Chapter 7:
Biodiversity

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Chapter 7 Biodiversity

7.1 Introduction

This chapter examines the ecology of the receiving environment within and surrounding the proposed development at Trinity Wharf, Wexford ("the proposed development") and assesses the potential impacts of the proposed development on Biodiversity. The methods employed to establish the ecological baseline within and around the proposed development are described, together with the process followed to determine the nature conservation importance of the ecological features present. The ways in which habitats, species and ecosystems are likely to be affected by the proposed development are explained and the magnitude of the likely effects predicted, taking into account the conservation condition of the habitats and species under consideration. Mitigation and enhancement measures are also proposed, and any residual effects are assessed, taking into account the mitigation and enhancement measures proposed.

7.1.1 Conservation Legislation and Planning

The European Communities (Birds and Natural Habitats) Regulations, 2011 (as amended) ("the Habitats Regulations") transpose into Irish law Directive 2009/147/EC (the Birds Directive) and Council Directive 92/43/EEC (the Habitats Directive), which list priority habitats and species of international (European Union) conservation importance and that require protection. This protection is afforded in part through the designation of areas that represent significant populations of listed species within a European context, i.e. Natura 2000 sites. An area designated for bird species is classed as a Special Protection Area (SPA), and an area designated for other protected species and habitats is classed as a Special Area of Conservation (SAC). Wild bird species in SPAs and habitats and species listed on Annexes I and II, respectively, of the Habitats Directive in SACs in which they are designated features have full European protection. Species listed on Annex IV of the Habitats Directive are strictly protected wherever they occur, whether inside or outside the Natura 2000 network. This protection is afforded to animal and plant species by Sections 51 and 52, respectively, of the Habitats Regulations. Annex I habitats outside of SACs are still considered of national and international importance and, under Section 27(4)(b) of the Habitats Regulations, public authorities have a duty to strive to avoid the pollution or deterioration of Annex I habitats and habitats integral to the functioning of SPAs.

The Wildlife Act, 2000 (as amended) ("the Wildlife Acts") is the principle legislative mechanism for the protection of wildlife in Ireland. A network of nationally protected Nature Reserves was set up under the Wildlife Acts which public bodies have a duty to protect. Sites of national importance for nature conservation are afforded protection under planning policy and the Wildlife Acts. Natural Heritage Areas (NHAs) are sites that are designated under the Wildlife Acts for the protection of flora, fauna, habitats and geological interest. Proposed Natural Heritage Areas (pNHAs) are published sites identified as of similar conservation interest but have not been statutorily proposed or designated but are protected through planning policies and objectives. The Wildlife Acts also protect species of conservation value from injury, disturbance and damage to them or to their breeding and resting places. All species listed in the Wildlife Acts must, therefore, be a material consideration in the planning process. An important piece of national legislation for the protection of wild flora, i.e. vascular plants, mosses, liverworts, lichens and stoneworts, is the Flora (Protection) Order, 2015, which makes it illegal to cut, uproot or damage listed species in any way or to alter, damage or interfere in any way with their habitats.

Ireland's national biodiversity action plan *Actions for Biodiversity 2017-2021* (DAHG, 2011), in accordance with the Convention on Biological Diversity, is a framework for the conservation and protection of Ireland's biodiversity, with an overall objective to secure the conservation, including, where possible, the enhancement and sustainable use of biological diversity in Ireland and to contribute to collective efforts for conservation of biodiversity globally. Action 1.1.3 of the National Biodiversity Strategy states that "all Public Authorities and private sector bodies move towards no net loss of biodiversity through strategies, planning, mitigation measures, appropriate offsetting and/or investment in Blue-Green infrastructure". This is particularly relevant to developments. The plan is implemented through legislation and statutory instruments concerned with nature conservation.

The *County Wexford Biodiversity Action Plan 2013-2018 (WCC,2013)* lists actions to effectively manage wildlife in the County. This includes raising awareness of biodiversity as well as more specific actions such as promoting Swift breeding colonies in urban environments (Action 1.14).

The *All-Ireland Pollinator Plan 2015-2021* (NBDC, 2015) seeks to halt the decline in pollinators through a range of objectives. This plan is supplemented by the guidance document *Councils: actions to help pollinators* (NBDC, 2016).

7.1.2 Approach and Objectives

A habitat is the environment in which an animal or plant lives and is generally defined in terms of vegetation and physical structures. Habitats and species of ecological significance occurring or likely to occur within the defined **Zone of Influence** and **study area** of the Proposed development were classified as **Key Ecological Receptors**.

In accordance with Transport Infrastructure Ireland (TII) *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (2009), an impact assessment has been undertaken of Key Ecological Receptors within the Zone of Influence of the proposed development. According to these guidelines, the Zone of Influence is the "effect area" over which change resulting from the proposed development is likely to occur and the Key Ecological Receptors are defined as features of sufficient value as to be material in the decision-making process for which potential impacts are likely.

In the context of the proposed development, a Key Ecological Receptor is defined as any feature valued as follows:

- International Importance
- National Importance
- County Importance
- Local Importance (Higher Value)

Features of local importance (Lower Value) and features of no ecological value are not considered to be Key Ecological Receptors. The assessment does not consider any other type of environmental impact other than Biodiversity (Flora and Fauna).

This chapter quantifies the potential impacts on identified Key Ecological Receptors and prescribes mitigation measures required to avoid and reduce any negative impacts.

Determining the ecological issues to be addressed for the assessment was informed by early engagement with relevant stakeholders. During this scoping process,

selected consultees were provided the opportunity to provide comments and observations on the proposed development. Further details of the consultation process, including a list of the statutory and non-statutory consultees, can be found in Section 7.2.5.

On completion of scoping, a desk study was undertaken to review all available published data describing ecological conditions within the greater area of the proposed development. The desk study cross-referenced this published data with publicly available maps and aerial orthophotography from Ordnance Survey Ireland (OSi), National Parks & Wildlife Service (NPWS) and Environmental Protection Agency (EPA) to identify Key Ecological Receptors. During this assessment, the statutory conservation agency, the NPWS, provided data on nature conservation designations, habitats and species of conservation interest. The baseline information obtained from the desk study was the first stage in defining the Zone of Influence of the proposed development.

The results of the invasive species and habitat survey undertaken in June 2018 are presented in thematic maps for ease of geospatial reference and interpretation (refer to Figures 7.1 and 7.2 in Volume 3). The multidisciplinary walkover surveys also included a bat roost suitability assessment, an otter survey and all plant and bird species were noted.

Where detrimental impacts were identified, detailed and specific mitigation measures have been proposed in accordance with the hierarchy of options suggested in the research for the European Commission publication; '*Assessment of plans and projects significantly affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC'*. Preference was given to avoiding impacts at their source. Where this was not possible, the following approaches were adopted, in order of decreasing preference: reduce impacts at source, abate on site, and finally abate at receptor. These measures have been incorporated into the design of the proposed development.

The information provided in this chapter accurately and comprehensively describes the baseline ecological environment, provides an accurate prediction of the potential ecological impacts of the proposed development, prescribes specific mitigation as necessary and describes the likely residual ecological effects.

7.1.3 Terminology

The valuation of Key Ecological Receptors and the terminology used to determine ecological value adheres to aforementioned guidance (TII, 2009). The definitions of impacts (e.g. description of effects) used to predict impacts and consider mitigation measures follows the definitions in the EPA's Draft *Guidelines on the Information to be Contained in Environmental Impact Statements* (EPA, 2017).

7.2 Methodology

This section describes the methodologies that were followed in collecting information, in describing the baseline ecological conditions and in assessing the likely impacts of the proposed development.

7.2.1 Guidelines on Environmental Impact Assessment

The process of identifying, quantifying and evaluating potential impacts of the proposed development on habitats, species and ecosystems was undertaken in

accordance with the Chartered Institute of Ecology and Environmental Management (CIEEM) best practice guidance (CIEEM, 2018).

In addition, reference to recognised guidance on the Environmental Impact Assessment of National Road Schemes provided for an appropriately defined scope and evaluation process:

- Draft Guidelines on information to be contained in the Environmental Impact Assessment Report, Environmental Protection Agency, August 2017;
- Draft Advice Notes for preparing Environmental Impact Statements Environmental Protection Agency. September, 2015;
- Guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency. 2002;
- Advice notes on current practice in the preparation of Environmental Impact Statements, Environmental Protection Agency. 2003;
- TII (2006a) *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes*. Transport Infrastructure Ireland.
- TII, (2006b) *Guidelines for the Treatment of Bats during the Construction of National Road Schemes.* Transport Infrastructure Ireland.
- TII (2006c) *Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes.* Transport Infrastructure Ireland.
- TII (2008a) *Environmental Impact Assessment of National Road Schemes – A Practical Guide. Revision 1*. Transport Infrastructure Ireland.
- TII (2008b) *Guidelines for Ecological Survey Techniques for Protected Flora and Fauna during the Planning of National Road Schemes.* Transport Infrastructure Ireland.
- TII (2008c) *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes.* Transport Infrastructure Ireland.
- TII (2008d) *Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes.* Transport Infrastructure Ireland.
- TII (2009) *Guidelines for Assessment of Ecological Impacts of National Road Schemes.* Transport Infrastructure Ireland.
- TII (2010) *Guidelines on management of noxious weeds and non-native invasive plant species on national roads.* Transport Infrastructure Ireland.

7.2.2 Establishing the Zone of Influence

The key variables determining whether Key Ecological Receptors will be subject to impacts through development are: the physical distance of the proposed development to the Key Ecological Receptors; the sensitivities of the Key Ecological Receptors within the receiving natural environment; and, the potential for in-combination impacts. The Zone of Influence was defined as the entire area within 550m of the proposed development (a precautionary flushing distance for waterbirds) and the Lower Slaney Estuary transitional water body (as far upstream as Ferrycarrig Bridge) together with the Wexford Harbour coastal water body. The Zone of Influence is presented in Figure 7.3 in Volume 3.

7.2.3 Establishing the Study Area

The extent of the study area is defined by the ecological features likely to occur within an effects distance from the proposed development. This is informed by the findings of the desk study (presence/absence of protected habitats, flora or fauna within the Zone of Influence) and best practice methodology referenced above for assessing impacts on those ecological features. The study area in this case included the entire Trinity Wharf site and an appropriate buffer (c. 150m on land and as far as visible with binoculars over the estuary).

7.2.4 Desk Study

The desk study undertaken for this assessment included a thorough review of the available baseline data within the study area. The following resources were used:

- Aquatic Services Unit, University College Cork (2018). Trinity Wharf Marina Development. Marine Benthic Assessment.
- Colhoun & Cummins, (2013). Birds of Conservation Concern (BoCCI) in Ireland 2014-2019.
- Envirico (2017) Invasive Alien Species Management Plan, Trinity Wharf, Wexford. Report for Wexford County Council.
- Environmental Protection Agency (EPA) Unified GIS Application provided data in relation to the Water Framework Directive Risk/Status of waterbodies and watercourses in the Zone of Influence.
- Gittings, Tom (2016) Carcur Park Development: Waterbird Report. Report for William Neville and Sons.
- Irish Wetland Bird Survey Site Inventory (I-WeBS).
- Mayes, Elanor (2015) Wexford to Rosslare Strand Active Travel Route: Waterbird Data. Report for Wexford County Council.
- National Parks & Wildlife Service (NPWS) map viewer was reviewed to determine the location of national (e.g. Natural Heritage Areas) and European (e.g. Natura 2000 sites) designated sites within the Zone of Influence of the proposed development.
- National Biodiversity Data Centre (NBDC) map viewer provided protected species data.
- Natura Environmental Consultants (2016) Trinity Wharf Wexford Harbour Bird Surveys 2015/16.
- Tom Philips and Associates (2007) Environmental Impact Statement: A Proposed Marina and Marina Facilities Building Amending a Previously Permitted Hotel Scheme Reg. Ref. 6042 at Trinity Wharf, Townparks (off Trinity Street), and an Adjoining Foreshore Area at Wexford Harbour, Wexford.
- RPS (2018) Trinity Wharf Marina Feasibility Study.
- RPS (2018b) Trinity Wharf Marina. Additional Modelling Services.
- Scott Cawley Ecological Consultants (2018) Natura Impact Statement: Wexford to Curracloe Greenway. Prepared for Wexford County Council.

As with all desk studies, the data considered were only as good as the data supplied by the recorders and recording schemes. The recording schemes provide disclaimers

in relation to the quality and quantity of the data they provide, and these were considered when examining outputs of the desk study.

7.2.5 Consultation

The statutory and non-statutory consultees listed in Table 7.1 were contacted during the desk study and invited to submit any observations in relation to the proposed development. Consultees were also provided with a drawing showing the proposed development.

The purpose of the consultations was to:

- Identify any relevant information that consultees held, including the presence of data on protected species or species of conservation concern;
- Identify any concerns that consultees may have about the proposed development; and,
- Identify any issues that the consultees would like to see addressed during the ecological impact assessment process.

Organisations or individuals consulted in relation to ecology and nature conservation, together with a summary of responses, are listed in Table 7.1. In each case, only the responses relevant to this chapter have been included. All issues raised by the consultees have been addressed as in depth as possible in this chapter.

Table 7.1 Consultation Responses

Consultee	Date Correspondence Received	Summary of Response
Statutory Consultees		
National Parks & Wildlife Service (NPWS)	26th November 2018	Protected species of particular concern to the NPWS were birds, marine mammals, badgers and bats. The NPWS highlighted the need to address invasive species in the assessment and outlined the potential impacts of pile driving to marine mammals and artificial lighting to bats. The NPWS requested that adequate ecological surveys be carried out to confirm/deny presence of protected species and detailed European designated sites in proximity to the proposed development. Rare and Protected Species records were provided on the 7th September 2018.
Inland Fisheries Ireland (IFI)	3rd December 2018	IFI provided description of species groups present in estuarine environments and examples of potential impacts that require mitigation such as uncured concrete, silt laden run-off and oils/fuels. IFI also noted that access to slip ways must be maintained and any impacts on shore angling are addressed.

Consultee	Date Correspondence Received	Summary of Response
Non-statutory Consultees		
Wexford Harbour Harbour Master	4th December	The Harbour Master was consulted in relation to existing boat traffic and any impacts associated with the new marina. The new marina will mainly facilitate leisure craft already in the harbour where tidal restrictions currently limit vessel access to moorings further upstream. Jet-skiing and similar activities require the permission of the Harbour Master to take place, in accordance with the Wexford County Council Harbour and Piers Bye-laws. The Harbour Master has received one request for jet-ski access since 2014. A decline in wildfowling was also noted.
BirdWatch Ireland (BWI)	12th September 2018	BWI provided counts from i-WeBS sites in proximity to the proposed development. BWI do not provide pre-planning consultations.
Coastwatch Europe	N/A	No response

An EIA Scoping Document was also sent to a list of statutory and non-statutory consultees as part of the EIA process.

