

12.0 Benthic Ecology – Addendum

Introduction

- 12.1 The proposed development will occupy subtidal and intertidal areas of Loch Ryan that provide habitat for benthic communities. This chapter of the Environmental Impact Assessment (EIA) Report (EIAR) will provide an assessment of the potential impacts of the proposed development on these receptors.
- 12.2 This chapter is presented as an addendum to the main body of the EIAR which was submitted to the Consenting Authorities in July 2025. Due to the need for the benthic characterisation surveys to be undertaken in late spring/early summer 2025 in order to capture any potential seagrass bed growth, the results of the field survey were not available at the time of submission. As such, a previous chapter was submitted with the main EIAR to set out the position on this and provide a high level overview of the likely potential effects of the proposed development on benthic ecology. Following completion of the benthic characterisation survey, this chapter now presents the impact assessment which is fully informed by the field data.
- 12.3 Potential impacts considered within this chapter include:
- Potential impacts of permanent and temporary habitat loss due to land reclamation and dredging;
 - Potential for water quality impacts (increased suspended sediment concentrations (SSC) due to dredging;
 - Potential for resuspension of contaminated sediments with effects on benthic ecology receptors;
 - Potential for the introduction or spread of Invasive Non-Native Species (INNS); and
 - Potential impacts of creating new artificial habitat surrounding the new berths and breakwater extension on benthic ecology.
- 12.4 This chapter is accompanied by a full benthic technical report (**Appendix 12.1**) detailing the results of the drop down video (DDV), benthic, and intertidal surveys upon which this assessment is based.

Competency Statement

- 12.5 This Chapter has been prepared by David Alexander, BSc (Hons) MSc, and Bethany Reed, BSc (Hons) MSc. David has over 15 years of experience providing consultancy advice to development projects and working on marine ecological assessments, including Nationally Significant Infrastructure Projects in the UK. David has principally worked within ports and harbours sector, the aggregates/dredging industry and various renewable energy development and interconnector projects. He has been the lead author for numerous publications and has overseen the conduct of multiple published research works. Bethany is a Senior Consultant with numerous years of experience working on infrastructure development projects. She is

experienced in a wide range of essential skills including survey techniques, statistical data analysis, literature reviews and reporting, all which have been developed through involvement in multi-sectoral projects.

Legislation, Policy and Guidance

12.6 The benthic ecology assessment will be undertaken within the context of the following relevant legislation, planning policies, and guidance documents:

- **Marine (Scotland) Act 2010**¹
Framework for managing Scotland's seas through marine planning, licensing, and conservation, with the goal of achieving sustainable development and protection of the marine environment;
- **Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017**²
Regulations requiring environmental impact assessments for certain marine works to ensure potential environmental effects are considered before development consent is granted;
- **The Harbour Works (Environmental Impact Assessment) Regulations 1999**³
Legislation mandating environmental impact assessments for harbour-related developments that may significantly affect the environment, aiming to minimize harm through early-stage planning;
- **Wildlife and Countryside Act 1981**⁴
Legislation for the protection of native species, habitats, and Sites of Special Scientific Interest, in addition to supporting biodiversity conservation and the control of invasive species;
- **Conservation of Habitats and Species Regulations 2010 (commonly referred to as the Habitats Regulations)**⁵
Regulations to transpose the EU Habitats and Birds Directives into UK law, protecting important habitats and species through designated sites and legal safeguards;
- **National Marine Plan (Scotland)**⁶
Policies to guide sustainable development and decision-making in Scottish marine areas;

¹ Scottish Government: Marine (Scotland) Act 2010: February 2010.

² Scottish Government: Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017: May 2017

³ UK Government: The Harbour Works (Environmental Impact Assessment) Regulations 1999: February 2000

⁴ UK Government: Wildlife and Countryside Act, 1981: November 2019

⁵ UK Government: Conservation of Habitats and Species Regulations 2010 (commonly referred to as the Habitats Regulations): March 2010

⁶ Scottish Government: National Marine Plan (Scotland): March 2015

- **UK Marine Policy Statement⁷**
Guides for the development of marine plans across the UK, setting principles for sustainable use of marine resources and ecosystem protection;
- **Scottish National Planning Framework 4 (NPF4)⁸**
Scotland's long-term spatial strategy integrating land use planning with national policies on climate change, biodiversity, and sustainable development; and
- **Dumfries and Galloway Local Development Plan 2⁹**
Local level plan outlining land use policies and proposals specific to Dumfries and Galloway, guiding development and protecting natural and cultural assets in the region.
- **Marine Invasive Non-Native Species in the Solway Firth 2021-2024¹⁰**
Plan describing the biosecurity issues of the Solway and presenting actions that have been agreed with stakeholders for the prevention, early detection, control, and mitigation of the introduction and spread of marine INNS.

Methodology Used for Assessment

Introduction

- 12.7 In order to characterise the benthic habitats and communities present within and adjacent to Stranraer Marina, it was determined that a dedicated benthic survey would be necessary to collect primary data from within the study area.
- 12.8 Due to the potential presence of seagrass within the survey area, advice from NatureScot indicated that the benthic survey should take place no earlier than late May 2025 given the seasonal dieback and growth of seagrass beds. As such, a benthic survey of Stranraer Marina and the surrounding environment was undertaken in late May 2025 in order to inform the impact assessment to be undertaken in this chapter. The benthic survey undertaken included drop down video (DDV), benthic grab sampling, and an intertidal walkover survey.

Study Area

- 12.9 The study area for this EIA topic comprises the predicted maximum area in which potential environmental effects may occur and has been principally informed by the hydrodynamic and sedimentary plume modelling undertaken. In addition, consultation with NatureScot led to intertidal areas east and west of the proposed development being included within the scope of the characterisation surveys and potential impact assessments.

⁷ UK Government: UK Marine Policy Statement: March 2011

⁸ Scottish Government: National Planning Framework 4: February 2023

⁹ Dumfries and Galloway Council: Local Development Plan 2: October 2019

¹⁰ Solway Firth Partnership (2024). Marine Invasive Non-Native Species in the Solway Firth. Revised for 2024-2027. 45pp.

Dredge Plume Modelling

- 12.10 The details and full results of the dredge plume modelling exercise that has been completed are set out within the Coastal Processes Chapter (**Chapter 7.0** of the EIAR).
- 12.11 Modelling was undertaken to identify the potential zone of influence in which suspended sediment concentration (SSC) and sedimentation would be elevated compared to background levels during and subsequent to the dredging programme. The modelling examined realistic worst-case scenarios to ensure any method proposed by the contractor would be well within the envelope of effects. To give an accurate assessment, plumes were modelled under conditions representative of both the beginning of the dredging programme, e.g. offshore sediment deposition and existing breakwater layout, and near the end, e.g. onshore sediment reclamation and the new breakwater layout, as well as at all states of tide. The models also incorporated the potential of material being resuspended on subsequent tides after the cessation of dredging.
- 12.12 Within this chapter, the outputs of these models have been used to aid in assessing the potential effects of changes in the levels of suspended sediment and water quality on sensitive marine receptors, specifically benthic habitats and communities.

Desk Study

- 12.13 In order to characterise the benthic habitats in the vicinity of the study area, the following resources were consulted:
- Marine Scotland National Marine Plan interactive (NMPi) maps¹¹;
 - Stranraer Marine Environmental Impact Assessment Scoping Report¹²;
 - Loch Ryan Management Plan 2014¹³;
 - Priority Marine Features (PMF) distribution data from Scotland NMPi online;
 - Marine Invasive Non-Native Species in the Solway Firth¹⁴;
 - EMODnet Habitat Maps¹⁵; and
 - Seagrass Spotter Tool¹⁶.

¹¹ Marine Scotland. (2024). Marine Scotland Maps NMPi part of Scotland's environment. Available at: Marine Scotland - National Marine Plan Interactive (atkinsgeospatial.com). Accessed on: 4th November 2024.

¹² RPS Consulting Engineers. (2021). Environmental Impact Assessment Scoping Report - Stranraer Marina. Prepared on behalf of Dumfries and Galloway Council. NI2285. 93pp.

¹³ Solway Firth Partnership. (2014). Loch Ryan Management Plan 2014. Using marine planning to identify management needs and opportunities for enhanced community amenity and economic regeneration of the surrounding area. Solway Firth Partnership. 58pp.

¹⁴ Solway Firth Partnership (2017). *Marine Invasive Non-Native Species in the Solway Firth*. Revised for 2018 – 2021. Solway Firth Partnership. 46pp.

¹⁵ EMODnet. (2024). The European Marine Observation and Data Network (EMODnet). Available at: EMODnet Central Portal | Geoviewer. Accessed on: 28 May 2024.

¹⁶ Seagrass Spotter (2024). Seagrass Location Tool. Available at: seagrassspotter.org. Accessed on: 28 May 2024.

12.14 Online searches for relevant literature were also made though very little additional data on benthic habitats within the survey area were found.

Field Survey

12.15 The principal source of data used to inform the assessment is the targeted benthic and intertidal survey conducted on behalf of the proposed development. Comments on the survey specification were received from NatureScot prior to the survey mobilisation (**Table 12.5**). The survey comprised the following features:

- **Drop down video (DDV) survey;** a DDV survey was initially conducted as part of the marine ecological survey for the proposed development. This was undertaken in order to define the nature of the seabed habitats within and adjacent to Stranraer marina and to confirm the presence or absence of any species/habitats of conservation interest or Priority Marine Features (PMFs). The survey targeted a total of seven underwater video transects, in addition to camera drops at each of the proposed benthic grab sample locations. The transects and grab locations were spread across Stranraer marina and the potential area of influence from the sediment plume resulting from dredging operations (**Section 12.10**). Seabed imagery was captured and reviewed, before biotopes (areas of uniform environmental conditions supporting a particular ecological community) were assigned based on the physical and biological characteristics of the seabed.
- **Benthic grab sampling survey:** following the DDV assessment, grab samples were acquired at 20 locations across Stranraer marina and within the predicted area of influence from sediments to potentially be mobilised by the dredging process. The samples were analysed for macrofaunal and sediment particle size distribution in order to examine the nature of seabed communities present.
- **Intertidal survey:** a detailed intertidal Phase I habitat survey was conducted across the foreshores east and west of Stranraer Marina in order to assess for the presence of any habitats of conservation importance or PMFs that could potentially be affected by the proposed development. The intertidal survey was conducted before the final version of the sediment plume model was completed and therefore was undertaken as a precautionary measure. Habitats were mapped up to a kilometre in each direction from the marina breakwaters using handheld GPS units and photographs were taken of each different habitat type observed so that biotopes could be assigned in order to classify the foreshore area.

