habitat Regulations Assessment.

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