7.2.6 Ecological Survey Methodology

Following the desk study, field surveys were conducted over the full area of the proposed development adhering to the following guidelines:

- Ecological Survey Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (TII, 2008b);
- Guidelines for Assessment of Ecological Impacts of National Road Schemes (TII, 2009); and
- Best Practice Guidance for Habitat Survey and Mapping (Smith et al., 2011).

The multidisciplinary walkover survey classified habitats according to *A Guide to Habitats in Ireland* (Fossitt, 2000) and identified any habitats corresponding to Annex I of the Habitats Directive using the *Interpretation Manual of European Union Habitats* (European Commission, 2013).

7.2.7 Multidisciplinary Walkover Survey

The multi-disciplinary walkover survey was undertaken in June 2018 and included a habitat survey and aimed to detect the presence, or likely presence, of protected and invasive species. The survey provided baseline information regarding the existing ecology of the study area and informed the need for further specialist species-specific survey work. The walkover survey was undertaken by ROD Ecologist Owen O'Keefe ACIEEM. Owen holds a BSc. (Hons) in Ecology from University College Cork and has over three years' experience in ecological surveying and impact assessment.

The desk study and walkover survey identified Key Ecological Receptors in the Zone of Influence. The following sections outline methodologies followed during the ecological surveys.

7.2.8 Habitat Survey

The habitat survey was conducted to define the habitats present in the study area. The site was systematically walked, and habitats were assessed, classified and sketched on to field maps of the site in accordance with Smith et al. (2011). Habitats were identified in accordance with the Heritage Council's *A Guide to Habitats in Ireland* (Fossitt, 2000).

7.2.9 Survey of Aquatic Habtiats

The proposed development is within and adjacent to the River Slaney Estuary and Wexford Harbour.

A marine benthic assessment of the subtidal and intertidal communities within the area of proposed development was undertaken by Aquatic Services Unit (UCC) in November 2018 (Appendix 7.1).

7.2.10 Otter

The purpose of the otter survey was to identify any sensitive features within the study area used by otter for breeding, resting, foraging and to establish presence or absence of otter activity in the vicinity of the proposed development. The otter survey was conducted adhering to best practice guidance (TII, 2008c) and involved a systematic search of the Trinity Wharf site and the shoreline within 150 m of the site for physical evidence of otters, e.g. spraints, prints, slides, trails, couches and holts.

7.2.11 Bats

Bat Suitability Assessment

A bat suitability assessment was undertaken in June 2018 as part of the walkover survey following to best practice guidance (TII, 2006a; 2006b, Collins (ed.), 2016)

The purpose of the bat suitability assessment was to categorise any suitable features on trees and man-made structures capable of supporting a bat roost.

Bat Activity Survey

A bat activity survey was conducted on the 24th September 2018. The survey involved walking the entire site including taking in the 50-100m of surface water (the approximate limit of the bat detector) adjacent to the site to observe and record bat activity in the survey area. This survey was used to identify the species and numbers of bats using the survey area and to allocate a value to these features. The bat activity survey was undertaken between sunset and 2 hours after sunset. Health and Safety policy dictated that surveyors operated in pairs. During the survey, the site was walked slowly using an Anabat Walkabout bat detector to record bat echolocations. The bat detector allows visual validation of echolocation recordings (species/species group identification) in real time.

7.2.12 Badger

The badger survey was conducted in order to determine the presence or absence of badger within the survey area. The Badger survey was conducted adhering to best practice guidance (TII, 2006c; 2009) and involved a systematic search for physical evidence of badger e.g. setts, latrines, badger paths of the full extent of the study area of the proposed development in June 2018. The Trinity Wharf Site itself is made up entirely of built land and therefore the likelihood of badger setts being present was considered low.

7.2.13 Other Mammals, Reptiles and Amphibians

During the multi-disciplinary ecological walkover survey the potential for the study area to support additional protected mammals, reptiles and amphibians listed in the Wildlife Acts was assessed. Given that the study area is on built land and no evidence of these species was recorded, no that additional species-specific surveys were undertaken.

7.2.14 Breeding Birds

All birds seen or heard during the walkover survey were recorded. The character of the site limited the availability of nesting habitat and existing disturbance meant that no specific breeding bird survey was undertaken for the proposed development. Breeding bird surveys undertaken for a greenway development on the north side of Wexford Harbour between the Raven and Ferrybank (Scott Cawley, 2018) provided information on the breeding birds present in Wexford Harbour.

7.2.15 Wintering Birds

A wintering bird survey (Natura, 2016) was undertaken for the proposed development in 2015/2016 (Appendix 7.2). Two wintering bird survey reports (Gittings, 2016; Mayes, 2015) for projects in the vicinity of the proposed development were also reviewed.

7.2.16 Fisheries and Aquatic Fauna

The water bodies potentially affected by the proposed development were assessed with regard to their potential to support aquatic habitats and species, including but not limited to Annex I estuaries and mudflats and protected lampreys, salmonids and shads. Data relating to protected fish species had been collected during the desk study, so detailed fish stock surveys were not necessary. All water bodies potentially impacted by the proposed development are either transitional/brackish/estuarine or coastal/marine, therefore surveys for Freshwater Pearl Mussel and White-clawed Crayfish, both of which occur exclusively in freshwater, were not necessary.

7.2.17 Invasive Species

During the multi-disciplinary walkover survey, the presence of invasive species was recorded. In particular, the invasive species survey focussed on species subject to restrictions under Regulation 49 of the Habitats Regulations, including Japanese Knotweed (*Fallopia japonica*), which is known to occur in the area.

7.2.18 Ecological Evaluation and Impact Assessment Methodology

The ecological evaluation and Impact assessment within this chapter follows the methodology that is set out in Chapter 03 of the '*Guidelines for Assessment of Ecological Impacts of National Roads Schemes*' (TII, 2009).

7.2.19 Evaluation of Ecological Resources

The criteria used for the ecological evaluation follows those set out in Section 3.3 of TII (2009). These guidelines set out the context for the determination of value on a geographic basis with a hierarchy assigned in relation to the importance of any particular receptor. The guidelines provide a basis for determination of whether any particular site is of importance on the following scale:

- International
- National
- County

- Local Importance (Higher Value)
- Local Importance (Lower Value)

This guidance clearly sets out the criteria by which each geographic level of importance can be assigned. For example, Locally Important (Lower Value) receptors contain habitats and species that are widespread and of low ecological significance and only of importance in the local area. Conversely, Internationally Important receptors are either designated for conservation as part of the Natura 2000 network (SAC or SPA) or provide the best examples of habitats or internationally important populations of protected fauna.

All habitats and species within the Zone of Influence and study area were assigned a level of significance on the above basis and Key Ecological Receptors were established and classified on this basis.

7.2.20 Impact Assessment Methodology

The impact assessment uses the EPA (2002 & 2003) guidelines, but also has regard to the EPA (2015 & 2017) draft revised guidelines, for characterising the impact that the proposed development would have on the receiving environment. The parameters used to characterise impacts were:

- Magnitude - relates to the quantum of impact, for example the number of individuals affected by an activity;
- Extent - relates to the area over which the impact occurs;
- Duration - intended to refer to the length of time for which the impact is predicted to continue, until recovery or re-instatement;
- Reversibility - whether an impact is ecologically reversible, either spontaneously or through specific action; and,
- Timing/frequency of impacts in relation to important seasonal and/or life-cycle constraints should be evaluated. Similarly, the frequency with which activities (and associated impacts) would take place can be an important determinant of the impact on receptors.

It is necessary to ensure that any assessment of impact takes account of construction and operational phases; direct, indirect and cumulative impacts; and, those that are temporary, reversible and irreversible. The most relevant criteria for assessment of effect include quality and significance and these criteria are defined in

Table **7.2** and Table **7.3**. The following terms are defined when quantifying duration (EPA, 2017):

- Temporary – up to 1 year
- Short-term – 1 to 7 years
- Medium-term – 7 to 15 years
- Long-term – 15 to 60 years
- Permanent – over 60 years

Table 7.2 Criteria for Assessing Impact Significance based on EPA (2017)

Impact Magnitude	Definition
No change	No discernible change in the ecology of the affected feature
Imperceptible Impact	An impact capable of measurement but without noticeable consequences
Slight Impact	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate Impact	An impact that alters the character of the environment that is consistent with existing and emerging trends
Significant Impact	An impact which, by its character, its magnitude, duration or intensity alters a sensitive aspect of the environment
Profound Impact	An impact which obliterates sensitive characteristics

Table 7.3 Criteria for Assessing Impact Quality based on EPA (2017)

Impact Type	Criteria
Positive	A change which improves the quality of the environment e.g. increasing species diversity, improving reproductive capacity of an ecosystem or removing nuisances
Neutral	A change which does not affect the quality of the environment
Negative	A change which reduces the quality of the environment e.g. lessening species diversity or reducing the reproductive capacity of an ecosystem

Once the potential impacts are characterised, the significance of any such impacts on each of the Key Ecological Receptors is evaluated.

7.2.21 Process of Asessing Significance

The significance of impacts was determined following guidance set out in Section 7.2.20 of TII (2009), whereby impacts are assigned significance based on their characterisation, irrespective of the value of the receptor. Significance is determined by effects on conservation status or integrity, regardless of geographical level at which these would be relevant.

7.2.22 Mitigation

The proposed development has been designed to specifically avoid, reduce and minimise impacts on all Key Ecological Receptors. Where potential impacts on Key Ecological Receptors are predicted, mitigation has been prescribed to ameliorate such impacts. Ecological Enhancements have been built into the proposed development to increase the overall biodiversity value of the site in the long term.

Proposed best practice design and mitigation measures are specifically set out in this chapter and are realistic in terms of cost and practicality. Provided measures follow the prescribed methodologies and best practice where available, they have a high probability of success in terms of addressing the impacts on the identified Key Ecological Receptors.

The potential impacts of the proposed development were considered and assessed to ensure that all impacts on Key Ecological Receptors are adequately addressed and no significant residual impacts remain following mitigation.

7.2.23 Survey Limitations

Standard survey methods were followed, however, any biases or limitations associated with these methods could potentially affect the results collected. Whilst every effort was made to provide a full assessment and comprehensive description of the study area, population fluctuations may not be fully reflected due to the instantaneous nature of the field surveys. However, the field surveys together with the background knowledge provided by the desk study, provides a robust representation of the baseline for the habitats and species within the Zone of Influence.

7.3 Desk Study Results

7.3.1 General Description and Context

The proposed development comprises a new urban quarter created on derelict lands reclaimed from the sea in Wexford Town. The existing Trinity Wharf site comprises a 3.6 ha brownfield site southeast of Wexford Town Centre. The development will also include a marina, boardwalk, access road and roadworks on Trinity Street resulting in a total area for development reaching 5.47 ha. The development will prioritise job creation and economic development through the provision of key areas for advanced office and technology buildings. The mixed-use site will also accommodate a mix of office, leisure and residential development and will include a 64-berth marina. The new marina will mainly facilitate leisure craft already in the harbour where tidal restrictions currently limit vessel access to moorings further upstream. The construction of the proposed development is expected to take place over a period of 80 months. Piling works and the construction of the rock revetments take place over seven months.

New road infrastructure is required for the internal road network and to create a vehicular and pedestrian access from Trinity Street, crossing the Dublin-Rosslare railway line, while a pedestrian access to Paul Quay will link the development to the existing Quay-front.

The proposed development is close to the mouth of the River Slaney, and although this habitat is highly modified through quay walls, training walls, dredging, intensive mussel farming and visual and noise disturbance associated with an urban area, it is still of high biodiversity value. The biodiversity value of the site is evident in the number of designated sites in the River Slaney/Wexford Harbour which includes SACs, SPAs, Nature Reserves and Ramsar Sites. The river also supports species listed on Annex II and IV of the Habitats Directive and functions as a link between the sea and freshwater habtiats.

7.3.2 Designated Sites

The NPWS map viewer was reviewed for the location of designated sites within the Zone of Influence. The proposed development lies within the Wexford Harbour and Slobs SPA, the Slaney River Valley SAC and the Wexford Harbour and Slobs pNHA. Designated sites within the Zone of Influence are presented in Table 7.4. European Sites and other designated sites are illustrated in Figures 7.3 and 7.4 of Volume 3 respectively.

Table 7.4 Designated sites within the Zone of Influence

Designated Site	Distance from proposed development
European Designated Sites	
Wexford Harbour and Slobs SPA [004076]	Within proposed development Area
The Raven SPA [004019]	4.7 km
Raven Point Nature Reserve SAC [000710]	4.6 km
Slaney River Valley SAC [000781]	Within proposed development Area
Nationally and other Designated Sites	
Wexford Slobs and Harbour pNHA [000712]	Within proposed development Area
Slaney River Valley pNHA [000781]	5km
The Raven (Nature Reserve & Ramsar Site)	4.6 km

Designated Site	Distance from proposed development
Wexford Wildfowl Reserve (Nature Reserve & Ramsar Site)	3 km

Wexford Harbour and Slobs (SPA and pNHA)

Wexford Harbour is the lowermost part of the estuary of the River Slaney, a major river which drains much of the south-east region. The site is divided between the natural estuarine habitats of Wexford Harbour, the reclaimed polders known as the North and South "Slobs", and the tidal section of the River Slaney. The seaward boundary extends from the Rosslare peninsula in the south to the area just west of The Raven Point in the north. Shallow marine water is a principal habitat, but at low tide extensive areas of intertidal flats are exposed. Wexford Harbour and Slobs is one of the top three sites in the country for numbers and diversity of wintering birds. The combination of estuarine habitats, including shallow waters for grebes, diving ducks and sea ducks, and the farmland of the polders, which include freshwater drainage channels, provides optimum feeding and roost areas for a wide range of species. The habitats within the land take surrounding Trinity Wharf will be impacted directly by the proposed development and therefore 'Mudflats and Benthic Habitats' has been included as a Key Ecological Receptor. Impacts on water quality are addressed under the Key Ecological Receptor 'River Slaney and Wexford Harbour waterbodies'.

Slaney River Valley SAC

The Slaney River Valley encompasses the entire watercourse from its headwater in the Wicklow Mountains to Wexford Harbour. It is designated for freshwater and saltwater aquatic habitats, terrestrial habitats as well as mammals, invertebrates and fish. The lower reaches of the SAC also provide important habitat for wintering birds. Features of this site have the potential to be impacted by the proposed development, therefore, the 'River Slaney and Wexford Harbour waterbodies', 'Mudflats and Benthic Habitats', 'Migratory Fish', 'Otter' and 'Marine Mammals' have all been included as Key Ecological Receptors.

The Raven (SPA, SAC, Nature Reserve and Ramsar Site)

The Raven forms part of the Wexford Harbour complex and consists of a diverse dynamic dune system. Areas of the dunes have been planted with conifers. The site is the primary roost for internationally important numbers of Greenland White-fronted Goose. The gravel banks that form part of the site also host breeding Little Terns and Ringed Plover. Six species listed on Annex I of the Birds Directive regularly occur here, namely Red-throated Diver, Great Northern Diver, Greenland White-fronted Goose, Golden Plover and Bar-tailed Godwit. The site contains an introduced population of Natterjack Toad. Impacts on water quality are addressed under the Key Ecological Receptor 'River Slaney and Wexford Harbour waterbodies'.