12.16 The full benthic technical report detailing the results of the DDV, benthic, and intertidal surveys upon which this assessment is based is included as **Appendix 12.1** to this document.

Assessment Methodology

12.17 This assessment has been prepared in accordance with the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment¹⁷ and the Institute of Ecological and Environmental Management (IEEM) Guidelines for Ecological Impact Assessment (Marine and Coastal)¹⁸.

12.18 The methodology is summarised below:

- Data are obtained on the benthic habitats and communities present in the vicinity of the proposed development which will potentially be affected, through a targeted benthic and intertidal survey of the location as primary resources. This is supplemented where possible with secondary sources through desk-based assessments;
- The value and sensitivity of the identified benthic habitats and communities that have been defined are determined;
- Potential impacts on benthic habitats and communities are quantified on the basis of their magnitude, nature, probability, duration, and reversibility. The potential for cumulative and combined effects is also considered where appropriate;
- Where potential significant environmental effects are identified in the assessment process, mitigation and/or compensation measures are identified alongside specific monitoring needs, and the residual effects after mitigation/compensation are evaluated; and
- The significance of any residual effects is reported.

12.19 The sensitivity of the identified receptors is determined according to the relative importance of the existing environmental features or the potential susceptibility of the receptors to change. The criteria for the determination of sensitivity/value of the receptors are established based on relevant guidance, legislation, statutory designation, and/or professional judgment.

12.20 The definitions of receptor sensitivity/value for the purposes of benthic ecology are shown in **Table 12-1**.

¹⁷ CIEEM. (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.3. Chartered Institute of Ecology and Environmental Management, Winchester.

¹⁸ IEEM. (2010). Guidelines for Ecological Impact in Britain and Ireland. Marine and Coastal. Council of the Institute of Ecology and Environmental Management.

Table 12-1: Criteria used to define receptor value/sensitivity.

Sensitivity/ Value Criteria	Definition
High	The receptor is of high environmental value or contains species/habitats of international or national importance. There is likely to be little capacity for the receptor to absorb change without considerable alterations to the current state.
Medium	The receptor has some environmental value or contains species/habitats of regional importance. There is likely to be medium capacity for the receptor to absorb change without considerable alterations to the current state.
Low	The receptor is of low environmental value or contains species/habitats of local importance. The receptor is tolerant of change without detriment to its character.
Negligible	The receptor is of limited environmental value and is resistant to change.

12.21 The impact assessment considers impacts during both construction and operational phases of the proposed development (as identified in the EIA Scoping Opinion¹⁹), defined as short to medium term impacts and long-term impacts. Short to medium term impacts are considered to be those associated with the construction phase of the proposed development, and long-term impacts are those associated with the development once operational. These factors are considered along with the scale of potential changes and reversibility in the definition of magnitude. **Table 12-2** shows the definitions of impact magnitude adopted for the assessment of benthic ecology.

Table 12-2: Criteria used to define the magnitude of impacts

Magnitude Criteria	Definition
High	Total loss or substantial alteration to the integrity of the receptor or key features of baseline conditions that are likely to be irreversible, even in the long-term, such that the fundamental character of the receptor is permanently changed.
Medium	Loss or clear impact on one or more key features of the baseline conditions resulting in a material change to the character of the receptor, though likely to be reversible in the long-term.
Low	Slight shift away from baseline conditions such that any changes to the baseline conditions will be detectable but not material and similar to the pre-development situation. Changes likely to be reversible in the short to medium term.
Negligible	Very slight change from baseline conditions. Any impacts likely to be reversible in the very short term.

12.22 A combination of the value/sensitivity of the identified receptors and the magnitude of potential impacts will be used to determine the significance of the resulting effects. **Table 12-3** illustrates the matrix based on these parameters which will be used for guidance in the assessment of significance, which will be informed by professional judgement.

¹⁹ Marine Scotland: Scoping Opinion adopted by the Scottish Ministers under Part 4 of The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 Dumfries and Galloway Council Stranraer Marina Development: February 2023

Table 12-3: Significance of Effects Matrix

Magnitude of impact	Sensitivity of Receptor			
	High	Medium	Low	Negligible
High	Substantial	Substantial	Moderate	Slight
Medium	Substantial	Moderate	Slight	Negligible
Low	Moderate	Slight	Negligible	Negligible
Negligible	Slight	Negligible	Negligible	Negligible

12.23 Significance criteria will be based on the type of potential consequences, the probability of the consequence occurring, and the magnitude of the consequence. **Table 12-4** identifies the scale that will be used to evaluate significance of effect.

Table 12-4: Definitions of significance used in the benthic ecology assessment.

Significance Criteria	Definition
Substantial Adverse/Beneficial Effect	Substantial deterioration/improvement compared to the current scenario e.g. high impact on a regionally or nationally importance resource
Moderate Adverse/Beneficial Effect	Noticeable deterioration/improvement compared to the current scenario e.g. moderate to high impact on a locally important resource
Slight Adverse/Beneficial Effect	Slight deterioration/improvement compared to the current scenario e.g. low impact on a locally important resource
Neutral	No noticeable alterations to the current scenario

12.24 The following potential impacts on benthic ecology have been identified for the marine works associated with the proposed development:

- Potential for permanent habitat loss arising from the berth extension and the area of land reclamation;
- Potential for temporary disturbance/loss of habitat arising from dredging activity within the marina;
- Potential effects of increased suspended sediment concentrations and sediment deposition within Stranraer Marina on benthic ecology receptors;
- Potential for resuspension of contaminated sediments with effects on benthic ecology receptors;
- Potential effects of reduced water quality and dissolved oxygen on benthic ecology receptors;
- Potential for increased risk of importing marine INNS to the area due to the higher numbers of visiting boats and the potential to further spread INNS already present; and
- Potential impacts of creating new artificial habitat surrounding the new berths and breakwater extension.

Summary of Consultation

12.25 Consultation responses of relevance to this chapter were received from the organisations in **Table 12.5** below.

Table 12.5: Summary of Consultation Responses with Relevance to Benthic Ecology

Consultee	Summary Response	Comment/Action Taken
Marine Scotland	<p>Impacts are likely on benthic habitats. The potential impacts of habitat creation should be scoped into the EIA report.</p> <p>The EIA report must consider the possible impacts of the proposed works on Priority Marine Features (PMFs) and any Invasive Non-Native Species (INNS).</p> <p>The Scottish Ministers highlight the SeagrassSpotter tool and the native oyster information referenced in the MSS advice and encourage the Applicant to consider the inclusion of these in the EIA Report.</p>	<p>Potential effects from habitat creation on benthic habitats and communities will be considered in this chapter.</p> <p>Any potential impacts on either PMFs or INNS will be considered in this chapter.</p> <p>The Seagrass Spotter tool and the information on native oyster beds have been consulted as part of the desk-based assessment for this chapter. Additionally, the targeted benthic survey conducted for the project was specifically designed to capture evidence of any seagrass or native oyster communities in the area.</p>
NatureScot	<p>The benthic survey to be undertaken must include use of drop down video to identify any PMFs within the area of potential impacts, specifically seagrass beds and native oyster reefs, alongside grab sampling.</p> <p>An intertidal survey must also be undertaken along the foreshore east and west of Stranraer Marina to assess for any presence of seagrass or other PMFs in these areas.</p> <p>Any survey work must be timed from late May through to autumn to make sure that no areas of seagrass are missed due to seasonal dieback.</p>	<p>The benthic survey plan was designed in consultation with NatureScot and drafts were provided for comment and agreement prior to mobilisation.</p> <p>DDV to be included as part of the benthic survey, including drops at each grab sampling station in addition to seven video transects.</p> <p>Intertidal surveys designed to cover the east and west beaches at Stranraer for a minimum of 1km in either direction from the proposed development.</p>

Limitations

12.26 Site specific surveys have been undertaken in relation to the proposed works in order to provide primary evidence as part of the characterisation process for benthic and intertidal habitats. The surveys included the use of DDV transect methodologies to inspect the dredge footprint area for any habitats of conservation importance or any PMFs; whilst survey coverage was high and

as agreed with NatureScot, it did not cover 100% of the seabed in this area. Nonetheless, the field team completing the survey were confident that no such features were present across the sediment plume footprint. As such, there are no significant limitations that are applicable to this chapter.

Baseline Conditions

- 12.27 A dedicated benthic and intertidal survey has been undertaken in order to characterise the baseline conditions within and adjacent to Stranraer Marina. The full technical report upon which this assessment is based is included as **Appendix 12.1** to this chapter.
- 12.28 Stranraer Marina is located at the southern end of Loch Ryan. The marina is primarily subtidal, with the exception of some surrounding margins and the area to the eastern end of the basin, which dries at low water.