Wexford Wildfowl Reserve (Nature Reserve and Ramsar Site)

The Wexford Wildfowl Reserve covers 194 hectares on the North Slob of Wexford Harbour. The site provides an important site for migrating birds. Waders and wildfowl in particular, are attracted to the area where the flat landscape is accentuated by a number of complementary characteristics that create a safe place to feed, loaf, roost and breed. These features are dominated by the wide shallow harbour with its sandbars and mud-banks. Over 260 bird species have been recorded to date of which 69 are considered common in winter, with a further 37 being categorised as scarce. This is a wintering ground of international importance for a number of migratory waterfowl including in particular Greenland White-fronted Goose and Brent Goose, as well as Bewick's Swans and Wigeon. The reserve has recorded 29 species of duck

and 42 species of wader. Hares are fully protected on the Reserve and on the surrounding townlands of the North Slob. Impacts on water quality are addressed under the Key Ecological Receptor 'River Slaney and Wexford Harbour waterbodies'.

7.3.3 Habitats, Flora and fauna

The desk study also identified which important habitats and species have been recorded and are, therefore, likely to occur within the Zone of Influence and study area. The following sections give an overview of the results of the desk study.

National Parks & Wildlife Service Data

Table 7.5 lists rare and protected species records within the Zone of Influence obtained from NPWS in September 2018.

Table 7.5 Records for Rare and Protected Species, NPWS

Common Name	Scientific Name	Status
Mammals		
Irish Hare	*Lepus timidus hibernicus*	Annex V HD, WA
European Hedgehog	*Erinaceus europaeus*	WA
Otter	*Lutra lutra*	Annexes II, IV HD, WA
Badger	*Meles meles*	WA
Stoat	*Mustela erminea hibernica*	WA
Hedgehog	*Erinaceus europaeus*	WA
Grey Seal	*Halichoerus grypus*	Annex II, V HD, WA
Harbour Seal	*Phoca vitulina*	Annex II, V HD, WA
Eurasian Pygmy Shrew	*Sorex minutus*	WA
Reptiles & Amphibians		
Common Lizard	*Zootoca vivipara*	WA
Natterjack Toad	*Bufo calamita*	Annex IV HD, WA
Common Frog	*Rana temporaria*	Annex V HD, WA
Fish		
Twaite Shad	*Alosa fallax*	Annexes II HD, WA
Plants/ Lichens/ Mosses		
Borrer's Saltmarsh-grass	*Puccinellia fasciculata*	FPO, NT
Betony	*Betonica officinalis*	FPO, NT
Lesser Centaury	*Centaurium pulchellum*	FPO; NT
Cladonia ciliata var. *tenuis*	*Cladonia ciliata* var. *tenuis*	Annex V HD
Reindeer Moss	*Cladonia portentosa*	Annex V HD
Moore's Horsetail	*Equisetum hyemale x ramosissimum = E. x moorei*	FPO; NT
Small Cudweed	*Logfia minima*	FPO; NT
Henbane	*Hyoscyamus niger*	NT
Hairy Bird's-foot-trefoil	*Lotus subbiflorus*	FPO, NT
Yellow Bird's-nest	*Hypopitys monotropa*	NT
Wintergreen	*Pyrola rotundifolia subsp. maritima*	FPO, VU

Status (listing conferring protection or describing conservation status) abbreviations: Annex II/IV/V (non-avian species) = Habitats Directive (HD); WA = Wildlife Acts 1976 (as amended); FPO = Flora (Protection) Order. IRL Red List: R: NT: Near Threatened. VU: Vulnerable.

National Biodiversity Data Centre

Table 7.6 lists the rare and protected species recorded by the National Biodiversity Data Centre (NBDC) within the Zone of Influence. To avoid replication, all records of species represented in the NPWS dataset have been removed from the displayed NBDC data. Table 7.7 lists the Invasive Species recorded within the Zone of Influence.

Table 7.6 NBDC Records from within the Zone of Influence

Common Name	Scientific Name	Status
Marine Mammals & Amphibians		
Harbour Porpoise	*Phocoena*	WA; Annex II, IV HD
Common Dolphin	*Delphinus delphis*	WA; Annex IV HD
Bottle-nosed Dolphin	*Tursiops truncates*	WA; Annex II, IV HD
Smooth Newt	*Lissotriton vulgaris*	WA
Birds		
Bar-tailed Godwit	*Limosa lapponica*	Annex I BD, Amber BOCCI
Black-headed Gull	*Larus ridibundus*	Red List BOCCI
Black-necked Grebe	*Podiceps nigricollis*	Red List BOCCI
Common Guillemot	*Uria aalge*	Amber BOCCI
Cormorant	*Phalacrocorax carbo*	Amber BOCCI
Dunlin	*Calidris alpina*	Annex I BD, Red List BOCCI
Goldeneye	*Bucephala clangula*	Red List BOCCI
Great Black-backed Gull	*Larus marinus*	Amber BOCCI
Great Crested Grebe	*Podiceps cristatus*	Amber BOCCI
Great Northern Diver	*Gavia immer*	Annex I BD, Amber BOCCI
Greenshank	*Tringa nebularia*	Annex II BD
Herring Gull	*Larus argentatus*	Red List BOCCI
Little Grebe	*Tachybaptus ruficollis*	Amber BOCCI
Little Tern	*Sternula albifrons*	Annex I BD, Amber BOCCI
Lesser Black-backed Gull	*Larus fuscus*	Amber BOCCI
Long-tailed Duck	*Clangula hyemalis*	Red BOCCI
Oystercatcher	*Haematopus ostralegus*	Amber BOCCI
Redshank	*Tringa totanus*	Red List BOCCI
Shelduck	*Tadorna*	Amber BOCCI
Slavonian Grebe	*Podiceps auritus*	Annex I BD, Amber BOCCI
Swift	*Apus apus*	Amber BOCCI

Status (listing conferring protection or describing conservation status) abbreviations: Annex II/IV/V (non-avian species) = Habitats Directive (HD); Birds Directive (BD); and, Red/Amber = Birds of Conservation Concern in Ireland, 2014 to 2019 (BOCCI). All bird species in Ireland are protected under the Wildlife Acts 1976 to 2012.

Table 7.7 Invasive Species Recorded within the Zone of Influence

Common Name	Scientific Name
Japanese Knotweed	*Fallopia japonica*
Common Cord-grass	*Spartina anglica*

Invasive Species

An invasive species survey was carried out by Envireco in November 2017 and is presented in Appendix 7.4 to this Chapter. This survey was undertaken outside the optimum survey season for vegetation and was subsequently verified and updated in June 2018. The results of the June 2018 survey are described in Section 7.4.4. Two invasive species, Japanese knotweed and three-cornered leek were recorded within the Trinity Wharf site. The construction and operation of the proposed development has the potential to spread invasive species, therefore 'invasive species' has been included as a Key Ecological Receptor.

Wintering Birds

To inform this EIAR, BirdWatch Ireland provided Irish Wetland Bird Survey (I-WeBS) data for the two subsites closest to the proposed development (O0496 and O0490). Subsite O0496 extends from Trinity Wharf and includes the south slob and a significant portion of the southern side of Wexford Harbour. Subsite O0490 encompasses the north side of Wexford Harbour from the Wexford Bridge to the Raven Point. The I-WeBS data show that these subsites are used by large numbers of wintering birds, including nationally important number of 13 species and internationally important numbers of two species, golden plover and bar-tailed godwit.

A wintering bird survey was carried out during the winter of 2015/2016 by Natura Environmental Consultants (Natura, 2016) for the proposed development. The study area included the entire area within 1km of the proposed development. The surveys recorded 23 species of bird, 15 of which are qualifying interests of the Wexford Harbour and Slobs SPA. The report concluded that: *"The most abundant species here were Black-headed Gull, Oystercatcher and Lapwing. The most important habitats are the training walls on either side of the river mouth. The bird numbers present in this area* [within 1km of Trinity Wharf] *represent a small proportion of the total numbers in the Wexford Harbour and Slobs SPA. Very few individuals occurred within the immediate vicinity (200m) of the Wharf because there is limited suitable habitat here*". As there is limited suitable habitat and low numbers of wintering birds using the area within 200m of the proposed development, the impacts of visual and noise disturbance, considering the ambient visual and noise disturbance levels in the area, will be limited to very few individuals.

The sensitivity of birds to disturbance varies by species and whether the source of the disturbance is visual, or noise based (IECS, 2009). Additionally, the current level of habituation will also determine a bird's response to disturbance (IECS, 2013). The noise levels from impact hammers and vibratory hammers are less than 100 Db(A). Put into practice, this will mean that if an impact hammer generates 100 Db(A) at 1.0m from the source, this sound will be 70 Db(A) at 34m away. The 'acceptable dose' for waterbirds is 70 Db(A) at receptor (IECS, 2013). Regular noise above this level is likely to illicit a response, although this depends on species and the level of habituation (which in the case of Trinity Wharf is high).

There are a number of mitigation measures included for other receptors, namely people, marine mammals and migratory fish, which will reduce the noise and visual impacts on the small numbers of birds within 200m of the proposed development. These include the erection of 3m-4m high hoarding along the southern and northern site boundaries of the site once the sea wall is constructed and the implementation of a 30 minute soft start/ ramp up procedure for piling associated with the marina and boardwalk. During the operation phase, the breakwaters will provide a roosting site for waterbirds.

Mayes (2015) provided data from winter 2014/ 2015 from two areas relevant to the proposed development, the south training wall and the area between Goodtide Harbour and the Wexford Creamery outfall. Eight species were recorded on the south training wall, with Lapwing (peak 109) and Oystercatcher (peak 71) occurring in the highest numbers. The creamery outfall, 1km from the proposed development, is used as a hightide roost, with black-headed gulls (peak 271) and cormorant (peak 44) occurring in the highest numbers. These numbers are relatively low and are not significant in the context of Wexford Harbour.

During the operation of the proposed development, birds in the vicinity of Trinity Wharf, which are already habituated to the ambient levels of disturbance will habituate to the increased levels in noise and visual impacts. Gittings (2016) provided data on disturbance responses to walkers, walkers with dogs and bait diggers in the vicinity of the Carcur Park development (1.3km upstream of Wexford Bridge) from the winter 2015/ 2016. Across all species recorded during the surveys, the modal distance at which birds were disturbed was 100-150m with some species feeding within 25-50m of the disturbance source.

In considering the potential impacts on wintering birds including the direct and indirect habitat loss; the fact that bird use is low within 200m of Trinity Wharf as described by Natura (2016), the location of the proposed development within an existing urban environment, and the conclusion that feeding, roosting areas and flight paths of wintering birds will be unaffected, wintering birds have not been included as a Key Ecological Receptor.

Breeding Birds

Scott Cawley (2018) was the main source of information on breeding birds in Wexford Harbour. The survey was undertaken on three separate days in May and June 2018 and covered the area between the Raven and Ferrybank. Fifty species were recorded, 26 of which were recorded as breeding. The species assemblage on the north side of Wexford Harbour should be considered representative of the species present in Wexford Harbour during the breeding season, however it should be noted that the area in the vicinity of the proposed development is urbanised and far less suitable for birds than the north side of the harbour. Certain groups of birds are susceptible to flying into glass facades and windows and therefore 'Birds' have been included as a Key Ecological Receptor. The potential impacts and proposed mitigation are described in table 7.15 and Section 7.8.2.

Marine Mammals

A marine mammal risk assessment (IWDGC, 2018) was undertaken for the proposed development and is provided in Appendix 7.3. To summarise, two cetacean species, harbour porpoise (*Phocoena phocoena*) and common dolphin (*Delphinus delphis*), have been recorded in Wexford Harbour, but are rare. The conservation status of grey and harbour seals in Ireland has been assessed as favourable. The main activities that could impact on marine mammals were identified as the installation of the steel sheet pile wall around the entire coastal boundary of the site, the addition of rock armour revetment along the south-east and north-west edges and piling for the construction of the marina and boardwalk. Marine mammals have therefore been included as a Key Ecological Receptor. The potential impacts and proposed mitigation are described in table 7.15 and Section 7.8.2.

Marine Benthic Surveys

The marine benthic assessment (ASU, 2018) assessed the subtidal and intertidal communities within the area of proposed marina development at Trinity Wharf, Wexford.

The benthic habitats in the vicinity of the proposed development consist of mixed sediments, dominated by shell and coarse gravels with scattered clusters of mussels interspersed with shell gravel on muddy sands / sandy muds. The soft sediment intertidal community is typified by low faunal densities and diversity at all intertidal sites. The proposed development will include the loss of intertidal and subtidal habitats, and therefore 'Mudflats and Benthic Habitats' have been included as a KER.

7.3.4 Fisheries and Aquatic Fauna

The River Slaney is internationally important for the presence of fish species including Atlantic Salmon (*Salmo salar*), Twaite Shad (*Alosa fallax*), Sea Lamprey (*Petromyzon marinus)*, River Lamprey (*Lampetra fluviatilis)* and European Eel (*Anguilla anguilla*). The status and occurrence of these species within the study area are described below. Allis Shad (*Alosa alosa*) and Brown Trout (*Salmo trutta*) also occur in the River Slaney Estuary. Migratory fish could be impacted by the proposed development and have been included as a Key Ecological Receptor. Freshwater Pearl Mussel (*Margaritifera margaritifera*) and White-clawed Crayfish (*Austropotamobius pallipes)* both occur in the River Slaney; however, these species are strictly freshwater and therefore they will not be directly impacted by the proposed development. A reduction in salmonids in the River Slaney could potentially lead to reduced recruitment of Freshwater Pearl Mussel, however the proposed development will have no perceptible impact on salmonid abundance in the River Slaney and therefore impacts on Freshwater Pearl Mussel, or White-clawed Crayfish, are not considered further.

Twaite Shad

The River Slaney is known to have supported an important population of Twaite Shad (Doherty et al., 2004). As such, this species is a Qualifying Interest of the Slaney River Valley SAC. Twaite Shad spawns at the top of the tidal waters in May and June, and the juvenile fish spend 1-2 years in the estuary before migrating to sea (IFI, 2018). After spawning, most adults return to sea and may spawn again in subsequent years (King & Roche, 2008). The species is classed Vulnerable in the Irish Red List (King et al., 2011) and anecdotal reports indicate a substantial decline in the River Slaney (King & Linnane, 2004; King & Roche, 2008; King et al., 2011; NPWS, 2013). Given the proximity of Twaite Shad habitat (i.e. estuary) to the proposed development, this species could potentially be impacted by the proposed development and therefore Twaite Shad, as a migratory fish, has been identified as a Key Ecological Receptor.

Atlantic Salmon

Atlantic Salmon is a Qualifying Interest of the Slaney River Valley SAC. Salmonids require unimpeded passage through the estuary. While the River Slaney at the location of the proposed development and downstream does not provide suitable spawning gravels for Salmonid species (salmon and trout), Atlantic Salmon could be impacted by increased barriers to connectivity during in-stream works and reduced water quality as a result of accidental pollution. Therefore, Atlantic Salmon, as a migratory fish, has been included as a Key Ecological Receptor.

Lamprey Species

All three lamprey species found in Ireland are Qualifying Interests of the Slaney River Valley SAC. Areas of significance (optimum spawning or nursery habitat) for these

species does not exist at the location of the proposed development. Sea Lamprey and River Lamprey require unimpeded passage from the sea to freshwater habitats in the River Slaney to spawn. Therefore, River and Sea Lamprey, as migratory fish, have been included as a Key Ecological Receptor.

European Eel

European Eel stocks have undergone a serious population decline, and recently introduced EU legislation (EC 1100/2007) specifies major conservation actions. Juvenile eels make their way to the upper estuary and river to mature. Given that European Eel require unimpeded passage from the sea to freshwater habitats in the River Slaney, Eel, as a migratory fish, has been included as a Key Ecological Receptor.

European Sea Bass

European Sea Bass is an important commercial and recreational fish. It has suffered declines across its range in recent years as a result of increased pressure from fishing and the slow rate at which the species reaches reproductive age. The species is migratory, spending the winter in the offshore where they spawn. Mature bass migrate to coastal feeding grounds. Estuaries and sheltered bays provide nursery habitat for juvenile bass, who spend 4-5 years in these habitats before returning to the open ocean to spawn. Wexford Harbour is likely to be the most important bass nursery in Ireland (IFI, pers. comm.). European Bass could be impacted by noise and a deterioration in water quality and have been included as a Key Ecological Receptor, under migratory fish.

7.3.5 Aquatic Environment

Water Quality

The WFD requires that each member state protects and improves water quality in all waters so that good ecological status is achieved. Additionally, proposed actions (within discrete River Basin Management Plans) are also required, to secure national natural water resources for the future. The EPA is the competent authority responsible for monitoring, protecting and improving the water environment in Ireland. In accordance with WFD guidelines, water quality 'Status' is assigned using a variety of available data on aquatic flora and fauna (including fish), the availability of nutrients, and aspects like salinity, temperature and pollution by chemical pollutants. Morphological features, such as quantity, water flow, water depths and the structure of the river beds, are also taken into account.

The online EPA Unified GIS Application provides access to information at individual waterbody level and at Water Management Unit level for all the River Basin Districts in Ireland. Waterbodies can relate to surface waters (these include rivers, lakes, estuaries, and coastal waters) or to groundwater. Table 7.8 shows the information recorded regarding water quality status within the proposed development.

Table 7.8 EPA Water Quality Results

Waterbody	Transitional Waterbody WFD Status (2010-2012)	Coastal Water Quality (2010-2012)
Lower Slaney Estuary	Potentially Eutrophic	N/A
Wexford Harbour	N/A	Potentially Eutrophic

Environmental Testing

The sea bed in the vicinity of the Trinity Wharf development, corresponding to the location of the boardwalk, marina and the sea wall/revetments, was sampled and

tested as a part of the Trinity Wharf Marina Feasibility Study by RPS Group (2018). A comprehensive sampling programme was undertaken in July 2016 by Hydrographic Surveys Ltd to inform the feasibility study, whilst the sediment quality analysis was undertaken by the RPS Laboratory Services. The samples returned values above the upper guidance threshold for polycyclic aromatic hydrocarbons (PAH) and organochlorine pesticides (OCP) levels that are substantially in excess of the lower guidance limit (Marine Institute's Guidelines for the Assessment of Dredge Material for Disposal in Irish Waters). Generally speaking, the area returned results showing mild levels of contamination in the sediments although in a couple of instances there were moderate levels of contamination. Further details on contaminated lands are presented in Chapter 08.

Hydrodynamic Modelling

As part of the Trinity Wharf Marina Feasibility Study, hydrodynamic modelling undertaken for the proposed development (RPS,2018b; Appendix 4.4) concluded that:

> "*neither the proposed landside development, nor the landside development in combination with a marina will result in any significant differences to either the tidal regime or the prevailing wave climate it can be concluded that neither development would result in any significant changes to the sediment transport regime*. *As such, it can be concluded that the nearby environmentally sensitive areas will be not be adversely impacted by any changes in the sediment transport as a result of either the landside development in isolation or the landside development in combination with the marina".*

7.4 Field Survey Results

7.4.1 Habitats

This section describes the habitats recorded during the field survey in June 2018. Nine habitats were recorded within the study area (Table 7.9). For the habitat map, refer to Figure 7.1 of Volume 3 of this EIAR.

Table 7.9 Habitats Recorded Within the Study Area

Habitat Name	Fossitt Code
Sea Walls, Piers, Jetties	CC1
Spoil and Bare Ground/ Scrub	ED2/WS1
Scrub	WS1
Dry Meadows and Grassy Verges	GS2
Recolonising Bare Ground	ED3
Mud shores	LS4
Estuaries	MW4
Buildings and artificial surfaces	BL3
Buildings and artificial surfaces/ Amenity Grassland	BL3/GA2

Sea Walls, Piers, Jetties (CC1)

This habitat includes the training walls, the rock armour and concrete walls around the site and the harbour wall at Goodtide Harbour to the south of the site. These structures are inundated by sea water at high tide and exposed to wave action. This habitat, has, in places, been colonised by salt tolerant plants such as Scurvygrass (*Cochleria officinalis*) and Sea Plantain (*Plantago maritima*).

Spoil and Bare Ground/ Scrub (ED2/WS1)

This habitat occurs in the site where rubble has been collected in heaps and where scrub is developing. The most common scrub species is Butterfly Bush (*Buddleja davidii*).

Scrub (WS1)

Scrub refers to habitats less than 5 m tall that are dominated by stunted trees, shrubs and brambles. It frequently develops as a precursor to woodland. Scrub is found in areas of the site that have been allowed to regenerate naturally. Almost all of the scrub within the site is Butterfly Bush (*Buddleja davidii*).

Dry Meadows and Grassy Verges (GS2)

This habitat is found in areas of the site where grasses and herbs dominate the flora. The exposure of the site to the sea has led to some salt tolerant species such as Rock Sea-spurrey (*Spergularia rupicola*) and Sea Plantain (*Plantago maritima*) colonising the areas closest to the sea. Other species include Red Clover (*Trifolium pratense*), Ox-eye daisy (*Leucanthemum vulgare),* Red Valerian (*Centranthus ruber)* and Pale Flax *(Linum bienne).*

Recolonising Bare Ground (ED3)

This habitat refers to land that is former built land which has been recolonised and where vegetation cover is greater than 50%. It is found as a transitional habitat between BL3 and GS2.

Mud Shores (LS4)

This habitat was recorded immediately north and south of proposed development along the shore. The substrate is predominantly mud and is covered by water at high tide. Goodtide Harbour is used for small fishing boats and pleasure craft. This habitat has links to the following Annex I habitats in Ireland:

- *Mudflats and Sandflats not covered by sea water at low tide* [1140]

The intertidal areas around the proposed development correspond to the Annex I habitat *Mudflats and Sandflats not covered by sea water at low tide* [1140]. EC (2013) describes this habitat as Sands and muds of the coasts of the oceans, their connected seas and associated lagoons, not covered by sea water at low tide, devoid of vascular plants, usually coated by blue algae and diatoms. The marine benthic study for the proposed development (ASU, 2018) describes "*The soft sediment intertidal community is typified by low faunal densities and diversity at all intertidal sites*".

Surveys by NPWS identified a single faunal community in the vicinity of the Trinity Wharf complex. This 'Estuarine muds dominated by polychaetes and crustaceans community complex' occurs on the large intertidal mudflat south-east of Wexford Town and as a narrow shoreline band on the north and south shores of the site (NPWS, 2011). Mudflats and Benthic Habitats have been included as a Key Ecological Receptor of the proposed development.

Estuaries (MW4)

The proposed development is immediately adjacent to and within the River Slaney estuary and Wexford Harbour. At this point the salinity is permanently variable because it is open to the sea, is influenced by the tide and also has the input of large amounts of freshwater from the River Slaney. The river is designated as the Slaney River Valley SAC at the location of the proposed development. This river has links to the following Annex I habitats in Ireland:

- *Estuaries* [1130]

The River Slaney/ Wexford Harbour at this location corresponds to the Annex I habitat Estuaries. EC (2013) describes this habitat as the downstream part of a river valley, subject to the tide and extending from the limit of brackish waters. The River Slaney/ Wexford Harbour waterbody has been selected as Key Ecological Receptor of the proposed development.

Buildings and Artificial Surfaces (BL3)

The most common habitat in the footprint of the proposed development is built land in the form of old foundations and hard standing. All former industrial buildings on the site have been demolished. Generally built habitats are not considered of high ecological significance.

Buildings and Artificial Surfaces/ Amenity Grassland (BL3/GA2)

This habitat mosaic refers to domestic dwellings within gardens which are found in the wider area.

Character of Habitats

The site of the proposed development has been highly modified from its natural state over centuries of urbanisation and navigation. It is urban in its character.

Significance of Habitats

The habitats present on the site were assessed in accordance with best practice guidance (TII, 2009). The River Slaney/Wexford Harbour itself, although highly modified, is the habitat with the highest biodiversity value within the site. The River Slaney/Wexford Harbour immediately adjacent to and within the proposed development footprint corresponds to the Annex I habitats 'Estuaries' and 'Mudflats and Sandflats not covered by water at low tide'. Furthermore, the estuary is regarded as being a receptor of International Importance on the basis of its designation as an SAC and SPA.

7.4.2 Fauna

Terrestrial Mammals

Badger

No evidence of badger was recorded on the Trinity Wharf Site and there is limited suitable habitat in the area. Therefore, badger have not been included as a Key Ecological Receptor.

Otter

European Otter is listed on Annex II and Annex IV to the Habitats Directive and is also protected under the Wildlife Acts. Otter is a Qualifying Interest for the River Slaney Valley SAC. During the otter survey, the edge of the site and 150m along the shore were walked slowly in order to search for signs of Otter. No signs of otter were recorded during the walkover survey; however, an otter was seen along the northern side of Trinity Wharf during the bat activity survey. In-stream works and artificial lighting have the potential to increase barriers of connectivity for otter commuting between the Estuary and the River Slaney. This species may be impacted by the proposed development and has been included as a Key Ecological Receptor.

Bats

All nine resident breeding bat species in Ireland are legally protected and roost sites (whether in use or not) are also protected under both European and Irish legislation. All bat species occurring in Ireland are listed on Schedule V of the Wildlife Acts as protected species.

The bat suitability assessment conducted in June 2018 during the walkover survey did not identify any potential bat roosts within the study area.

A bat activity survey was undertaken on the 24th September 2018 in suitable weather conditions. Details of the survey is presented in Table 7.10 below.

Table 7.10 Bat Survey Details

Date	Start Time	End Time	Temperature	Wind and Rain
24th September 2018	19:45	21:35	7-9°C	Very calm, no rain.

Bat activity during the survey was low. Only one species of bat, Common Pipistrelle (*Pipistrellus pipistrellus*), was recorded during the activity survey. The first recording was made of a bat foraging along the embankment on the land-side of the proposed development. The second was made of a bat commuting (flying directly) across the site in an east-west direction.

Bats could be negatively impacted by poorly-designed or excessive artificial lighting during the construction and operation of the proposed development. Therefore, bats have been included among the Key Ecological Receptor of the proposed development.

Marine Mammals

No sightings or evidence of any marine mammals were recorded during the multidisciplinary survey. The marine mammal risk assessment (MMRA) listed four species of marine mammal that have been recorded in Wexford Harbour (Appendix 7.3). The MMRA also concluded that the likelihood of cetaceans being in the area is very low. Only harbour porpoise and common dolphin have been reported from the area and only very occasionally. There are important haul out sites for both harbour and grey seal in the mouth of Wexford Harbour and at the Raven. The proposed development occurs within an SAC for which harbour seal is a Qualifying Interest. These haul out sites are typically >2km away from the construction site but individual seals are likely to forage within the harbour and thus may occur in the water near the proposed development. All cetaceans and grey seals are part of a larger population and are very mobile, with records of movements of grey seals between SE Ireland and west Wales.

Piling and installing rock armour could lead to temporary disturbance including injury to marine mammals. While the construction of the marina is expected to increase boat traffic, this would occur over an extended period, allowing seals adjacent to the site to accommodate this increase. Wexford Harbour is already a busy site with recreational and fishing activity, thus any increase in recreational traffic is against a back drop of high levels of use and will not significantly increase long term disturbance of the haul-out sites.

On the basis that marine mammals could be impacted through construction activities, they have been included as a Key Ecological Receptor of the proposed development.

Birds

Table 7.11 lists the birds that were recorded during the multidisciplinary walkover survey in June 2018.

Table 7.11 Bird species recorded during the walkover survey

Common Name	Scientific Name
Bar-tailed Godwit	*Limosa lapponica*
Black-headed Gull	*Chroicocephalus ridibundus*
Jackdaw	*Corvus monedula*

The buildings proposed in the Trinity Wharf Site include buildings with glass facades. Glass poses a risk of collision to certain groups of birds, particularly passerines. Poorly designed buildings could impact on local populations including night-time migrants (e.g. warblers, thrushes), falcons and kingfisher. The proposed development may lead to direct impacts on certain groups of birds, therefore, birds have been included as a Key Ecological Receptor.

Reptiles and Amphibians

The multidisciplinary walkover surveys did not record any evidence of common frog, smooth newt or common lizard within the study area. There are no ponds or ditches within or close to the site. The historical use of the site and means that the site is unlikely to be used by common lizard. If small numbers of lizard are present on the

site, the loss of this habitat will not be important in the context of the local population in Wexford Harbour. Therefore, reptiles and amphibians have not been included as a Key Ecological Receptor.

7.4.3 Flora

No flora listed on the Flora Protection Order were recorded within the study area. One species, rock sea-spurrey *(Spergularia rupicola)* is listed on the Irish Red List No. 10 Vascular Plants (Wyse Jackson et al., 2016) as Internationally Significant. This species is frequently found around Ireland's coasts and is on the Red List because Ireland holds >25% of the European population. Table 7.12 below provides a list of plant species recorded during the field survey in June 2018.