Intertidal Ecology

- 12.29 The intertidal Phase I survey conducted in May 2025 established the intertidal areas east and west of Stranraer Marina as a mixture of intertidal sand and coarse sediment interspersed with rocky areas. The foreshore west and north of the marina area comprised a complex mosaic of habitats typically dominated by coarse sediments and rocky substrata, along with faunal communities typical for those habitat types. The intertidal areas east of Stranraer were dominated by sandy sediments and formed a shallow sloping beach, with rocky habitats and coarse sediments found at the boundaries. Rock armour and man-made sea defences were also prevalent at the edges of these habitats.
- 12.30 The marine species observed across the intertidal areas adjacent to Stranraer were typical of intertidal habitats widely distributed in Scottish coastal waters. Common fauna species included Paguridae, *Carcinus maenas*, and *Littorina littorea*. Casts from the polychaete *Arenicola marina* were also identified. Common algal species were also present, including *Fucus vesiculosus*, *Fucus serratus*, and *Chondrus crispus*.
- 12.31 The eastern beach area contained a large expanse which was categorised as seagrass beds (*Zostera noltii*). These beds were patchy in nature, however covered a wide area of the foreshore. Aside from the seagrass beds identified, there were no other PMFs or species/habitats of nature conservation importance identified across any areas.
- 12.32 In total, there were nine distinct biotopes (habitats) identified as described below (EUNIS biotope code and biotope name). At some locations, multiple biotopes were present in combination and have been determined as mosaics. The locations of the biotopes mapped during the field survey are shown in Figure 12.1.
- MA123A *Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata
 - MA123D2 *Fucus vesiculosus* on mid eulittoral mixed substrata

- MA1242 *Fucus spiralis* on full salinity exposed to moderately exposed upper eulittoral rock
- MA32 Atlantic littoral coarse sediment
- MA4211 Ephemeral green and red seaweeds (freshwater influenced, or disturbed or organically enriched) on Atlantic littoral mixed substrata
- MA423 Unvegetated Atlantic littoral mixed sediment
- MB5237 *Arenicola marina* in Atlantic infralittoral fine sand or muddy sand
- MA123D2 & MA123A Mosaic of *Fucus vesiculosus* on mid eulittoral mixed substrata and *Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata
- MA123D2 & MB5237 Mosaic of *Fucus vesiculosus* on mid eulittoral mixed substrata and *Arenicola marina* in Atlantic infralittoral fine sand or muddy sand
- MA52 & MA4211 Mosaic of Atlantic littoral sand and Ephemeral green and red seaweeds (freshwater influenced, or disturbed or organically enriched) on Atlantic littoral mixed substrata
- MA5222 & MB5237 Mosaic of *Zostera noltii* beds on Atlantic littoral sand and *Arenicola marina* in Atlantic infralittoral fine sand or muddy sand

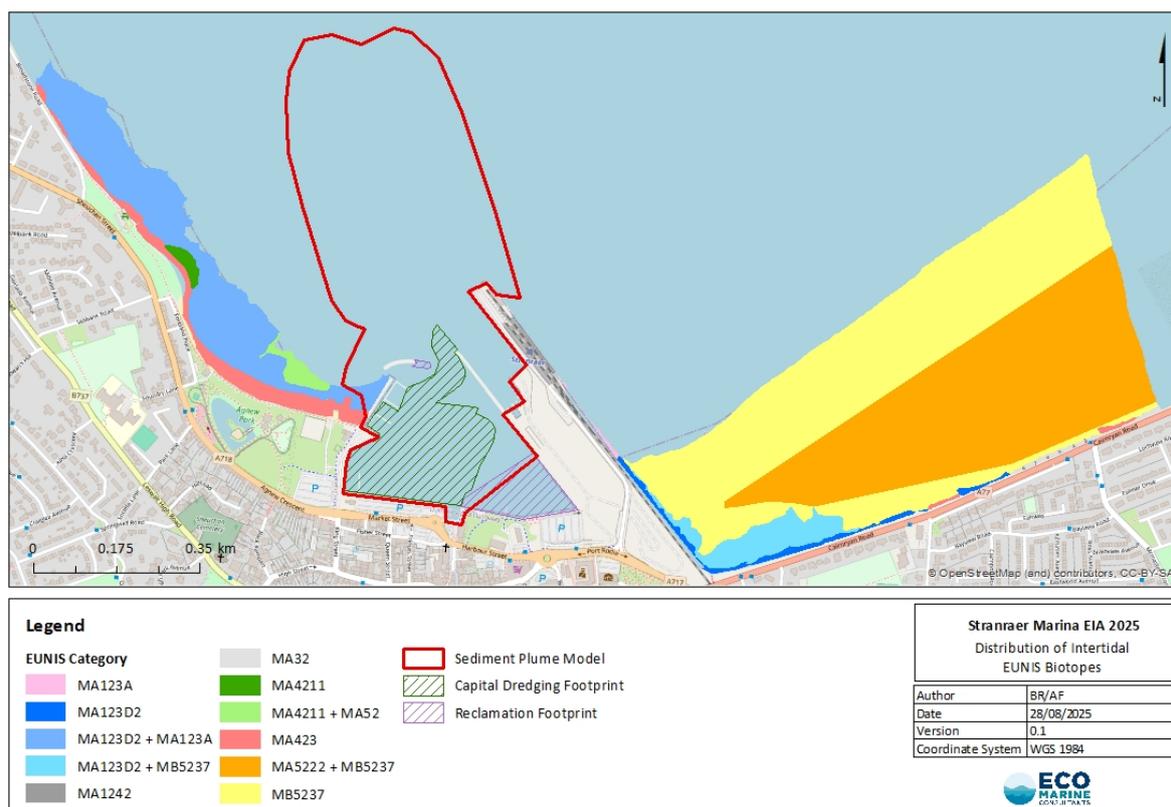


Figure 12-1: Intertidal habitats in the vicinity of Stranraer, as informed by the 2025 field survey.

Subtidal Ecology

- 12.33 The benthic field survey undertaken in May 2025 to characterise the benthic ecology in the vicinity of Stranraer Marina indicated that subtidal benthic communities within the marina were primarily dominated by representatives of the faunal group Annelida, followed by Mollusca, miscellaneous taxa, and finally Crustacea. Samples were dominated by the phylum Nematoda the polychaetes *Capitella* spp. and *Chaetozone gibber*, the bivalve *Abra alba* and the polychaete *Malacoceros vulgaris*.
- 12.34 Sampling points within the marina boundary exhibited varying faunal abundance, with both the maximum and minimum values recorded during the survey being found in close spatial proximity. Sampling points outside of the marina within the sediment plume footprint showed moderate abundance levels with less variation, and typically comprised those faunal communities associated with sandy and gravelly mud. The distribution of species diversity showed variability across the survey area, with a maximum of 29 different taxa in a single sample being observed at two locations, one inside and one outside of the marina.
- 12.35 From the grab and DDV data 13 biotopes were determined, as described below and as shown in Figure 12.2:
- MA123D2 *Fucus vesiculosus* on mid eulittoral mixed substrata
 - MA421 Seaweed communities on Atlantic littoral mixed sediments

- MA4233 *Cirratulids* and *Cerastoderma edule* in Atlantic littoral mixed sediment
- MA524 Polychaete/amphipod-dominated Atlantic littoral fine sand
- MA525 Polychaete/bivalve-dominated Atlantic littoral muddy sand
- MB32 Atlantic infralittoral coarse sediment
- MB423 Faunal communities on full salinity Atlantic infralittoral mixed sediment
- MB523 Faunal communities on full salinity Atlantic infralittoral sand
- MB62 Atlantic infralittoral mud
- MB621 Vegetated communities on Atlantic infralittoral mud
- MB624 Faunal communities on full salinity Atlantic infralittoral mud
- MB6244 *Melinna palmata* with *Magelona* spp. and *Thyasira* spp. in Atlantic infralittoral sandy mud
- MB6246 *Capitella capitata* in enriched Atlantic infralittoral muddy sediments

12.36 The seabed observed during the video survey was principally comprised of sands and muds. Some macroalgae turf communities and sparse fauna were observed, though generally the habitats observed showed low complexity. The DDV survey found no evidence of any PMFs across the subtidal survey area.

12.37 Two native oyster *Ostrea edulis* individuals were observed from one grab sample during the benthic survey, located within the marina basin. Additionally, the benthic field survey identified the presence of the non-native barnacle *Austrominius modestus* at two survey stations, both of which were located in the area designated for land reclamation as part of the proposed project. No other species of conservation importance or non-native species were identified.

Sediment Composition

12.38 Sediment samples were obtained from 20 stations within and adjacent to Stranraer Marina. From these, a total of eight different Folk categories were identified; to the north of the survey area slightly gravelly sandy mud dominated, whereas within the marina basin there was greater overall variability and a higher percentage of sand and gravel within the sediments.

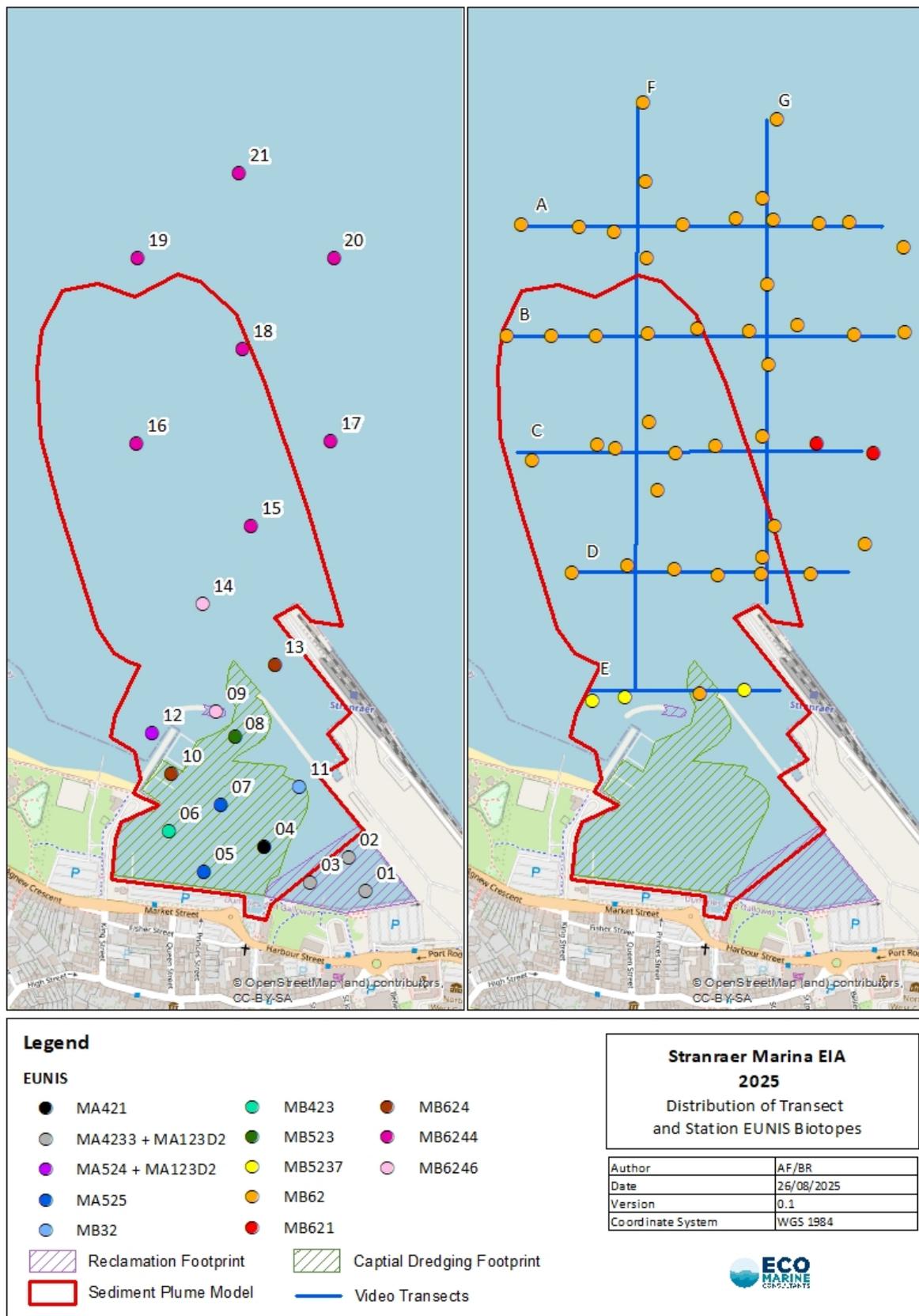


Figure 12.2: The distribution of subtidal habitats in the vicinity of Stranraer, informed by the grab sampling survey and DDV survey.