Table 7.12 Plant species recorded during the survey

Common name	Scientific name
Alexanders	*Smyrnium olusatrum*
Bird's-foot Trefoil	*Lotus corniculatus*
Bramble	*Rubus fruticosus* agg.
Butterfly Bush	*Buddleja davidii*
Cleavers	*Galium aparine*
Cock's Foot	*Dactylis glomerata*
Common Bent Grass	Agrostis capillaris
Common Bird's-foot Trefoil	*Lotus corniculatus*
Common Couch Grass	*Elymus repens*
Common Hogweed	*Heracleum sphondylium*
Common Mallow	*Malva sylvestris*
Common Nettle	*Urtica dioica*
Common Salt-Marsh Grass	*Puccinellia maritima*
Cordyline	*Cordyline* sp.
Cotoneaster	*Cotoneaster* sp.
Cow Parsley	*Anthriscus sylvestris*
Creeping Buttercup	*Ranunculus* repens
Curled Dock	*Rumex crispus*
Cut-leaved Crane's-bill	*Geranium dissectum*
Dandelion	*Taraxacum agg.*
Docks	*Rumex* ascetosa
Elder	*Sambucus nigra*
Field Horsetail	*Equisetum arvense*
Flowering Currant	*Ribes sanguineum*
Fuchsia	*Fuchsia magellanica*
Goat's-beard	*Tragopogon pratensis*
Gorse	*Ulex europaeus*
Hawthorn	*Crataegus monogyna*
Hedge Bindweed	*Calystegia sepium*
Herb-robert	*Geranium robertianum*
Himalayan Balsam	*Impatiens glandulifera*

Common name	Scientific name
Hogweed	*Heracleum sphondylium*
Ivy	*Hedera helix*
Japanese Knotweed	*Fallopia japonica*
Kidney Vetch	*Anthyllis vulneraria*
Lancelote Plantain	*Plantago lancelota*
Leylan Cypress	*Cupressus × leylandii*
Meadow Buttercup	*Ranunculus acris*
Nettle	*Urtica dioica*
Pale Flax	*Linum bienne*
Privet (non-native)	*Ligustrum* sp.
Red Clover	*Trifolium pratense*
Red Fescue	*Festuca rubra*
Red Valerian	*Centranthus ruber*
Ribwort Plantain	*Plantago lanceolata*
Rock Sea-spurrey	*Spergularia rupicola*
Rosebay Willowherb	*Epilobium* angustifolium
Scarlet Pimpernel	*Anagallis arvensis*
Scurvygrass	*Cochlearia officinalis*
Sea Arrowgrass	*Triglochin maritima*
Sea Plantain	*Plantago maritima*
Silverweed	*Potentilla anserina*
Short-fruited Willowherb	*Epilobium obscurum*
Sycamore	*Acer pseudoplatanus*
Thistles	*Cirsium sp.*
Three-cornered Leek	*Allium triquetrum*
White Clover	*Trifolium repens*
Willow	*Salix* spp.
Winter Heliotrope	*Petasites fragrans*
Yorkshire Fog	*Holcus lanatus*

7.4.4 Invasive Species

Two species, Japanese Knotweed and Three-cornered Leek, which are subject to restrictions as listed on the Third Schedule of the Habitats Regulations were recorded in the study area. A number of examples of other unlisted but invasive species, including Butterfly Bush, Winter Heliotrope and Cotoneaster were recorded within the study area. Himalayan Balsam (*Impatiens glandulifera*) is present in close proximity to the site but not within it. The location of Japanese Knotweed is shown in Figure 7.2 of Volume 3. Invasive species pose a threat to biodiversity in the area and have been included as a Key Ecological Receptor.

7.4.5 Ecological Corridors

Article 10 of the Habitats Directive recognises the importance of ecological networks as corridors and stepping stones for wildlife, including for migration, dispersal and genetic exchange of species of flora and fauna. The Directive requires that ecological connectivity and areas of ecological value outside the Natura 2000 network of

designated ecological sites are maintained and it recognises the need for the management of these areas through land use planning and development policies.

Ecological corridors are important in connecting areas of local biodiversity with each other and with nearby designated sites to prevent islands of habitat from becoming isolated. Ecological corridors include linear features such as treelines, hedgerows, disused railway lines, rivers, streams, canals and ditches as stepping stones for wildlife moving within their range. They are particularly important for mammals, especially bats, and small birds. The River Slaney is an important ecological corridor and provides a range of habitats and facilitate networks and linkages between the sea and freshwater habitats upstream. The River Slaney and Wexford Harbour waterbodies has been selected as a Key Ecological Receptor of the proposed development.

7.5 Key Ecological Receptors

This section of the report provides details of the Key Ecological Receptors that were identified during the desk study and the field surveys. The desk study provided information on rare and protected species and on designated sites of conservation interest in relation to the proposed development. This included an assessment of features of interest of Natura 2000 sites with the potential to be impacted by the proposed development and also a study of sites that are designated under national legislation (Nature Reserves and NHAs) and international conventions (Ramsar sites). Features of Proposed Natural Heritage Areas (pNHAs) were also considered within the study area.

Key Ecological Receptors Identified During Desk Studies and Field Surveys

The Key Ecological Receptors identified are described in greater detail in Table 7.13 together with an ecological evaluation for each.

Table 7.13 Key Ecological Receptor Description and Evaluation

Key Ecological Receptor	Description	Importance/Ecological Valuation (TII, 2009)
Key Ecological Receptor 1 Mudflats and Benthic Habitats	The proposed development is immediately adjacent to and within mudflats and benthic habitats, the former being a Qualifying Interest of the Slaney River Valley SAC and the Wexford Harbour and Slobs SPA ("Wetlands and Waterbirds" [A999]). The proposed development will result in a total maximum habitat loss of 2,168 m^2 of this habitat. A breakdown of the habitat loss associated with the proposed development is presented in Table 7.14.	**International Importance** on the basis that mudflats form an integral part of two Natura 2000 sites and supports habitats and species listed on Annexes I, II and IV of the Habitats Directive and Annex I of the Birds Directive.
Key Ecological Receptor 2 River Slaney and Wexford Harbour waterbodies	The proposed development is located on the banks of the River Slaney Estuary which includes the waters that are subject to the tidal influence from the sea. This habitat forms a link between salt and freshwater systems and is important for migrating fish moving between feeding and breeding grounds. The estuary provides an important nursery habitat for fish. The proposed development will result in the loss of 969 m^2 of subtidal habitat from the River Slaney Estuary to construct the marina and boardwalk piles and the sea walls which could lead to impacts on water quality. Water will be allowed to circulate freely under the boardwalk and marina. A breakdown of the habitat loss associated with the proposed development is presented in Table 7.14.	**International Importance** on the basis that this habitat forms an integral part of a Natura 2000 site and supports habitats and species listed on Annexes I, II and IV of the Habitats Directive and Annex I of the Birds Directive.
Key Ecological Receptor 3 Migratory Fish	Twaite Shad, Atlantic Salmon and Sea Lamprey and River Lamprey are all Qualifying Interests for the Slaney River Valley SAC. These species require unimpeded passage upstream to spawn. European Eel also require unimpeded passage from sea to freshwater habitats in the River Slaney. Fish could be impacted by increased barriers to connectivity and reduced water quality as a result of accidental pollution events and disturbance during construction and operation.	**International Importance** on the basis that species listed on Annex II of the Habitats Directive are present at critical phases in their life cycles.
Key Ecological Receptor 4 Otter	Otter is a Qualifying Interest of the Slaney River Valley SAC. Otter are protected wherever they occur and were confirmed as present at the site during the surveys. No otter shelters (holts or couches) were recorded within 150m of the proposed development.	**International Importance** on the basis that this species listed on Annex II and IV of the Habitats Directive and that the population represents more than 1% of the national population. No holts or couched were identified with 150 m of the proposed development.

Key Ecological Receptor	Description	Importance/Ecological Valuation (TII, 2009)
Key Ecological Receptor 5 Marine Mammals	Harbour porpoise, common dolphin, harbour seal and grey seal have been recorded in Wexford Harbour. Harbour seals are known to breed in Wexford Harbour. Harbour Seal is known to use the sandbanks in Wexford Harbour as haul-out sites for breeding, moulting and resting. At their haul-out sites, seals are extremely unlikely to be disturbed by human activities at a distance more than 850 m. As there are no haul-out sites within 2 km of the proposed development, the proposed development will not give rise to disturbance impacts on seals. Piling and installing rock armour could lead to temporary disturbance including injury to marine mammals.	**International Importance** on the basis that a species listed on Annex II and Annex IV of the Habitats Directive and protected under the Wildlife Acts breeds within the Zone of Influence.
Key Ecological Receptor 6 Bats	Bats are protected wherever they occur. One species, Common Pipistrelle, was recorded within the site of the proposed development during the survey. Bats could be negatively impacted by poorly-designed or excessive artificial lighting during the construction and operation of the proposed development. Vegetation removal could also result in habitat deterioration for this Key Ecological Receptor.	**Local Importance (Higher Value)** on the basis that these species are listed on Annex IV of the Habitats Directive and protected under the Wildlife Acts are present within the study area, however not occurring in county or nationally important numbers.
Key Ecological Receptor 7 Invasive Species	Japanese knotweed and three-cornered Leek were identified within the proposed development site. Invasive species are present within the study area and could potentially be spread further by the proposed development. Construction and operation could lead to the introduction of invasive marine species through the equipment and ballast water.	Invasive species have the potential to impact negatively on native species diversity and structures. There is a risk of spread of invasive species associated with the proposed development.
Key Ecological Receptor 8 Birds	Certain groups of birds are vulnerable to collision with glass facades and windows. Poorly designed buildings could impact on local populations including night-time migrants (e.g. warblers, thrushes), falcons and kingfisher.	**County Importance** on the basis that birds listed on Annex I of the Birds Directive, the BOCCI Red List and protected under the Wildlife Acts are present within the study area and are at risk of colliding with glass facades and windows.

7.6 'Do Nothing' Scenario

If the proposed development does not proceed, there will be no loss of mudflat, estuarine or terrestrial habitat.

The limited value of the site to otter, pollinators, birds and bats would continue.

Pressures and threats associated with infrastructure projects, such as noise, lighting and the fragmentation of habitats, would not be introduced to the area.

Mussel farming would continue in Wexford Harbour, which covers approximately half of the subtidal seabed area. Harvesting mussels involves dredging which is highly disruptive to benthic habitats.

Japanese Knotweed would likely spread and in time it would become the dominant species.

Due to the proximity of the site to the River Slaney, the Japanese Knotweed would act as a source of dispersal to other areas of the Lower River Slaney and Wexford Harbour.

The site would continue to be eroded by the sea, which will lead to the release of contaminants into Wexford Harbour.

7.7 Description of Likely Impacts (Unmitigated)

7.7.1 Impacts on Designated Areas

The proposed development occurs within two Natura 2000 sites; the Slaney River Valley SAC and the Wexford Harbour and Slobs SPA. Seven other designated sites occur within the Zone of Influence (Table 7.4). Some of these designated sites refer to the same areas with multiple designations.

As likely significant effects on the Natura 2000 sites could not be excluded at the screening stage, an Appropriate Assessment (AA) was deemed necessary and a Natura Impact Statement (NIS) was prepared. The NIS presents all of the predicted impacts on the sites and their Qualifying Interests and also provides a detailed analysis and evaluation of these impacts in the context of the Conservation Objectives. The NIS also prescribes mitigation to eliminate adverse effects on the integrity of the Natura 2000 sites.

7.7.2 General Impacts on Key Ecological Receptors

General impacts on biodiversity that are typical of development are described in this section. These potential negative effects are considered with reference to the previously defined Key Ecological Receptors.

Habitat Loss

The proposed development will lead to the permanent loss of estuary and intertidal mudflat habitat. This includes a narrow strip around the seaward perimeter of the site. This reclamation is required to prevent the need for excavation of the existing site, which contains contaminants originating from its former industrial use. The new sea wall will prevent the further infiltration of contaminants into the River Slaney. The other areas that will be reclaimed are the small area at the north-western corner for the boardwalk landing and the areas occupied by the steel piles for the boardwalk and

marina (the method of restraint for the marina will be decided at detailed design and, for the purposes of this assessment it has taken into account the largest surface area possible)

The maximum area of Annex I habitat that will be lost is 2,168 m^2, 621 m^2 of which is outside the Natura 2000 network and 1,547 m^2 of which is inside the Natura 2000 network. Of the 1,547 m^2 within the Natura 2000 network, 969 m^2 is within the Slaney River Valley SAC and 999 m^2 is within the Wexford Harbour and Slobs SPA (there is an overlap of 421 m^2 between these two areas). The 969 m^2 within the Slaney River Valley SAC is classified as both "Estuaries" and "Mudflats and sandflats not covered by seawater at low tide" and represents c. 0.005% and c. 0.009%, respectively, of the estimated total area of these habitats within the SAC. The 999 m^2 within the Wexford Harbour and Slobs SPA is classified as "Wetlands and Waterbirds" and represents c. 0.002% of the total area of wetland habitat within the SPA.

A breakdown of Annex I habitats which will be lost is presented in Table 7.14 and Figure 7.1 below. The overall area of the marina and boardwalk has not been included as water will be allowed to circulate freely underneath these structures. The mudflats and benthic habitats have been found to have low faunal diversity (RPS, 2018) and are not an important area for wintering birds (Natura, 2016).

Table 7.14 Annex I Habitat Loss Breakdown

Slaney River Valley SAC	**Inside Slaney River Valley SAC (m^2)**	**Outside Slaney River Valley SAC (m^2)**
Estuaries [1130]; *Mudflats and sandflats not covered by seawater at low tide* [1140]	969	1,199
Wexford Harbour and Slobs SPA	**Inside Wexford Harbour and Slobs SPA (m^2)**	**Outside Wexford Harbour and Slobs SPA (m^2)**
Wetland and Waterbirds [A999]	999	1,169

The terrestrial habitats are considered to be of Local Importance (Lower Value) and are not considered further. 'Mudflats and Benthic habitats' and the 'River Slaney/ Wexford Harbour waterbody' have been identified as Key Ecological Receptors are discussed in Table 7.15 below.

Figure 7.1 Annex I Habitat Loss Breakdown

Habitat Fragmentation

The construction and operation of the proposed development within the River Slaney could potentially inhibit the movement of fish species which migrate upstream and downstream through the estuary or which make extensive use of the estuary throughout their lives. Artificial light, visual disturbance, noise and vibration may create barriers to connectivity for fish, marine mammal, otter and bats.

Disturbance

Disturbance may occur during construction and operation as a result of noise, lighting and vibration. The new marina will lead to an increase in boat traffic which could disturb birds, seals and other species. The new marina will mainly facilitate leisure craft already in the harbour where tidal restrictions currently limit vessel access to moorings further upstream (pers. comm. Captain Philip Murphy, Senior Marine Officer, Wexford County Council). The increase in leisure craft is expected to be modest and any impacts insignificant in comparison to the current levels of recreational and commercial boat traffic as well as the fishing and aquaculture activities which take place in Wexford Harbour.