Identification of Receptor Value and Sensitivity

- 12.39 The information presented above highlights the benthic communities found in the vicinity of Stranraer and the surrounding area. The subtidal areas within and adjacent to Stranraer Marina principally comprise muds, sands, and mixed sediments. The benthic faunal communities documented across the area of interest are typical for these habitat types and are likely to be ubiquitous throughout Loch Ryan and the surrounding area.
- 12.40 Survey data suggest that benthic faunal communities differ within and outside of the confines of Stranraer Marina, likely a result of the increased shelter afforded by the breakwater and possibly historic dredging and disturbance. No PMF habitats or species were observed during either the dropdown video or the grab sampling survey (aside from native oysters *Ostrea edulis*, discussed below). In light of the ubiquitous nature of the benthic communities present, the historic dredging that has occurred in the area, and the likely moderate tolerance of these communities to changes, benthic habitats are considered to be of low sensitivity.
- 12.41 Two native oyster *Ostrea edulis* individuals were observed from one grab sample during the benthic survey; native oysters are included in the Oslo and Paris (OSPAR) Commission list of 'Threatened and/or Declining Species and Habitats'²⁰ and are a PMF in Scotland. No evidence of any native oyster reefs was documented during the survey, though oyster reefs are understood to be widespread within the wider Loch Ryan area. Native oysters are of international importance and are unlikely to be tolerant of changes, thus receptor sensitivity is assessed as High.
- 12.42 The intertidal habitats present in the vicinity of Stranraer are varied but typical for the environment. The foreshore west of the proposed development comprised mixed and algae sediment dominated shores, whilst the foreshore to the east was typically comprised of sandy beach. These habitats (excluding seagrass beds, discussed below) are not subject to any protection and appear to be widespread and typical in Loch Ryan and the wider region. As such they are of local importance only, and likely to be tolerant to some degree of any impacts potentially arising from the proposed project^{21,22}. The intertidal habitats in the vicinity of Stranraer are thus considered to be of Low sensitivity.
- 12.43 The area of intertidal foreshore to the east of Stranraer Marina was notable as supporting dwarf eelgrass *Zostera noltii* beds. These beds were fairly extensive and covered a wide area with varying density. Seagrass beds are designated as a PMF in Scotland and are of national importance, due to the rare habitat type, biological productivity, and importance for habitat

²⁰ OSPAR Commission: OSPAR List of Threatened and/or Declining Species and Habitats (OSPAR Agreement 2008-06): June 2008

²¹ Tillin, H.M. and Budd, G., (2016). Ephemeral green and red seaweeds on variable salinity and/or disturbed eu littoral mixed substrata. In Tyler-Walters H. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom.

²² Tyler-Walters, H., Garrard, S.L., Lloyd, K.A., and Watson, A., (2023). *Arenicola marina* in infralittoral fine sand or muddy sand. In Tyler-Walters H. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom.

complexity, with likely low tolerance to changes that may be associated with the proposed project²³. As such this receptor is considered to be of High sensitivity.

12.44 Table 12-5 provides a summary of the benthic receptors relevant to the proposed development which will be considered in this assessment, together with their assigned value/sensitivity.

Table 12-5: Sensitivity of benthic receptors potentially in proximity to the proposed development.

Receptor	Representative habitats/species	Description	Value/Sensitivity of Receptor
Subtidal habitats	<ul style="list-style-type: none"> • Seaweed communities on Atlantic littoral mixed sediment (MA421) • <i>Cirratulids</i> and <i>Cerastoderma edule</i> in Atlantic littoral mixed sediment (MA4233) • Polychaete/amphipod-dominated Atlantic littoral fine sand (MA524) • Polychaete/bivalve-dominated Atlantic littoral muddy sand (MA525) • Atlantic infralittoral coarse sediment (MB32) • Faunal communities on full salinity Atlantic infralittoral mixed sediment (MB423) • Faunal communities of full salinity Atlantic infralittoral sand (MB523) • Faunal communities on full salinity Atlantic infralittoral mud (MB624) • <i>Melinna palmata</i> with <i>Magelona</i> spp. and <i>Thyasira</i> spp. in Atlantic infralittoral sandy mud (MB6244) • <i>Capitella capitata</i> in enriched Atlantic infralittoral muddy sediments (MB6246) 	Subtidal benthic habitats present in the vicinity of Stranraer are dominated by sands and muds, and not subject to any level of protection, being typical of and widespread in the coastal areas of Scotland. Habitats are of local importance and likely to be relatively tolerant of changes which may be associated with the proposed development.	Low
Intertidal habitats	<ul style="list-style-type: none"> • <i>Fucus serratus</i> with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata (MA123A) • <i>Fucus vesiculosus</i> on mid eulittoral mixed substrata (MA123D2) • <i>Fucus spiralis</i> on full salinity exposed to moderately exposed upper eulittoral rock (MA1242) • Atlantic littoral coarse sediment (MA32) • Ephemeral green and red seaweeds (freshwater influenced, or disturbed or organically enriched) on Atlantic littoral mixed substrata (MA4211) 	<p>The intertidal habitats in the vicinity of Stranraer Marina comprise either sandy/muddy beach to the east, or mixed sediment, with some gravelly areas to the west/north.</p> <p>The habitats present are not subject to any level of protection, being typical of and widespread in the coastal areas of Scotland. Habitats are of</p>	Low

²³ Tyler-Walters, H., (2005). *Zostera noltii* Dwarf eelgrass. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom.

Receptor	Representative habitats/species	Description	Value/Sensitivity of Receptor
	<ul style="list-style-type: none"> • Unvegetated Atlantic littoral mixed sediment (MA423) • Atlantic littoral sand (MA52) • <i>Arenicola marina</i> in Atlantic infralittoral fine sand or muddy sand (MB5237) 	local importance and likely to be relatively tolerant of changes which may be associated with the proposed development.	
Native oysters	<i>Ostrea edulis</i>	Native oysters <i>Ostrea edulis</i> are a Priority Marine Feature in Scotland and are protected under the OSPAR convention. They are of national importance and likely to be sensitive to changes.	High
Seagrass beds	<i>Zostera noltii</i> beds on Atlantic littoral sand	Dwarf eelgrass <i>Zostera noltii</i> is a Priority Marine Feature in Scotland. The species is of national importance and likely to have low resilience to changes.	High

Impact Assessment

12.45 The proposed development at Stranraer may result in a range of potential direct and indirect impacts on the identified receptors. The assessment of these potential impacts follows the methodology outlined in this chapter.

Embedded Mitigation

12.46 In order to lessen any environmental effects from the proposed development, embedded mitigation measures have been proposed where appropriate. These features are incorporated into the project design and construction methods.

12.47 One consideration of embedded mitigation related to benthic ecology is the use of underwater lighting. Underwater lighting has the potential to negatively influence the behaviour of marine organisms, potentially causing stress, disruption to natural physiology, and potentially resulting in localised decreases in the abundance of some taxa. As such, the project will incorporate no elements of underwater lighting in order to minimise impacts on benthic faunal populations in the immediate vicinity of the development. All other lighting to be installed on pontoons within the marina and surrounds will be of industry standard.

12.48 It should also be noted that detailed consideration has been given to the disposal of dredged material throughout the project design. To this extent a Best Practice Environmental Option

(BPEO) assessment has been undertaken to ensure that the most appropriate methods and locations of dredge spoil disposal are implemented for the project.

12.49 Additional 'non-embedded' mitigation is also proposed as detailed in the Mitigation section of this chapter.

Construction Phase

Permanent Habitat Loss

12.50 As part of the proposed development, it is planned that there will be an area of land reclamation in the southeast of Stranraer Marina. In addition, it has been proposed that the existing breakwater is extended and that piles are installed at multiple locations across the development. The construction activities and reclamation of land associated with the development will result in complete loss or considerable modification to all habitats within the footprint areas. This section considers the potential effects of temporary habitat loss on subtidal receptor habitats.

12.51 Footprint areas that are likely to result in complete habitat loss as part of the proposed development are as follows:

- Land reclamation habitat loss: ~18,600 m²
- Breakwater extension habitat loss: ~500 m²
- Total habitat loss: ~19,100 m²

12.52 It should be noted that the habitat to be lost is that within the confines of Stranraer marina, in the area of land reclamation and breakwater extension, rather than any areas of intertidal or subtidal habitat either east or west, or offshore of the development outside the existing marina boundaries or breakwater.

12.53 Habitat loss within these areas is predicted to be permanent and not reversible or recoverable. However, losses are of a local spatial extent and are limited to within the confines of Stranraer Marina.

12.54 No features of conservation interest or PMFs have been identified within any of the permanent habitat loss areas. Field data indicates that the habitats present within the loss areas were characterised by a comparatively low abundance of benthic fauna which comprised in part short-lived, fast reproducing species, and are recognised as being widespread throughout the area of interest and common across the wider regional area. As such, loss of habitats and species within the footprint areas are unlikely to have any effect on the integrity of wider habitats or populations.

12.55 No evidence of any seagrass or native oyster beds was documented within the areas of permanent habitat loss during the field survey; thus it is considered that there is no pathway for this impact to affect these receptors.

12.56 Subtidal habitat receptor sensitivity has been assessed as low. The magnitude of impacts arising from permanent habitat loss is medium, owing to the limited spatial scales involved. This equates to an impact of **Slight Adverse** significance for permanent habitat loss in subtidal areas associated with the proposed project, which is not significant in EIA terms.

Temporary Habitat Loss

12.57 The impacts of temporary habitat loss associated with the proposed project principally relate to dredging activity. The dredge area proposed at Stranraer Marina is ~61,500 m², and benthic communities within this footprint will be directly affected by the removal of sediment and loss of habitat, in addition to the mortality of benthic organisms. However, recovery of habitats following the completion of dredging (and thus sensitivity of the receptors) is likely to some degree depending on the nature of the habitats present. This section considers the potential effects of temporary habitat loss on subtidal habitats and native oysters.

12.58 Field data suggests that the biotopes present within the dredge footprint area comprised the following:

- Seaweed communities on Atlantic littoral mixed sediment
- Faunal communities on full salinity Atlantic infralittoral mixed sediment
- Polychaete/bivalve-dominated Atlantic littoral muddy sand
- Faunal communities of full salinity Atlantic infralittoral sand
- Faunal communities on full salinity Atlantic infralittoral mud
- Atlantic infralittoral coarse sediment

12.59 None of the habitats present within the dredge footprint are subject to any nature conservation designations.

12.60 Evidence from the field survey indicated that the faunal communities within the dredge footprint were all of a similar nature throughout, with moderate faunal abundance and mostly characterised by Annelida. In particular, the species *Dipolydora quadrilobate*, *C. gibber*, *Pygospio elegans*, and *Scoloplos armiger*. Sediments recorded ranged from mixed substrates to fine sands and muds.

12.61 The biotopes present within the dredge footprint are likely to be moderately sensitive to substratum loss with a moderate recoverability, dependent on the return of suitable sediment and recruitment of individuals²⁴. These habitats are thought to have little resistance to temporary habitat loss, though recovery is likely to be relatively fast and within a matter of years due to the migration of adults and larvae from surrounding habitats²⁵. The majority of species

²⁴ Tyler-Walters, H. and Marshall, C., (2006). Polychaete / bivalve dominated muddy sand shores. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 13-08-2025].

²⁵ Ashley, M. and Watson, A., 2024. Polychaetes in littoral fine sand. In Tyler-Walters H. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom.

present are fast growing and short-lived; polychaetes such as *P. elegans* and *C. gibber* are quick to mature and exhibit several reproductive strategies, allowing for rapid recolonisation of disturbed sediments^{26,27}.

- 12.62 None of the species present are listed under any nature conservation legislation. Given that the biotopes identified as present within the dredge footprint are likely to be typical for the area and across the region, the history of disturbance from past dredging within the marina, the small scale of proposed dredging operations, and the moderate potential for recovery shown by the habitats, it is considered that the magnitude of potential impacts on benthic communities from temporary habitat loss is Low. As subtidal receptor habitats have been identified to be a receptor of Low sensitivity this results in an impact of **Negligible** significance.
- 12.63 Two *Ostrea edulis* individuals were recorded within the capital dredge footprint area within Stranraer Marina as part of the benthic characterisation survey undertaken in support of this project. *O. edulis* are a PMF in Scotland, however these individuals were the only specimens recorded during the field survey and there was no evidence of any oyster reef identified in the vicinity of Stranraer. Given the prevalence of *O. edulis* beds in the wider Loch Ryan area and the very low numbers of individuals recorded at one location, the magnitude of temporary habitat loss is assessed as being Negligible. The sensitivity of native oysters is High, resulting in an overall **Slight Adverse** effect, which is not significant in EIA terms.
- 12.64 No seagrass beds or intertidal habitats were identified within the dredge footprint, thus these features will not be affected by temporary habitat loss and as such have been excluded from this assessment.

Suspended Sediment and Water Quality

- 12.65 Part of the proposed development includes a capital dredging programme, followed by land reclamation within Stranraer Marina as a means of dredge spoil disposal, plus an extension of the existing breakwater. These activities both have the potential to increase the concentration of suspended sediments, sediment deposition, and the release of any seabed contaminants into the water column.
- 12.66 Dredging across the marina will be undertaken to varying degrees. Approximately 132,616m³ of sediment will be dredged, of which approximately 48,340m³ will be utilised in the land reclamation area and breakwater extension with the remainder to be disposed at sea. Sea disposal will be at the Beaufort Dyke. Other options for on land remediation will also be explored as part of the project.

²⁶ Van Colen, C., Montserrat, F., Vincx, M., Herman, P.M., Ysebaert, T. and Degraer, S., 2008. Macrobenthic recovery from hypoxia in an estuarine tidal mudflat. *Marine Ecology-Progress Series*, **372**, 31-42.

²⁷ Marine Ecological Surveys Limited (MES), 2008. *Marine Macrofauna Genus Trait Handbook*. Marine Ecological Surveys Limited: Bath.

- 12.67 The main approach channel will be dredged to minus 3.5 mCD, with the main pontoon areas being dredged to minus 4.5 mCD, minus 3.5 mCD, minus 3.0 mCD, or minus 2.0 mCD depending on the berth sizes. The gradient of change between depths is assumed to be 1:5 at this stage, with the area around the existing breakwater extension and a small area on the northern edge of the marina being 1:4, though this may be adjusted subject to ground investigation. A detailed description of the proposed dredge design is presented in **Chapter 2.0** of the EIAR.
- 12.68 The final method of dredging will be confirmed once the dredging contractor has been appointed. However, for the purpose of undertaking this EIA, it has been assumed that a cutter suction dredger (CSD) will be deployed to undertake the dredging required for the Proposed Development. During CSD operations, dredged material is drawn up through the cutterhead and suction pipe and discharged in a hopper barge for transport. Overflowing will not be allowed from the hopper barges during dredging operations.
- 12.69 Alternatively, a backhoe dredger may be used for some areas of the marina depending on seabed/ground conditions. Taking a conservative approach, the utilisation of CSD methods is also considered to be a worst-case scenario, therefore this assessment has been based on this method alone.
- 12.70 Results of the initial ground investigation works indicates that surface sediments from within the dredge area predominantly comprise sand and silt material. However, sediments obtained from below the surface (i.e. borehole and vibrocore samples) indicate a slightly increased proportion of coarser material (sand and gravel) with fewer fines.
- 12.71 Sediment samples were analysed for concentrations of contaminants as part of the ground investigation works and also as part of the Best Practicable Environmental Option (BPEO) assessment (**Appendix 11.1**). Concentrations of heavy metals, tributyltin (TBT), polyaromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs), as well as total hydrocarbons (THC), were assessed at Stranraer, the methods of which are detailed in **Chapter 11.0**. Within Stranraer Marina, marine sediment contamination was found to be widespread, with elevated levels of chromium and nickel found to be above revised action level (RAL) ¹²⁸ at all three stations sampled for the GI works. Concentrations of chromium, copper, PAHs, and THC were found to be above RAL1 in the BPEO report, whilst concentrations of nickel were found to be above RAL2 at one site and above RAL1 at the majority of sites tested. Action levels, originally established in 1995 and revised in 2003, are generally used to determine the suitability of sediments for disposal at sea. Samples below RAL1 are generally considered acceptable for disposal at sea, while sediments above RAL2 are considered unacceptable for uncontrolled disposal at sea without special handling and containment, with those in between requiring further consideration. However, in the proposed project it is anticipated that some dredge spoil

²⁸ Marine Scotland. (2017). Pre-disposal Sampling Guidance. Version 2 – November 2017. 5pp.

sediments will be re-utilised within the development with the rest being disposed at sea. Action levels have been referred to in order to give a representation of the scale of contamination.

- 12.72 The breakwater extension will be constructed using dredge material as fill, with a rock armour exterior to match the existing structure. This activity will be completed by specialist contractors using marine dredging equipment and stabilisation will be conducted of the dredge material using a secondary treatment process to alter the properties of the material to the desired specification. Heavy excavation equipment will be used to place and form the rock armour revetment, with a subsequent heavy duty compaction plant used to stabilise the final formation level in layers as infilling progresses to the desired finished level, likely in layers of 250mm to 300mm in depth.
- 12.73 In addition to the dredging works, the placement of dredge spoil in the construction of the breakwater extension, rock armour placement, and land reclamation activities all have the potential to increase sediment loading in the water column.
- 12.74 The following sub-sections outline the potential effects of each of these individual impacts on benthic ecology receptors.
- 12.75 No seagrass beds or native oysters were identified as part of the intertidal or subtidal survey within the dredge plume modelling footprint. These features will not be affected by changes to suspended sediments, increased sedimentation, or water quality changes and as such have been excluded from this assessment.