Trinity Wharf Marina will be competing with other marinas in nearby towns and the long navigational channel that is required to travel through coming into Wexford Harbour, may discourage some vessels passing along the coast. However, an increase in the volume of boats and boating activity adjacent to the marina and its approaches should be anticipated. The MMRA carried out (IWDGC, 2018) found that while small vessels tend to produce broadband low frequency sound which harbour seals would detect, seals in the area are already accustomed to existing boat traffic, including recreational and fishing activity, and seals are known to be quite tolerant to boat traffic (See Appendix 7.3).

Reduction in Water Quality

Construction and operational activities within and adjacent to surface waters can negatively impact on water quality.

The driving of piles for the boardwalk/bridge, sheet-piling and placement of sloped revetments for coastal protection and the construction of restraints for the marina (either tubular steel piles, helical anchors or weighted anchors) could lead to sediments containing contaminants being disturbed and becoming suspended in the water column. This may lead to agitation of harmful material which has accumulated in high concentrations on the river bed.

Surface water run-off from construction areas has the potential to contain high levels of suspended sediments (and also contaminants). Such run-off, if not attenuated and treated prior to discharge, has the potential to cause significant ecological impacts. Large amounts of fine sediment deposition can smother benthic habitats, leading to changes in biological composition. Disturbance of fine sediments can also increase the amounts and persistence of chemical contaminants in the receiving habitat, leading to further changes in the biological composition and overall condition of habitats.

During construction, concrete, grout or other pollutants may spill directly into the local environment or be washed into the water in construction site run-off. These materials are highly alkaline and, consequently, can drastically alter the pH of the receiving water body. This can lead to profound ecological impacts and can affect the condition of habitats by causing damage to pH-sensitive species.

Vehicles, plant and equipment which will be used during construction rely on hydrocarbons such as diesel, petrol and lubricating oils. Leaks from poorly maintained vehicles, plant, equipment or storage tanks provide for a risk of input of hydrocarbons into the environment. In the absence of appropriate mitigation, hydrocarbons from the construction site may spill directly into Wexford Harbour or be washed into the river in construction site run-off. This has the potential to cause negative ecological impacts on the estuary, including intertidal habitats. Hydrocarbons can have direct toxic effects, including reducing the ability of organisms to absorb water and nutrients. Hydrocarbons can also alter the nutrient balance and microbiota in soil and water, which can benefit some species while detrimentally affecting others. Such changes have the potential to alter the biological composition of the habitat.

Inadequate treatment of waste water from on-site toilets and washing facilities also provides for potential water quality impacts which could lead to ecological effects in the estuary. Faecal contamination can alter the nutrient balance in soils and water, causing significant changes in microbial communities and reductions in oxygen levels. This can have significant effects on the biological composition of receiving habitats.

The increase in boat traffic as a result of the new marina brings an increased risk of accidental pollution through fuels, oils and sewage.

Direct Mortality

Piling during construction may lead to injury or mortality of fish and marine mammals during the construction phase. The operation of the proposed development, specifically the use of glass facades and windows, has the potential to lead to bird mortality through collision.

Spread of Invasive Species

Construction activities could aid the of spread of Japanese knotweed and three-cornered leek within the site. In the absence of control measures, there is a possibility that these species may be inadvertently spread during construction through the movement of equipment and contaminated soil to, from or within the site.

7.7.3 Impacts on Key Ecological Receptors

Impacts on the Key Ecological Receptor as defined in the preceding sections are described in Table 7.15.

Table 7.15 Impact characterisation for Key Ecological Receptors based on EPA (2017) and TII (2009)

Key Ecological Receptor	Construction-phase impacts	Operational-phase impacts	Ecological significance if unmitigated
Key Ecological Receptor 1 Mudflats and Benthic habitats	The proposed development is on lands immediately adjacent to and within Wexford Harbour. The habitat around the proposed development conforms to two Annex I habitats; '*Estuaries'* and '*Mudflats and sandflats not covered by seawater at low tide'*. Direct impacts of the proposed works on this Key Ecological Receptor potentially include the following: Permanent loss of subtidal and intertidal habitats within the footprint of reclaimed land. Permanent loss of sub-tidal benthic habitat. Temporary and permanent displacement, injury and death of fauna. Habitat fragmentation and barrier effect may occur if Otter and aquatic species are not able to migrate along the watercourse during the construction of the proposed development. This impact could also affect birds and bats that may use this section of the river as a commuting route. Accidental pollution events may result in pollutants entering the environment and affecting water quality during the construction phase.	Habitat fragmentation and barrier effect as a result of lighting and the potential release of pollutants are ongoing direct impacts during the operational phase of the proposed development.	The proposed development involves the loss of 2,168 m^2 of intertidal and subtidal habitat. This is considered to constitute a **Permanent Significant Negative Impact** over a very small area of a receptor of International Importance. This impact will not affect the integrity or favourable conservation status of this habitat. The potential for habitat fragmentation and barrier effects during construction and operation as a result of lighting, noise and vibration is considered to constitute a **Temporary and Permanent Moderate Negative Impact.** The construction of the marina will prevent mussel farming taking place in this area in the future, thereby allowing natural habitats to develop. This will constitute a **Potential Permanent Positive Impact.** The risk of pollution of the estuary during the construction phase is considered to constitute a **Potential Temporary Significant Negative Impact** as, if it were to occur, it would have the potential to impact sensitive receptors such as wintering birds over a short period of time and over a far wider area than the site itself.

Key Ecological Receptor	Construction-phase impacts	Operational-phase impacts	Ecological significance if unmitigated
Key Ecological Receptor 2 River Slaney/ Wexford Harbour waterbody	The proposed development is on lands immediately adjacent to and within Wexford Harbour. The habitat around the proposed development consisting of tidal water conforms to the Annex I habitat, '*Estuaries'*. Instream structures include a marina, boardwalk and new sea walls with some reclamation of land from the estuary. Direct impacts of the proposed works on this Key Ecological Receptor potentially include the following: Permanent loss of habitat within the footprint of reclaimed land and under the marina and associated piles/ restraints. Temporary displacement of fauna during construction. Habitat fragmentation and barrier effect may occur if Otter and aquatic species are not able to migrate along the watercourse during the construction of the proposed development. This impact could also affect birds and bats that may use this section of river as a commuting route. Accidental pollution events may result in pollutants entering the river and affecting water quality during the construction phase.	Habitat fragmentation and barrier effect as a result of lighting and the potential release of pollutants are ongoing direct impacts during the operational phase of the proposed development	The proposed development involves the loss of 2,168 m^2 of intertidal and subtidal habitat. This is considered to constitute a **Permanent Significant Negative Impact** over a very small area of a receptor of International Importance. This impact will not affect the integrity or favourable conservation status of this habitat. The potential for habitat fragmentation and barrier effects during construction and operation as a result of lighting, noise and vibration is considered to constitute a **Temporary and Permanent Moderate Negative Impact.** The construction of the marina will prevent mussel farming taking place in the area in the future, thereby allowing natural habitats to develop. This will constitute a **Potential Permanent Positive Impact.** The risk of pollution of the river during the construction phase is considered to constitute a **Potential Temporary Significant Negative Impact** as, if it were to occur, it would have the potential to impact sensitive receptors such as Atlantic Salmon and Twaite Shad over a short period of time and over a far wider area than the site itself.

Key Ecological Receptor	Construction-phase impacts	Operational-phase impacts	Ecological significance if unmitigated
Key Ecological Receptor 3 Migratory Fish	Direct impacts to fish at the construction phase include habitat fragmentation and barrier effect. Direct mortality or injury or temporary disturbance due to vibration during in-stream piling and the construction of the marina. Fish may be impacted indirectly by a deterioration in water quality during the construction phase caused by run-off of sediment and/or pollutants entering the river.	Habitat fragmentation and barrier effect as a result of lighting and the potential release of pollutants are ongoing direct impacts during the operational phase of the proposed development.	The potential for habitat fragmentation and barrier effect during construction is considered to constitute a **Temporary Slight-Moderate Negative Impact** as it applies to the migratory fish that commute upstream. The risk of pollution of the river during the construction phase is considered to constitute a **Potential Short-term Significant Negative Impact** as, if it were to occur, it would have the potential to impact sensitive receptors such as Atlantic Salmon and Twaite Shad over a short period of time and over a far wider area than the site itself. Operational impacts include disturbance due to the increase in boat traffic. Following consultation with the Harbourmaster, this impact is considered to be **Permanent Imperceptible Negative Impact** as the increase in the number and frequency of vessels and their movements will be very small. Activities such as jet-skiing and water-skiing are very infrequent and require permission of the harbourmaster. Habitat fragmentation and barrier effects during operation are considered to constitute a **Permanent Slight Negative Impact.** Significant impacts on migratory fish are not anticipated at the International, National or County Level.

Key Ecological Receptor	Construction-phase impacts	Operational-phase impacts	Ecological significance if unmitigated
Key Ecological Receptor 4 Otter	Otter may be impacted by noise associated with construction activities. None of the habitat in the vicinity of the proposed development is considered to be of particular significance as otter habitat. No holts or couches were recorded within 150m of the proposed development. Construction and operation may lead to habitat fragmentation and barrier effect.	Habitat fragmentation and barrier effect as a result of lighting and the potential release of pollutants are ongoing direct impacts during the operational phase of the proposed development.	No significant direct impacts are anticipated on this species given the nature of the habitats and given that no breeding or resting places were recorded near the proposed development. Construction phase impacts include an increase in noise and lighting. This is considered to be a **Temporary Slight Negative Impact.** The risk of pollution and reduced prey availability during the construction phase would be considered to constitute a **Potential Short-term Moderate Negative Impact** as, if it were to occur. Operational impacts include disturbance due to the increase in noise and lighting. It is considered to be **Permanent Slight Negative Impact.** Significant impacts on Otter are not anticipated at the National or County Level.
Key Ecological Receptor 5 Marine Mammals	Piling and the construction of the rock armour revetments could lead to displacement and injury of marine mammals.	The marina will lead to an increase in boat traffic using Wexford Harbour which may lead to disturbance of marine mammals, especially seals at haul out sites.	The impacts of piling and the construction of the rock armour revetments are considered to be a **Potential Temporary Moderate Negative Impact.** The increase in boat use in Wexford Harbour is considered to be a **Permanent Imperceptible Negative Impact** as the increase in the number and frequency of vessels and their movements will be very small.

Key Ecological Receptor	Construction-phase impacts	Operational-phase impacts	Ecological significance if unmitigated
Key Ecological Receptor 6 Bats	Bats may be temporarily displaced from the construction footprint during construction due to habitat degradation.	Habitat fragmentation, barrier effects and habitat deterioration due to presence of artificial lighting are potential ongoing direct impacts during the operational phase.	It is considered that indirect impacts on bats are likely to be **Long-term Slight Negative Impacts** resulting from loss of foraging habitat through vegetation removal and artificial lighting. The habitat loss associated with the proposed development is considered to be minor given the available habitat in the wider area (along the railway line primarily). It is considered that there is the potential for **Permanent Slight Negative Impacts** on a resource of Local Importance (Higher Value) associated with the displacement of bats away from existing commuting and foraging areas within and adjacent to the site.
Key Ecological Receptor 7 Invasive Species	Two invasive species, Japanese knotweed and three-cornered leek were found within the site. invasive species may be inadvertently spread during construction through the movement of machinery within and outside the site. Importation of unscreened material and works close to the land-ward boundaries of the site may lead to the introduction if invasive species. The use of ships and barges during the construction phase could lead to the introduction of marine invasive species in ship's ballast water and may have a range of effects, from undetectable to the complete detriment of native communities. The risk of spreading marine invasive species by smaller craft is difficult to control and depends on regular maintenance.	Boats can facilitate the spread of invasive species.	Construction and operation of the proposed development may lead to the introduction and spread of invasive species.

Key Ecological Receptor	Construction-phase impacts	Operational-phase impacts	Ecological significance if unmitigated
Key Ecological Receptor 8 Birds	Direct impacts are the loss of nesting sites within the site footprint and the displacement of birds from within the site and from the surrounding area.	Bird collision with glass facades is considered to be the only operational impact. The planting of trees and hedges will provide additional nesting opportunities for birds.	The loss of nesting sites is considered to be a **Short-term Significant Negative Impact at the Local Scale.** Collision with glass is considered to be a **Long-term Moderate Negative Impact.**

7.8 Mitigation

This section describes the measures that are in place to mitigate any harmful or negative impacts associated with the proposed development and the identified Key Ecological Receptors, as described in the preceding sections. General mitigation measures included within the design of the proposed development are described first, with more specific measures to prevent or minimise impacts on the individual receptors provided subsequently.

7.8.1 General Mitigation

Mitigation by Avoidance

The proposed development minimises landtake from ecologically sensitive areas and has been constraints-led from the initial phase, through an iterative design process; and, into the final proposed development. The design has followed the basic principles outlined below to eliminate the potential for ecological impacts on Key Ecological Receptors where possible and to minimise such impacts where total elimination is not possible. The proposed development has been selected to avoid, as far as possible, direct, in-direct or secondary adverse impacts on Natura 2000 sites or other sites designated for nature conservation. The proposed development has been designed to minimise direct or indirect impacts on any habitats or species or other ecological features that were classified as being of Local Importance (Higher Value) or above. All piling within the Harbour will be restricted to the periods between the 1st June and the 31st January to avoid impacts on migratory fish. Wintering Bird surveys (Natura, 2016) carried for the proposed development concluded that "*The bird numbers present in this area* [within 1km of Trinity Wharf] *represent a small proportion of the total numbers in the Wexford Harbour and Slobs SPA*." The report also found that very few individuals occurred within 200m of Trinity Wharf owing to the lack of suitable habitat. The hydrodynamic modelling report concluded that *"the nearby environmentally sensitive areas will be not be adversely impacted by any changes in the sediment transport as a result of either the landside development in isolation or the landside development in combination with the marina".*

Mitigation by Design

The proposed development has been developed having regard to European and national legislation and all relevant guidelines in relation to ecology and engineering best practice for the planning and construction of proposed developments. These guidelines and best practice provide practical measures that can be incorporated into the design to minimise the impact and protect the receiving environment. The following is an overview of the design measures that will be employed to minimise and avoid significant impacts on the ecological receptors within the Zone of Influence.

- An Outline Construction and Environmental Management Plan (OCEMP) has been produced to ensure that the construction does not lead to any unanticipated negative impacts on the environment. A Construction Environmental Management Plan (CEMP) and Environmental Management Plan will be completed by each Contractor in line with Appendices 4.1 and 4.2 of this EIAR prior to construction works commencing.
- Vibratory driven sheet piles forming the sea wall on the site perimeter and the option of tubular steel piles, screw piles (helical anchors), or, weighted anchors with chains for the foundation of the marina and boardwalk elements (to be decided during detailed design) have been selected as their installation minimises disturbance and landtake from benthic habitats and mudflats.