Changes in Suspended Sediment Concentration and Sediment Deposition

- 12.76 Changes in suspended sediment concentration as a result of dredging and land reclamation have been considered and the impact assessment is presented in **Chapters 7.0 and 11.0** of the EIAR. The following assessment relates specifically to the impact on benthic ecology. This section considers the potential effects of changes in suspended sediment concentration and sediment deposition on subtidal habitat and intertidal habitat receptors.
- 12.77 Increased sediment loading in the water column has the potential to impact upon benthic organisms. Filter feeding organisms in particular may suffer from the clogging of feeding mechanisms, and increased turbidity has been shown to ultimately impair the growth of some filter feeding bivalves²⁹. Additionally, there is the potential for the smothering of benthic organisms and habitats due to settlement of fine material from the water column to the seabed.
- 12.78 The effects of increased turbidity are likely to be lessened in areas with a naturally high level of sediment loading, such as around coastal areas and within shallow sheltered bays not dissimilar to Loch Ryan, where the benthic communities present may be better adapted to tolerating such conditions. However, when sedimentation exceeds natural levels there is the potential for loss

²⁹ Widdows, J., Fieth, P., and Worral, C.M. (1979). Relationship between seston, available food and feeding activity in the common mussel *Mytilus edulis*. *Marine Biology*, 50(3): 195-207.

of habitats, due to increased mortality of benthic fauna, in particular sessile species³⁰. Increased turbidity also has the potential to impact light attenuation, possibly affecting benthic flora and algae communities.³¹

- 12.79 Dredging, land reclamation, and rock placement will all take place within or immediately adjacent to Stranraer Marina. Modelling of the anticipated dredge plume arising from the works has been undertaken and is presented in **Chapter 7.0**. Suspended sediment concentration plumes were calculated under two modelled scenarios which were representative of conditions at the beginning of the dredging programme (scenario one, e.g. offshore sediment deposition and existing breakwater layout) and near the end (scenario two, e.g. onshore sediment reclamation and the new breakwater layout). The maximum plume envelopes for suspended sediment, which represented the maximum value calculated by the models at any given location across the study area, showed for both scenarios that the zones of influence (minimum of 0.5mg/l) extended approximately 1.2km north from the mouth of the marina and was approximately 500m across at the widest point. The material to be dredged is mixed sand and silt with a smaller gravel fraction and is likely to settle moderately quickly, minimising the duration of increased sediment in the water column associated with dredging. There are also no strong tidal currents in the area which could transport suspended sediments significantly further from the site. Snapshots of the suspended sediment concentrations during ebb and flood tides showed that the zone of influence fluctuated in extent with the tides, however these fluctuations were minor and only varied in extent by approximately 100m in any direction. As such, the extent of the increase in sediment loading is expected to be confined to the local vicinity of the works.
- 12.80 The benthic habitats within the dredge footprint are considered to be impacted by temporary habitat loss as discussed above, and as such this assessment is based only on those habitats and species found outside of the direct dredging area and within the dredge plume model footprint.
- 12.81 The benthic field survey identified the presence of the following biotopes within the dredge plume footprint:
- Faunal communities on full salinity Atlantic infralittoral mud;
 - Polychaete/amphipod-dominated Atlantic littoral fine sand;
 - *Capitella capitata* in enriched Atlantic infralittoral muddy sediments; and
 - *Melinna palmata* with *Magelona* spp. and *Thyasira* spp. in Atlantic infralittoral sandy mud

³⁰ Miller, D., Muir, C., and Hauser, O. (2002). Detrimental effects of sedimentation on marine benthos: what can be learned from natural processes and rates? *Ecological Engineering*, 19(1), 211-232.

³¹ Pineda, M. C., Strehlow, B., Duckworth, A., Doyle, J., Jones, R., and Webster, N. S. (2016). Effects of light attenuation on the sponge holobiont- implications for dredging management. *Scientific Reports*, 6.

- 12.82 None of the biotopes present within the footprint of the predicted sediment plume are considered to be particularly sensitive to increases in turbidity or sedimentation, with the fauna typically present able to burrow or adapt to changes. Recovery for these habitats from any secondary impacts arising from dredging activity is likely to be relatively rapid^{32,33,34}. The benthic habitats present within the zone of secondary effects arising from the proposed dredging operations are likely to already have experienced some degree of reduced water clarity through vessel movements, propeller wash, and historic dredging, and species characterising the biotopes present have been found at a number of other locations around the UK where sediment loading is considerable^{35,36,37}.
- 12.83 It should additionally be noted that the sediment plume modelling exercise indicated that any sediments mobilised from the dredging process are unlikely to travel far from the works due to the nature of local hydrodynamic conditions (see **Chapter 7.0**). The impacts from increased suspended sediments and sediment smothering are therefore likely to be very limited in spatial scale.
- 12.84 Any sedimentation and increased suspended sediments resulting from development activity will settle out relatively quickly over a limited area and be limited in duration due to the short timescales of the proposed dredge activity. The subtidal habitats present within the sediment plume model footprint are resilient to change and of low sensitivity to the potential impacts. The magnitude of this impact is therefore assessed as being Negligible, and the sensitivity of subtidal habitats and benthic ecology within the footprint area is Low. The resulting effect on subtidal benthic ecology is therefore described as **Negligible**, which is not significant in EIA terms.
- 12.85 Mapping of the intertidal habitats present to the east and west of Stranraer Marina and the footprint of the predicted sediment plume shows that there is likely to be some interaction as a result of dredging for the proposed project. It can be seen from Figure 12-1 that a very small area of the intertidal habitat designated as a mosaic of '*Fucus vesiculosus* on mid eulittoral mixed substrata' (MA123D2) and '*Fucus serratus* with sponges, ascidians and red seaweeds

³² De-Bastos, E.S.R. and Watson, A., (2023). *Melinna palmata* with *Magelona* spp. and *Thyasira* spp. in infralittoral sandy mud. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 18-08-2025].

³³ Ashley, M. and Watson, A., (2024). Polychaetes in littoral fine sand. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 18-08-2025].

³⁴ Tillin, H.M. and Watson, A., (2023). *Capitella capitata* in enriched sublittoral muddy sediments. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 18-08-2025].

³⁵ Bartrop, J., Bishop, G., Harvey, R., Holme, N.A., Knight, S.J.T. and Powell, H.T. (1980). Survey of the Littoral Zone of the Coast of Great Britain. 7. Report on the Shores of the Moray Firth. Report to the Nature Conservancy Council by SMBA / MBA Intertidal Survey Unit, Inverness. Nature Conservancy Council. 66pp.

³⁶ Boon, P. (1995). An Examination and Assessment of the Development and Application of a Management Framework for Coastal Zone Management within the Moray Firth Coastal Zone. A Thesis Submitted for the Degree of Doctor of Philosophy Institute of Offshore Engineering Heriot-Watt University October 1995.

³⁷ Eleftheriou, A., Basford, D. and Moore, D.C (2004). Report for the Department of Trade and Industry Synthesis of Information on the Benthos of Area SEA 5 Final Draft 1 May 2004.

on tide-swept lower eulittoral mixed substrata' (MA123A) nearest to the breakwater and marina wall is likely to be impacted by secondary effects arising from construction. Both habitats are likely to have a moderate level of resistance to changes in suspended sediments and sediment deposition, with a moderate rate of recovery predicted^{38,39}. Given this, coupled with the very small area of interaction, it is considered that the impacts of increased suspended sediments and sedimentation on intertidal habitats in the vicinity of Stranraer are of a Negligible magnitude. The receptor sensitivity is Low, resulting in an overall **Negligible** effect, which is not significant in EIA terms.

- 12.86 No seagrass beds or native oyster reefs were identified as part of the benthic grab sampling or DDV survey within the dredge plume modelling footprint. These features will not be affected by changes to suspended sediments, increased sedimentation, or water quality changes and as such have been excluded from this assessment.

Changes in Water Quality - Contaminants

- 12.87 Changes in water quality as a result of dredging and land reclamation have been considered and the impact assessment is presented in **Chapter 11.0** of the EIAR. This section considers the potential effects of changes in water quality (specifically contaminants) on subtidal habitat and intertidal habitat receptors.
- 12.88 Heavy metals, PAHs, and PCBs are common in sediments exposed to shipping activity and/or industrial development. Dredging has the potential to release contaminants into the water column through disturbance of the sediments. Contaminants released into the water column can affect benthic species through direct exposure or they may accumulate in marine fauna and transfer up the food chain⁴⁰.
- 12.89 Ground investigation has shown that the sediments within Stranraer Marina are contaminated. Sampling undertaken for the BPEO assessment indicated that several contaminants of concern exceed RAL1, with a single exceedance recorded of RAL2. However, it was considered in the BPEO report that there was a low risk of the contaminants within the sediments impacting on the overall status of the water body surrounding Stranraer. Further, the exceedance of RAL2 for nickel was deemed to be due to naturally occurring concentrations and was unlikely to have arisen from anthropogenic sources. When data were averaged across the site, no exceedances of RAL2 were observed for any contaminants tested. This aligns with the initial ground investigation surveys, which concluded that many contaminants were only marginally over the

³⁸ Perry, F., d'Avack, E.A.S., Budd, G.C. and Watson, A., (2024). *Fucus vesiculosus* on mid eulittoral mixed substrata. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 27-08-2025].

³⁹ d'Avack, E.A.S., and Marshall, C.E., (2015). *Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 27-08-2025].

⁴⁰ Losada, S., Roach, A., Roosens, L., Santos, F.J., Galceran, M.T., Vetter, W., Neels, H., and Covaci, A. (2009). Biomagnification of anthropogenic and naturally-produced organobrominated compounds in a marine food web from Sydney Harbour, Australia. *Environment International*, 35(8): 1142-1149.

RAL1 threshold and upon averaging no longer exceeded the guide limits. Therefore, the contaminants can be seen to be largely present at relatively low levels.

- 12.90 Sediments are likely to exist within the water column for a short period of time; this is largely due to the types of sediments present, to which the contaminants are mostly bound, being likely to settle moderately quickly as well as the low tidal currents present in the area creating a limited zone of influence.
- 12.91 The species present at Stranraer are likely to be tolerant to the existing levels of contamination present, especially those that burrow into the sediments⁴¹. Polychaetes are known to be relatively tolerant of heavy metal contamination, as are some bivalve species such as *Abra* spp.^{42,43}. Nonetheless, it is noted that sub-lethal concentrations of hydrocarbon contamination may generally result in reduced feeding rates, food detection ability, and respiration rates in marine invertebrates in soft sediment habitats⁴⁴. The species that characterise the biotopes present across the dredge plume footprint are however generally noted as quickly maturing species that would likely recolonise any losses in a relatively short timeframe⁴⁵.
- 12.92 The maximum dissolved fraction of these metals in the water column has been calculated based on recognised sediment-water partition coefficients. This analysis, described in full in **Chapter 11.0**, indicates that dredging and disposal will result in increases in the concentration of these metals in the water. However, they will be very localised, largely restricted to the areas in which the activities occur, and they will be short-lived due to the rapid settlement of sediments, the partition to which they are mostly bound.
- 12.93 Therefore, these factors indicate a low ecotoxicological risk to benthic subtidal habitats and species in the area and, considering the short-term nature of the increases, the magnitude of the impact on subtidal habitats has subsequently been assessed as being Low. As subtidal benthic habitats have been identified to be a receptor of low sensitivity this results in an effect of **Negligible** significance.
- 12.94 The small area of intertidal habitat to the east of Stranraer that is likely to be impacted by secondary sediment plume effects arising from construction of the proposed development is noted to contain the biotopes '*Fucus vesiculosus* on mid eulittoral mixed substrata' (MA123D2)

⁴¹ Nikitik, C. C., and Robinson, A. W. (2003). Patterns in benthic populations in the Milford Haven waterway following the 'Sea Empress' oil spill with special reference to amphipods. *Marine pollution bulletin*, 46(9), 1125-1141.