- The lighting plan has been designed to minimise impacts on biodiversity. Low level downward facing bollard lighting or illuminated strips have been selected along the seaward perimeter to minimise light spill outside of the footpaths (See Figure 4.20 in Volume 3). All luminaries will be LED which lack UV elements and will have peak wavelengths greater than 550nm (~3000°K). This will produce a warm white colour, and, in tandem with maintaining the minimum allowable lux levels, will reduce the impacts on bats and other wildlife.
- Street lights will be located so that the rear shields are adjacent to the estuary and planted areas or optics are selected that stop back light.
- The drainage has been designed to provide a high level of attenuation and water quality controls, as described in detail in Chapter 04: Description of the Proposed Development.
- The buildings will have blue-green roofs. Species will include native coastal species and a variety of sedums which are pollinator friendly. The landscaping of the site will include trees, shrubs and a wildflower meadow which will provide opportunities for nesting and foraging birds. Details of the Planting Plan are in Appendix 4.6 which includes Drawing No. L-PP-01.
- A suitably qualified Project Ecologist and Marine Mammal Observer (this can be the same person) will be appointed by Wexford County Council for the duration of the proposed development.
- Each contractor will appoint a Site Environmental Manager to carry out environmental monitoring and to ensure that the mitigation measures proposed in this EIAR is followed.

7.8.2 Specific Mitigation Measures

Specific measures are described in relation to individual receptor types in the following sections.

Key Ecological Receptor 1 & 2- Mudflats and Benthic Habitats & River Slaney/ Wexford Harbour Waterbody

Habitat Loss

The loss of estuarine habitats cannot be mitigated for. In spite of the permanent loss of these habitats, this overall impact is considered insignificant given the total area is small (as described in section 7.7.2), has low faunal diversity (ASU, 2018) and is not an important area for wintering birds (Natura, 2016). Water will still be allowed to circulate underneath the marina and boardwalk and the new hard surfaces to which epifauna and seaweeds will attach, will add to the species diversity in the area (ASU, 2018).

Water Quality

Construction Phase

The following mitigation measures relating to the protection of water quality shall apply during the construction of the proposed development:

Sedimentation and surface water run-off

- In order to attenuate flows and minimise sediment input into the River Slaney from site run-off, all surface water run-off from the construction site shall be directed to a temporary attenuation facility, where the flow rate will be attenuated and sediment allowed to settle out, before passing through a hydrocarbon interceptor and being discharged.

- Sheet piling for the new seaward site boundary shall be installed prior to any excavation on the landward side (other than the access road and level crossing) and demolition of the existing wharf boundary. This will form an effective barrier to run-off from the site during construction.
- Any material stockpiled shall be located a minimum of 30m from the seaward boundary of the site and shall also be covered and remain stockpiled for as short a time as possible.
- The Contractors shall provide method statements for weather and tide/storm surge forecasting and continuous monitoring of water levels in Wexford Harbour and the removal of site materials, fuels, tools, vehicles and persons from flood zones in order to minimise the risk of input of sediment or construction materials into the river during flood events.
- The placing of anchor blocks (if required) shall be undertaking so as to minimise disturbance of sediment from the sea-bed. Should local excavation of the seabed be required it shall be carried out behind a geotextile screen and boom with oil barrier to prevent pollution of the river/estuary.

Cementitious materials

The measures prescribed with regard to sedimentation and surface water run-off will also minimise the risk of any input of cementitious material into the River Slaney from the landside elements of the construction. However, the following measures shall also apply:

- All shuttering shall be securely installed and inspected for leaks prior to concrete being poured and all pouring operations shall be supervised monitored for spills and leaks at all times.
- In order to eliminate any remaining risk of input of cementitious material into the River Slaney, all pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents etc. for outfalls shall be completed in dry weather.
- In order to prevent input of cementitious materials into the River Slaney from the in-stream elements of the construction, concrete structural elements shall be pre-cast, wherever possible.
- Where concrete or other wet materials are to be used over water, appropriate bunded platforms shall be in place to capture any spilled concrete, sealants or other materials.
- Any such materials collected on these platforms shall be disposed of in accordance with the Construction and Demolition Waste Management Plan (CDWMP) (Appendix 4.1).

Hydrocarbons and other chemicals (See also Chapter 09 and 10 of this EIAR)

- Land-based vehicles and plant shall be refuelled off-site, where possible.
- All land-based fuelling of machinery shall be undertaken on an impermeable base in bunded areas at least 50 m from the seaward boundary of the site.
- Marine based fuelling will only be undertaken using specifically designed nozzles to prevent spillages and spill kits will be available.
- All fuelling equipment shall be regularly inspected and serviced.
- Any petrol- or diesel-fuelled pumps or other machinery shall be located within temporary bunded units.

- All fuel, oils, chemicals, hydraulic fluids, on-site toilets etc. shall be stored in the construction site compound, on an impermeable base which shall be bunded to 110% capacity and appropriately secured.
- All plant and construction vehicles shall be inspected daily for oil leaks and a full service record shall be kept for all plant and machinery.
- Spill kits shall be available on site during construction, including on the jack-up barge during pile driving.
- All waste oils, empty oil containers and hazardous wastes shall be disposed of in accordance with the Waste Management Act, 1996 (as amended).
- Owing to the presence of contaminants within the construction site, excavation shall be limited to the absolute minimum necessary.

Painting of the boardwalk

- Paints containing organotin compounds, e.g. TBT, shall not be permitted.
- In order to minimise the risk of paint spillage into Wexford Harbour, the majority of the deck shall be painted over land, prior to be lifted into position over the estuary, and painting of the remaining sections (mostly at joining points) shall be carried out above bunded platforms which will capture any spilled paint.

Operational Phase

The surface water drainage of the proposed development will include blue-green roofs, rain gardens at building perimeters and soft landscaping features such as vegetated swales. The surface water drainage design will allow for storage during a 1-in-100-year flood event. The surface water drainage for the development site comprises a Sustainable Drainage System (SuDS) approach. The surface water drainage network will drain by gravity to the outfall locations around the site and will be designed to store the 1 in 100-year 6-hour rainfall event plus climate change (between tidal cycles). Surface water run-off from the proposed multi-storey car park will pass through a hydrocarbon interceptor. Details of the drainage for the proposed development are presented in Section 4.3.4.4 of Chapter 04.

The foul sewer will be directed to the public wastewater infrastructure. The risk to the River Slaney has been found to be low and the potential impact assessment is deemed to be imperceptible. See further impact assessment in Chapter 09 Hydrogeology. The bye-laws listed in the Wexford County Council Harbour and Piers Bye-Laws 2014 will apply to vessels using the proposed marina.

Lighting and Shade

Construction Phase

Light spill onto the estuary during hours of darkness has the potential to form a barrier to the migration of nocturnal species and to encourage night-time activity of diurnal species, causing them to become more vulnerable to nocturnal predators. Owing to the scale of the proposed development, it will not result in significant shading impacts.

Turning off construction lighting over the river outside of working hours will eliminate any risk of these impacts outside of those hours. This will eliminate the risk of such impacts occurring during the months of April to September, inclusive, and restrict such impacts to before 7:00 pm and after 7:00 am on weekdays and before 4:30 pm and after 8:00 am on Saturdays during the months of October to March, inclusive. This would ensure at least 12 hours free of artificial light every night of the year and more at weekends. The remaining level of artificial lighting is considered unlikely to result in

the significant effects discussed above. However, the risk of such effects occurring can be minimised further by ensuring that construction lighting is limited to the minimum area required, thereby minimising any light spill onto the river channel.

Therefore, subject to any Health & Safety and navigational requirements, construction lighting within 10m of the estuary shall be turned off outside of working hours. In addition, construction lighting will be limited to the minimum area required to be lit. The Project Ecologist will ensure that these measures are adhered to during the construction stage.

Operational Phase

The lighting plan has been designed to minimise impacts on biodiversity. Low level downward facing bollard lighting or illuminated strips have been selected along the seaward perimeter to minimise light spill outside of the footpaths, and onto the estuary (See Figure 4.19 in Volume 3). All luminaries will be LED which lack UV elements and will have peak wavelengths greater than 550nm (~3000°K). This will produce a warm white colour, and, in tandem with maintaining the minimum allowable lux levels, will reduce the impacts on bats and other wildlife.

Owing to the scale of the proposed development, neither its construction nor its operation has the potential to give rise to significant shading impacts on the River Slaney.

Key Ecological Receptor 2 - Migratory Fish

Mitigation measures prescribed for Migratory Fish below are relevant for nocturnal and diurnal fish species, fish of small body size and hearing specialists (fish with highly specialised auditory sense).

Noise and Vibration

The following are the mitigation measures which will apply to all pile driving for the marina, boardwalk and outer sea wall:

- There shall be no pile driving of the marina, boardwalk and sea wall permitted in the period beginning on 1st February and ending on 31st May in any year.
- All pile driving of the marina, boardwalk and sea wall shall be restricted to Monday to Friday, inclusive, i.e. there shall be no pile driving on Saturdays or Sundays.
- Pile driving shall be restricted to between 7:00 am and 7:00 pm from 1st June to 30th September, inclusive, and to between 8:00 am and 6:00 pm from 1st October to 31st January, inclusive.
- All breaks between pile driving of the marina and boardwalk shall be of at least 1 hour's duration and, in the case of multiple piling rigs being operational simultaneously, all such breaks shall be concurrent. This measure shall not apply to vibratory driven piles for the sea wall.
- A 30-minute soft-start/ramp-up procedure shall apply to each pile drive. This measure shall not apply to vibratory driven piles for the sea wall, however, a risk assessment will be undertaken in line with the MMRA (Appendix 7.3), and if underwater noise levels from vibratory piling are expected to reach the threshold SPL_{peak} of 170 dB re 1 µPa at 1 m, a soft start approach will be adopted.
- A trained and experienced Marine Mammal Observer (MMO) shall be appointed by WCC to perform that function in accordance with DAHG (2014) and the MMRA which is included in Appendix 7.3.

- If, for any reason, a derogation from any of the above is required, this shall only be permitted with the consent of WCC, the NPWS and IFI.
- All of the above measures shall be enforced by the WCC Project Ecologist and the SEM appointed by each Contractor.

Lighting and Shade

The mitigation prescribed for impacts of artificial lighting (above) are considered more than adequate to eliminate any risk of significant such impacts on Migratory Fish during the construction and operation of the proposed development.

Owing to the scale of the proposed development, neither its construction nor its operation has the potential to give rise to significant shading impacts on the River Slaney and the migratory fish species present.

Water quality

Given the full and proper implementation of the water quality protection measures, described above, the operation and maintenance of the proposed development will not give rise to any adverse effects on Migratory Fish through a deterioration of water quality.

Key Ecological Receptor 3 – Otter

Pre-construction Otter Survey

Prior to any works being carried out, a pre-construction otter survey will be undertaken to ensure that no otters have taken up residence within 150m of the proposed development.

Noise and Vibration

The mitigation prescribed for noise and vibration impacts (above) are considered more than adequate to eliminate any risk of significant direct and indirect noise and vibration impacts on otters during the construction of the proposed development. Therefore, no further mitigation is required in respect of noise and vibration impacts on this species.

Lighting

The mitigation prescribed for impacts of artificial lighting (above) are considered more than adequate to eliminate any risk of significant such impacts on Otter during the construction and operation of the proposed development. There will be no spillage of light to the river or to land within 10m of the estuary outside of working hours. Therefore, no further mitigation is required in respect of lighting impacts on this species.

Key Ecological Receptor 4- Marine Mammals

Marine Mammals may be injured as a result of marine-based piling and rock armour construction. The following mitigation measures for part of the proposed development:

- A qualified and experienced Marine Mammal Observer (MMO) shall be appointed to monitor for marine mammals and to log all relevant events using standardised data forms.
- Unless further information specific to the location and proposed development is otherwise available to inform the mitigation process (e.g., specific sound propagation and/or attenuation data) and a distance modification has been agreed with WCC, NPWS and IFI, pile driving activity shall not commence if

marine mammals are detected within a 500m radial distance of the pile driving sound source.

- Pre-Start Monitoring

  Pile driving activities shall only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved. Where effective visual monitoring, as determined by the MMO, is not possible the sound-producing activities shall be postponed until effective visual monitoring is possible.

  An agreed and clear on-site communication signal must be used between the MMO and the Works Superintendent as to whether the relevant activity may or may not proceed, or resume following a break (see below). It shall only proceed on positive confirmation with the MMO.

  The MMO shall conduct pre-start-up constant effort monitoring at least 30 minutes before the sound-producing activity is due to commence. Sound-producing activity shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO.

  This prescribed Pre-Start Monitoring shall subsequently be followed by an appropriate Ramp-Up Procedure which should include continued monitoring by the MMO.

- Ramp-Up Procedure

  In commencing a pile driving operation where the output peak sound pressure level (in water) from any source including equipment testing exceeds SPL_{peak} of 170 dB re 1 µPa at 1 m, an appropriate Ramp-up Procedure (i.e., "soft-start") must be used. The procedure for use should be informed by the risk assessment undertaken giving due consideration to the pile specification, the driving mechanism, the receiving substrate, the duration of the activity, the receiving environment and species therein, and other information (see section 3 of Appendix 7.3 of the EIAR).

  Where it is possible according to the operational parameters of the equipment and materials concerned, the underwater acoustic energy output shall commence from a lower energy start-up (i.e. an SPL_{peak} not exceeding 170 dB re 1 µPa at 1 m) and thereafter be allowed to gradually build up to the necessary maximum output over a period of 20-40 minutes.

  This controlled build-up of acoustic energy output shall occur in consistent stages to provide a steady and gradual increase over the ramp-up period.

  Where the measures outlined in the previous steps are not possible, alternatives must be examined whereby the underwater output of acoustic energy is introduced in a consistent, sequential and gradual manner over a period of 20-40 minutes prior to commencement of the full necessary output.

  In all cases where a Ramp-Up Procedure is employed the delay between the end of ramp-up and the necessary full output must be minimised to prevent unnecessary high-level sound introduction into the environment.

  Once an appropriate and effective Ramp-Up Procedure commences, there is no requirement to halt or discontinue the procedure at night-time, nor if weather or visibility conditions deteriorate nor if marine mammals occur within a 500m radial distance of the sound source, i.e., within the Monitored Zone.

- Breaks in sound output

  If there is a break in pile driving sound output for a period greater than 30 minutes (e.g., due to equipment failure, shut-down or location change) then all Pre-Start

Monitoring and a subsequent Ramp-up Procedure (where appropriate following Pre-Start Monitoring) must be undertaken.

For higher output pile driving operations which have the potential to produce injurious levels of underwater sound (see Appendix 7.3 MMRA sections 2.4, 3.2) as informed by the associated risk assessment, there is likely to be a regulatory requirement to adopt a shorter 5-10 minute break limit after which period all Pre-Start Monitoring and a subsequent Ramp-up Procedure (where appropriate following Pre-Start Monitoring) shall recommence as for start-up.

- Reporting

  Full reporting on MMO operations and mitigation undertaken must be provided to the NPWS.