⁴² Bryan, G.W., (1984). Pollution due to heavy metals and their compounds. In *Marine Ecology: A Comprehensive, Integrated Treatise on Life in the Oceans and Coastal Waters*, vol. 5. *Ocean Management*, part 3, (ed. O. Kinne), pp.1289-1431. New York: John Wiley & Sons.

⁴³ Budd, G.C. (2007). *Abra alba* White furrow shell. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom.

⁴⁴ Suchanek, T.H., (1993). Oil impacts on marine invertebrate populations and communities. *American Zoologist*, **33**, 510-523.

⁴⁵ Ashley, M. and Watson, A., (2024). Polychaetes in littoral fine sand. 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 18-08-2025].

and '*Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata' (MA123A) in a mosaic. Furoid species are known to be somewhat tolerant of heavy metal and hydrocarbon contamination and are likely to exhibit relatively rapid recovery where wider unimpacted populations exist in close proximity⁴⁶. Other fauna associated with these habitats are likely to be less tolerant of change, in line with those for benthic fauna identified above. Considering the overall low ecotoxicological risk to intertidal habitats and species in the area, the short-term nature of the increases, and the very small area likely to be affected (~2,700 m²), the magnitude of the impact of water quality (contaminants) changes on intertidal ecology has been assessed as being Negligible. As intertidal habitats have been identified as a receptor of low sensitivity this results in an effect of **Negligible** significance.

Changes in Water Quality – Dissolved Oxygen

- 12.95 Water quality indicators such as dissolved oxygen (DO) and biological and chemical oxygen demand can also be affected by the release of sediments into the water column via dredging. This is due to elevated suspended sediment concentrations increasing chemical and biological oxygen demand, which can reduce DO concentrations.
- 12.96 The habitats present within the dredge plume footprint area are likely to be somewhat resistant to reduced dissolved oxygen levels and are thought to not be overly sensitive to changes of this nature, with recovery from any impact occurring at a relatively quick rate^{32,34,39}.
- 12.97 Therefore, due to the above, the short-term nature of the proposed dredging activity and the low organic content of the marine deposits (**Chapter 11.0**), the potential magnitude of change in DO in the water column on subtidal and intertidal habitats has been assessed as Negligible.
- 12.98 As subtidal and intertidal habitats in the vicinity of Stranraer are of Low sensitivity, this results in an effect of **Negligible** significance.

Invasive Non-Native Species

- 12.99 Invasive Non-Native Species (INNS) are flora and fauna which have been introduced or transported outside of their natural range and have the potential to damage the environment⁴⁷. INNS have the potential to threaten the survival of native species and may damage sensitive ecosystems and habitats. The proposed development at Stranraer Marina carries the risk that INNS could be introduced to the local environment through the importing of construction materials, the use of plant machinery and increased vessel traffic. This section considers the potential effects of INNS on subtidal habitats, intertidal habitats, and native oysters.

⁴⁶ Holt, T.J., Hartnoll, R.G. and Hawkins, S.J., (1997). The sensitivity and vulnerability to man-induced change of selected communities: intertidal brown algal shrubs, *Zostera* beds and *Sabellaria spinulosa* reefs. English Nature, Peterborough, English Nature Research Report No. 234.

⁴⁷ Nall, C., Guerin, A., and Cook, E. (2015). Rapid assessment of marine non-native species in Scotland and synthesis of existing Scottish records. *Aquatic Invasions*, 10(1), 107-121.

12.100 The wider Solway Firth area is known to shelter multiple INNS, several of which are known to be located within Loch Ryan¹⁰. These comprise the following:

- Japanese wireweed (*Sargassum muticum*)
- Leathery sea squirt (*Styela clava*)
- Orange tipped sea squirt (*Corella eumyota*) – previously recorded inside Stranraer marina
- Green sea fingers (*Codium fragile*) – previously recorded inside Stranraer marina
- Japanese skeleton shrimp (*Caprella mutica*) – previously recorded inside Stranraer marina
- Wakame (*Undaria pinnatifida*) – previously recorded inside Stranraer marina

12.101 Monitoring has previously indicated that *Caprella mutica*, *Corella eumyota* and *Styela clava* were however absent from settlement tiles placed within Stranraer Marina in 2024⁴⁸, possibly suggesting that populations of these species were not well established.

12.102 The benthic field survey conducted in support of this assessment also identified the presence of the non-native barnacle *Austrominius modestus* at two survey stations. These were both located in the area designated for land reclamation as part of the proposed project. Additionally, a single individual of *S. clava* was recorded in the intertidal area to the west of Stranraer Marina. Though non-native, *A. modestus* and *S. clava* are well established in British waters and are known to be relatively widespread along the Scottish coast and in the Solway Firth^{46,49,50}. No INNS were noted during the benthic characterisation survey undertaken in order to inform this assessment (see Appendix 12.1).

12.103 A biosecurity action plan is currently in place for the Solway Firth, including Loch Ryan and Stranraer¹⁰[Error! Bookmark not defined.](#). This proposes measures to control the spread and impact of the current invasive species present, along with monitoring proposals and horizon scanning for other potential INNS that may impact the area in the future.

12.104 The habitats present within in the vicinity of Stranraer are likely to have mixed responses to the spread or introduction of INNS. Some biotopes, such as ‘*Melinna palmata* with *Magelona* spp. and *Thyasira* spp. in Atlantic infralittoral sandy mud’ and ‘Polychaete/bivalve dominated Atlantic littoral muddy sand’ are noted to have moderate resistance and low resilience to the introduction and spread of INNS^{32,24}, whereas other habitats such as ‘*Capitella capitata* in enriched Atlantic infralittoral muddy sediments’ and ‘Polychaete/amphipod-dominated Atlantic littoral fine sand’ have low sensitivity^{34,25}. Nonetheless, recovery from the impacts of invasive species is difficult, and efforts are best placed in ensuring that spread is limited in the first instance.

⁴⁸ Solway Firth Partnership (2024). Monitoring of Marine INNS Using Submerged Settlement Panels: Stranraer Marina. 15pp.

⁴⁹ Avant, P. (2007). *Austrominius modestus* Modest barnacle. *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom.

⁵⁰ Want, A. and Kakkonen, J.E. (2021). A new range-extending record of the invasive sea squirt *Styela clava* in the north of Scotland. *Marine Biodiversity Records*, 14(1): 15.

- 12.105 Prior to additional mitigation, it is therefore considered that the magnitude of impacts arising from the spread of INNS on subtidal and intertidal habitats in the vicinity of Stranraer is High, based on the scale and the likely irreversible nature of changes that the introduction of INNS could bring to a number of habitats found in close proximity to the proposed project. Benthic habitats have been assessed as Low sensitivity, resulting in an overall **Moderate Adverse** effect for both subtidal and intertidal communities, prior to additional mitigation.
- 12.106 Native oysters within the vicinity of Stranraer are also potentially vulnerable to the effects of the introduction of INNS. There have been notable declines in native oyster populations elsewhere in the UK in the past connected with the introduction of non-native species, such as *Crepidula fornicata*⁵¹. Native oysters are likely to be sensitive to the introduction of INNS, especially those that have the potential to modify habitats, cause a smothering effect, or that actively predate upon mature *O. edulis* or spat⁵². As with subtidal habitats, recovery from the effects of invasive species is difficult, and efforts are best placed in ensuring that spread is limited in the first instance. However, only two native oyster individuals were identified within the dredge footprint as part of the field survey, and no evidence of any other specimens or reef structures was documented. It is known that the wider Loch Ryan area supports a large native oyster population, however field data suggests that the population in proximity to Stranraer is small.
- 12.107 Prior to additional mitigation, it is therefore assessed that the magnitude of impact of the spread of INNS on native oysters in the vicinity of Stranraer is Low, considering the very limited numbers of oysters found within the survey area. Native oysters have been assessed as High sensitivity, resulting in an overall **Moderate Adverse** effect, prior to additional mitigation.

Operational Phase

Invasive Non-Native Species

- 12.108 As detailed in the assessment for the construction phase of the proposed project, Invasive Non-Native Species (INNS) have the potential to negatively affect the marine ecosystem. This section considers the potential effects of INNS on subtidal habitats, intertidal habitats, and native oysters during the operational phase.
- 12.109 In addition to impacts specifically related to the construction works, there also exists the potential for the ongoing operation of the completed marina to facilitate the spread of INNS through increased vessel traffic and visitors to the area.
- 12.110 It is acknowledged that with operation of the marina there will be a risk of the introduction and spread of potentially invasive marine species, as for during the construction phase. Prior to

⁵¹ Blanchard, M., (1997). Spread of the slipper limpet *Crepidula fornicata* (L.1758) in Europe. Current state and consequences. *Scientia Marina*, 61, Supplement 9, 109-118.

⁵² 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 17-09-2025].

additional mitigation, it is therefore considered that the magnitude of impacts arising from the spread of INNS on subtidal and intertidal habitats in the vicinity of Stranraer during operation of the marina is High, based on the scale and the likely irreversible nature of changes that the introduction of INNS could bring. Benthic habitats have been assessed as Low sensitivity, resulting in an overall **Moderate Adverse** effect for intertidal and subtidal habitats, prior to additional mitigation.

- 12.111 As with benthic habitats, the potential for effects arising from INNS on native oyster populations has the potential to continue past the construction stage of the proposed development and into the operational phase. It is considered that the assessment of potential effects will remain unchanged between construction and operation, and that prior to additional mitigation the magnitude of impacts of INNS on native oysters will be Low, receptor sensitivity will be High, and an overall **Moderate Adverse** effect is predicted.

Habitat Creation

- 12.112 Part of the proposed works at Stranraer includes an extension to the existing breakwater and the installation of new pontoons and marine structures, such as revetment steps along the reclaimed land area. These new structures are likely to provide additional habitat for the settlement of epibenthic taxa. The new underwater structures will increase habitat complexity by adding new hard substrates which will replace existing areas of finer sediments, that are likely to be colonised by epibenthic species. In turn, this may result in a greater abundance of prey species for fish and shellfish. This section considers the potential effects of habitat creation on subtidal habitat receptors.
- 12.113 The biotopes present within the dredge and sediment plume footprints are noted to be predominantly those associated with soft sediments. Nonetheless, species in the vicinity are likely to have the ability to colonise hard rock substrate. The temporary and permanent losses in habitat associated with dredging during the construction phase are noted in this assessment, however it is also considered that local species will benefit from the creation of hard habitat in the form of rock armour and marine structures, likely resulting in a positive impact on benthic ecology.
- 12.114 Details of the design of the pontoons and the extent of the breakwater extension are explained in **Chapter 2.0** of the EIAR. In summary the upgraded marina layout will include up to 185 new berths, around 14 of which will be for commercial use, in addition to the current approximately 45 existing berths available. The existing breakwater is approximately 80m in length (measured at seabed level) and is proposed to extend another approximately 32m. It can thus be seen that the scale of changes is comparatively small. As such, any impacts of habitat creation are likely to be highly small scale and long-term in duration. The magnitude of this impact is therefore considered to be Medium as the most appropriate category.
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12.115 Subtidal habitats as a receptor are deemed to be of Low sensitivity, which coupled with the Medium magnitude of this impact, equates to a **Slight Beneficial** effect, which is not significant in EIA terms.

Upgrading and Installation of New Lighting

12.116 As per the embedded mitigation identified for the project, no use of underwater lighting will be employed as part of the development. Any additional lighting to be installed as part of the project will be industry standard and will follow the same style and set-up as currently in place, thus it is not considered that there is an impact pathway to benthic ecology. As such, this potential impact has been scoped out of this assessment.

Do Nothing Scenario

12.117 Under the 'Do Nothing' scenario, in which the proposed development is not taken forward, the benthic ecology in Loch Ryan is likely to remain unaffected and no ongoing processes of change have been identified.

Mitigation, Monitoring and Residual Effects

Additional Mitigation

12.118 In addition to the embedded mitigation specified, the following section outlines additional mitigation measures proposed to reduce the significance of potential impacts on benthic ecology arising from the project.

12.119 As part of the proposed development, a final Construction Environmental Management Plan (CEMP) will be developed in order to ensure that the construction methods used are appropriate and so that any additional mitigation measures may be applied.

12.120 It is acknowledged that with construction and operational activities there will be a risk of contamination and the introduction of new species. However, control measures for the dredging process, including those related to INNS, will be specified as part of the CEMP that will be developed by the dredging contractor. The measures to be outlined in the CEMP are likely to significantly reduce the risk of any spread of INNS occurring. The CEMP should include details of control measures for INNS, such as the inspection and washing of equipment, and control of ballast water discharges for any vessels or dredgers to be used in the construction process. The CEMP should also reference and take into account the Solway Firth Biosecurity Action Plan, and the local measures adopted and recommended across the wider Solway Firth area. The plan should pay specific attention to the prevention of any impacts on native oysters.

12.121 Further to this, a Biosecurity Plan for the marina will be developed for the ongoing operational phase of the project to address the risks posed by operation of the marina, such as increased vessel traffic to the area. The Biosecurity Plan should also take the existing Solway Firth

Biosecurity Action Plan into consideration when determining the control measures to take, and should specifically reference and consider native oysters.

12.122 With the adoption of a CEMP and Biosecurity Plan, the magnitude of the potential impact from the spread of INNS on benthic communities (subtidal and intertidal) is therefore considered to be Negligible. Coupled with the low sensitivity of subtidal and intertidal habitats, this results in an overall **Negligible** effect, which is not significant in EIA terms.

12.123 Native oysters have been assigned a receptor sensitivity of High, and with the reduced magnitude of impact afforded by the measures outlined in this section, it is considered that the overall effect significance of INNS on native oysters following additional mitigation is **Slight Adverse**, which is not significant in EIA terms.

12.124 No additional mitigation can be applied to the potential impacts relating to permanent habitat loss, temporary habitat loss, or changes in water quality and suspended sediments.

Residual Effects

Construction and Operational

12.125 Prior to additional mitigation, the predicted significance of effect on subtidal habitats, intertidal habitats and native oysters from the spread of INNS was assessed as Moderate for both the construction and operational phases of the project.

12.126 Application of the measures described in 'Additional Mitigation' would serve to reduce the magnitude of the impacts INNS on benthic ecology. Through the adoption of control measures to reduce the risk of spreading and facilitating INNS, the overall magnitude of impacts from INNS associated with the proposed development decreases to Low, and the resulting significance to **Negligible** for subtidal and intertidal habitats, and **Slight Adverse** for native oysters for both the construction and operational phases of the project.

Cumulative Effects

12.127 This section considers the potential for cumulative effects arising from the proposed development in combination with other planned activities that have the potential to impact the marine environment, potentially increasing the overall magnitude of individual impacts.

12.128 Known additional projects that are committed to or reasonably foreseeable and may potentially provide cumulative effects in combination with the proposed development include:

- Deposition of oyster shells within Loch Ryan (Loch Ryan Oyster Fishery Co Ltd);
- Capital dredging and sea disposal of sediments from the Loch Ryan Port approach channel, berth pocket, and swinging area (Stena Line Ports);
- The construction of a platform for instructor shelter and removal of redundant sewer outfall pipes, debris, unlit beacon, and boulders as well as beach clearance at Stranraer Marina (Stranraer Watersports Association);

- Marine construction and pontoon deposit for eight pontoons and three racing markers at Stranraer Marina (Stranraer Watersports Association); and
- An additional 18 moorings at Stranraer Marina (Stranraer Watersports Association).

12.129 The above projects are either located considerably further up Loch Ryan and outside the zone of influence from any predicted impacts associated with the proposed development, or else it is considered that that their actions will result in no detrimental impact on the marine environment. This is based on the information provided in the Marine Licence applications made to Marine Scotland for the relevant projects.

12.130 **Chapter 11.0** of this EIA assesses that any cumulative/in-combination effects arising from the above projects are unlikely to alter any of the potential impact assessments made in relation to the proposed works in terms of water quality. **Chapter 7.0** of this EIA likewise concludes that localised, temporary increases in suspended sediment levels may occur in relation to the other planned developments in the area, however that cumulative impacts with the proposed development are very unlikely and, should they occur will be of negligible magnitude. Given these conclusions, it is assessed that none of the potential impacts from any of the proposed additional projects will significantly alter the assessment made in this chapter, thus the effects of potential impacts on benthic ecology will remain as described.

Summary and Conclusions

12.131 This chapter assesses potential effects of the proposed development on benthic ecology. The assessment of potential impacts, taking into consideration mitigation is summarised in **Table 12-7**.

12.132 As shown in **Table 12-7**, no significant adverse residual effects to benthic ecology receptors are predicted.

Table 12-7: Summary of Impact Assessment for Benthic Ecology.

Potential Effect	Receptor	Receptor Sensitivity	Impact Magnitude	Effect Significance (prior to mitigation)	Additional Mitigation Measures	Post Mitigation Effect Significance (Residual Effects)
Construction Phase						
Permanent habitat loss	Subtidal habitats	Low	Medium	Slight	-	Slight
Temporary habitat loss	Subtidal habitats	Low	Low	Negligible	-	Negligible
	Native oysters	High	Negligible	Slight	-	Slight
Changes in suspended sediment concentration and sediment deposition	Subtidal habitats	Low	Negligible	Negligible	-	Negligible
	Intertidal habitats	Low	Negligible	Negligible	-	Negligible
Changes in water quality (contaminants)	Subtidal habitats	Low	Low	Negligible	-	Negligible
	Intertidal habitats	Low	Negligible	Negligible	-	Negligible
Changes in water quality (dissolved oxygen)	Subtidal habitats	Low	Negligible	Negligible	-	Negligible
	Intertidal habitats	Low	Negligible	Negligible	-	Negligible
Invasive non-native species	Subtidal habitats	Low	High	Moderate	CEMP	Negligible
	Intertidal habitats	Low	High	Moderate	CEMP	Negligible
	Native oysters	High	Low	Moderate	CEMP	Slight
Operational Phase						
Invasive non-native species	Subtidal habitats	Low	High	Moderate	CEMP & Biosecurity Plan	Negligible
	Intertidal habitats	Low	High	Moderate	CEMP & Biosecurity Plan	Negligible
	Native oysters	High	Low	Moderate	CEMP & Biosecurity Plan	Slight
Artificial habitat creation	Subtidal habitats	Low	Medium	Slight (beneficial)	-	Slight (beneficial)

List of Abbreviations

AL	Action level
BPEO	Best Practice Environmental Option
CEMP	Construction environmental management plan
CIEEM	Chartered Institute of Ecology and Environmental Management
CSD	Cutter suction dredger
DDV	Drop down video
DO	Dissolved oxygen
EIA	Environmental impact assessment
EIAR	Environmental impact assessment report
EMODNet	European Marine Observation and Data Network
EUNIS	European Nature Information System
GI	Ground investigation
GPS	Global positioning system
IEEM	Institute of Ecological and Environmental Management
INNS	Invasive non-native species
NMPi	National Marine Plan interactive
OSPAR	Oslo and Paris agreement
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PMF	Priority marine feature
RAL	Revised action level
SSC	Suspended Sediment Concentration
TBT	Tri-butyl tin

List of Tables

Table 12-6: Criteria used to define receptor value/sensitivity.

Table 12-7: Criteria used to define the magnitude of impacts.

Table 12-8: Significance of Effects Matrix.

Table 12-9: Definitions of significance used in the benthic ecology assessment.

Table 12.5: Summary of Consultation Responses with Relevance to Benthic Ecology.

Table 12-10: Sensitivity of benthic receptors potentially in proximity to the proposed development.

Table 12-7: Summary of Impact Assessment for Benthic Ecology.