Monthly seal surveys of known and potential seal haul-out sites will be carried out immediately prior to and during the marine works. This is to ensure there are no changes in use of these sites and to provide the NPWS with useful monitoring data. These seal surveys will be carried out by the site MMO concurrent with implementing NPWS guidelines.

Signage at the marina will provide information to boat owners about the importance of Wexford Harbour for seals. It will also give information on how to avoid disturbance and signs of disturbance (head up etc).

Key Ecological Receptor 6 – Bats

Lighting during the construction phase will avoid direct illumination of the estuary. Follow the removal of vegetation within the sites, new areas will be planted which will include pollinator friendly, and therefore bat friendly species.

The lighting plan has been designed to minimise impacts on biodiversity. Low level downward facing bollard lighting or illuminated strips have been selected along the seaward perimeter to minimise light spill outside of the footpaths (See Figure 4.19 in Volume 3). All luminaries will be LED which lack UV elements and will have peak wavelengths greater than 550nm (~3000°K). This will produce a warm white colour, and, in tandem with maintaining the minimum allowable lux levels, will reduce the impacts on bats and other wildlife.

Key Ecological Receptor 7- Invasive Species

Regulation 49 of Habitats Regulations includes legislative measures to deal with the dispersal and introduction of Invasive Species, which are listed in the Third Schedule of the Regulations.

Japanese knotweed and three-cornered leek are present within the site. The construction works have the potential to spread invasive species within and outside the site. Prior to any works being carried out, a pre-construction invasive species survey will be undertaken to ensure that additional invasive have not been introduced to areas within or close to the proposed development footprint. The Invasive Species Management Plan that is currently in place is presented in Appendix 7.4.

Vessels associated with the construction of the sea walls, the boardwalk and the marina have the potential to introduce invasive species to Wexford Harbour. Vessels should adhere to the industry recommended guidelines for preventing the introduction of non-native marine species. UKMarineSAC (2009) recommends that vessels comply with International Maritime Organisation guidance wherever possible, seek guidance from the Wexford Harbour authority regarding areas where ballast water uptake should

be avoided (e.g. near sewage outfalls), encourage the exchange of ballast water in the open ocean, and discourage/prohibit the unnecessary discharge of ballast water in the harbour area.

Signage will be put in place at the marina informing the public of the marine invasive species that are associated with small craft and marinas and the importance of boat maintenance.

Key Ecological Receptor 8 – Birds

The protection of bird breeding habitats during the breeding season (1st March to 31st August, inclusive), are set out in the Wildlife Acts. Any removal of vegetation within this period will require the supervision of a suitably qualified and experienced ecologist to ensure no breeding birds are present. As part of the landscaping of the site, trees, shrubs, a hedgerow and a wildflower meadow will be planted (Appendix 4.6, Drawing No. L-PP-01 (Planting Plan). This will provide nesting and feeding opportunities for birds.

The mitigation prescribed for bats with regard to lighting (above) is considered more than adequate to eliminate any risk of significant direct and indirect lighting impacts on birds during the construction of the proposed development.

Bird-friendly glass (e.g. www.ornilux.com), which will reduce the reflectivity of glass facades and windows, will be used on all buildings.

7.9 Residual Impacts on Key Ecological Receptors

Table 7.16 Assessment of the Residual Impacts Scale and Significance based on EPA (2017) and TII (2009)

Key Ecological Receptor	Pre-Mitigation Impacts	Ecological Significance Following Mitigation
Key Ecological Receptor 1 Mudflats and Benthic Habitats	• Direct loss of habitat; • Displacement, injury and death of fauna; • Habitat fragmentation and barrier effects; and, • Potential accidental pollution.	The direct loss of mudflat and benthic habitat cannot be mitigated for as this lies within the footprint of the proposed development. The impact of this habitat loss will be a permanent significant negative impact over a small area (as outlined in section 7.7.2). These habitats in the vicinity of the proposed development are described as having low faunal diversity (ASU, 2018) and of are no importance to wintering birds (Natura, 2016). Therefore, habitat loss is not considered to be a significant impact on 'Mudflats and Benthic Habitats' and their associated species in Wexford Harbour. The displacement of fauna around the site during construction will be a temporary moderate impact act the local scale. Within the footprint of the marina structure outside of the piles/ restraints, the benthic habitats will be unavailable for mussel farming and will remain in a natural state. This will be a potential positive impact. There will be no other residual impacts on this Key Ecological Receptor associated with the construction phase. During operation, provided all of the mitigation measures recommended are implemented in full, residual impacts are expected to be confined to temporary disturbance of sub-tidal benthic habitats and short-term disturbance of intertidal hard benthos habitats associated with construction phase activities. Long-term changes associated with the loss of soft and hard benthos will be largely offset by the provision of additional hard benthic surfaces on piles, restraints and rock-armour flora and fauna will colonise. In addition, the proposed development will contain any contaminants inside the site. Taken in total these changes can be described as a slight permanent negative impact.

Key Ecological Receptor	Pre-Mitigation Impacts	Ecological Significance Following Mitigation
Key Ecological Receptor 2 River Slaney and Wexford Harbour waterbodies	• Direct loss of habitat; • Displacement, injury and death of fauna; • Habitat fragmentation and barrier effects; and, • Potential accidental pollution.	The direct loss of estuarine habitat cannot be mitigated for as this lies within the footprint of the proposed development. The impact of this habitat loss will be a permanent significant negative impact over a small area (as outlined in section 7.7.2). This habitat, in the vicinity of the proposed development, are described as having low faunal diversity (ASU, 2018) and of are no importance to wintering birds (Natura, 2016). Therefore, habitat loss is not considered to be a significant impact on 'River Slaney and Wexford Harbour waterbodies' and the associated species in Wexford Harbour. The displacement of fauna around the site during construction will be a temporary moderate impact at the local scale. Within the footprint of the marina structure outside of the piles/ restraints, the benthic habitats will be unavailable for mussel farming and will remain in a natural state. This will be a potential positive impact. There will be no other residual impacts on this Key Ecological Receptor associated with the construction phase. Provided all the mitigation measures recommended are implemented in full, residual impacts are expected to be confined to temporary disturbance of the estuarine habitats and short-term disturbance of intertidal hard benthos habitats associated with construction phase activities. Long-term changes associated with soft and hard benthos will be largely offset by the provision of additional hard benthic surfaces on piles, restraints and rock-armour which flora and fauna will colonise. In addition, the proposed development will contain any contaminants inside the site. Taken in total these changes can be described as a slight permanent negative impact.
Key Ecological Receptor 3 Migratory Fish	• Habitat fragmentation and direct mortality; and, • Potential accidental pollution.	No significant residual impact on this Key Ecological Receptor at any scale.

Key Ecological Receptor	Pre-Mitigation Impacts	Ecological Significance Following Mitigation
Key Ecological Receptor 4 Otter	• Habitat Fragmentation and barrier effects.	No significant residual impact on this Key Ecological Receptor at any scale.
Key Ecological Receptor 5 Marine Mammals	• Habitat loss and barrier effects. • Injury	No significant residual impact on this Key Ecological Receptor at any scale.
Key Ecological Receptor 6 Bats	• Habitat loss and barrier effects.	Habitat loss as a result of lighting and vegetation removal will constitute a permanent slight negative impact at the local scale. No significant residual impact on this Key Ecological Receptor at any scale.
Key Ecological Receptor 7 Invasive Species	• Construction and operation of the development may lead to the spread of invasive species.	No significant residual impact on this Key Ecological Receptor at any scale.
Key Ecological Receptor 8 Birds	• Direct Mortality through collision. • Habitat Loss	No significant residual impact on this Key Ecological Receptor at any scale.

7.10 Assessment of Cumulative Effects

Cumulative effects are impacts that result from incremental changes caused by other existing or proposed plans or projects, together with the Trinity Wharf Development. Cumulative impacts were assessed within a 1km buffer of the Slaney Estuary as far upstream as Ferrycarrig Bridge. An online planning search was also carried out for plans and projects within Wexford Town and the wider area within 15km of the proposed development for plans and projects which could have pathways for cumulative impacts to occur.

This assessment has considered cumulative impacts that are:

(a) Likely;

(b) Significant; and,

(c) Relating to a future event, reasonably foreseeable.

The cumulative assessment evaluates the additional change resulting from the Trinity Wharf Development in relation to the theoretical baseline scenario. None of the developments identified during the cumulative assessment were determined to result in significant adverse cumulative effects with regard to biodiversity, as described in Chapter 17: Inter-relationships, Major Accidents and Cumulative Effects.

7.11 Ecological Enhancements

Current planning policy requires that proposed developments minimise ecological damage and should contain elements of ecological enhancement where possible. Action 1.1.3 of the National Biodiversity Action Plan 2017-2021 states that "*all Public Authorities and private sector bodies move towards no net loss of biodiversity through strategies, planning, mitigation measures, appropriate offsetting and/or investment in Blue-Green infrastructure*". The following ecological enhancements are proposed as part of the proposed development:

- The Landscape Planting Plan (Appendix 4.6 Drawing No. L-PP-01 (Planting Plan)) has been cognisant of pollinators and includes a wildflower meadow and pollinator friendly trees and shrubs. All buildings will have blue-green roofs which includes drifts of native pollinator friendly species.
- Eight No. 17A Schwegler Swift Nest Boxes (triple cavity) will be incorporated into the development. These will be positioned on the north faces of the buildings out of the prevailing wind and at least 4.5m high. The type and position should be confirmed by the Project Ecologist. *Notes on the Common Swift and Setting up nest boxes* (Linda Huxley, 2014) provides guidance on setting up swift boxes.
- Ten bird boxes will be placed around the site. These should include boxes for a variety of species and should be placed out of direct sunlight and the prevailing wind. The positioning of the bird boxes should be decided by the Project Ecologist.
- Blue-green roofs may act as an enhancement measure by providing new nesting habitat for ground nesting birds such a ringed plover, lapwing, skylark, and terns.
- The construction of the marina will prevent potential mussel farming in approximately 25,000m^2 of sea bed (not including a buffer) which is not currently licensed. This will improve the quality of the benthic habitat in this area in the long term.
- The floating breakwaters will provide additional roosting habitat for wintering birds.
- Signage with information relating to the biodiversity of Wexford Harbour will be installed at the proposed development location to encourage an understanding and respect for the natural environment of the area. This will refer specifically to disturbance by boats and loose dogs.

7.12 Conclusions

This chapter has assessed the ecological impacts of the construction and operation of the Trinity Wharf Development. The assessment described herein has examined the receiving natural environment and identified the Key Ecological Receptors likely to be impacted upon by the proposed development, namely the Mudflats and Benthic habitats, River Slaney/Wexford Harbour waterbody, Migratory Fish, Otter, Marine Mammals, Bats, Invasive Species and Birds. Each Key Ecological Receptor was characterised in terms of its conservation value on a geographical scale. The chapter has analysed the potential impacts of the proposed development on these Key Ecological Receptors and characterised their likely effects in terms of their magnitude, extent, duration, frequency and reversibility, thereby determining their significance on a geographical scale.

Two of the Key Ecological Receptors, Mudflats and Benthic Habitats, and, the River Slaney/ Wexford Harbour waterbody, were considered to have impacts following mitigation relating to direct habitat loss within the footprint of the proposed development. These impacts are not considered to be significant.

The Natura Impact Statement concluded, in view of best scientific knowledge and the Conservation Objectives of European sites, that the proposed development, either individually or in combination with other plans or proposed developments, will not adversely affect the integrity of any European site.

Provided that the development proposed in the Trinity Wharf Development is constructed and operated in accordance with best practice guidelines and the mitigation measures described, there will be no significant negative impacts on the ecology of the Zone of Influence at the international, national or county level.

The loss of mudflats and benthic habitats is significant at the local scale; however, this impact is mitigated by the fact that these habitats are of low quality and the new hard surfaces will increase the diversity in the local area. In addition, the release of contaminants from the existing site will be prevented by the new outer sea wall. Therefore, the favourable conservation status of these Annex I habitats will not be compromised.

There are no other residual effects likely to be significant at the local, county, national or international level.

Furthermore, the assessment found no significant impacts arising from the cumulation of the impacts from the proposed development with the impacts from other existing or approved developments.

Following consideration of the residual (post-mitigation) impacts, it is noted that the proposed Trinity Wharf Development will not result in any significant impacts on any of the identified Key Ecological Receptors.

7.13 References

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Appendix 7.1 Marine Benthic Study

ROD
ROUGHAN & O'DONOVAN

Trinity Wharf Marina Development

Marine Benthic Assessment

(October 2018)

Commissioned by: RPS Group
Carried out by: Aquatic Service Unit, UCC.
November 2018

1 Introduction & Brief

Aquatic Services Unit were requested by RPS Group to undertake a marine benthic assessment of the subtidal and intertidal communities within the area of proposed marina development at Trinity Wharf, Wexford.

2 Methodology

2.1 Soft Benthos Survey

2.1.1 Soft Sediment Sampling

A total of 15 samples were collected in Trinity Wharf. 12 samples were collected from the subtidal area using a 0.1m^2 stainless steel Van Veen grab. 3 samples were collected from the intertidal area using a 0.028m^2 stove pipe core. All samples were collected on the 24th October, 2018. Pre-determined sampling positions were navigated to and once on site, the precise location of each sampling station was collected using a Trimble Geo-XM GPS. A full list of the stations sampled are presented in Table I and these stations are displayed on a map (Figure 1).

	Easting (m)	Northing (m)		Easting (m)	Northing (m)
Wexford_01 (c)	705596.4	621176.2	Wexford_09 (g)	705371.8	621478.7
Wexford_02 (c)	705622.2	621218.5	Wexford_10 (g)	705429.6	621474.3
Wexford_03 (g)	705666.3	621292.1	Wexford_11 (g)	705488.9	621474.6
Wexford_04 (g)	705648.1	621347.5	Wexford_12 (g)	705452.3	621531.4
Wexford_05 (g)	705590.8	621374.5	Wexford_13 (g)	705382.6	621527.7
Wexford_06 (g)	705543.0	621423.3	Wexford_14 (g)	705306.0	621620.1
Wexford_07 (g)	705449.8	621458.0	Wexford_15 (g)	705680.9	621441.4
Wexford_08 (c)	705384.1	621380.6			

Table I: Positions of sub-tidal soft sediment sampling stations. All positions are provided in Irish Transverse Mercator (ITM). (g – Subtidal grabs; c – Intertidal cores)

At each sediment station:

- 1 x 0.1m^2 Van-Veen grab taken for benthic faunal analysis (12 Stations).
  or
- 1 x 0.028m^2 Stove pipe core, taken to a depth of 20cm.

- 1 x 0.1m^2 Van-Veen grab from which a small amount of sediment was retained for Particle Size Analysis and Loss on Ignition Analysis (10 stations) - Two stations were unsuitable for detailed particle size analysis as the sediment consisted primarily of live mussels (Wexford S11) or Mussel/gravel (Wexford S06)
  or
- A surface scrape of sediment (3 Stations)

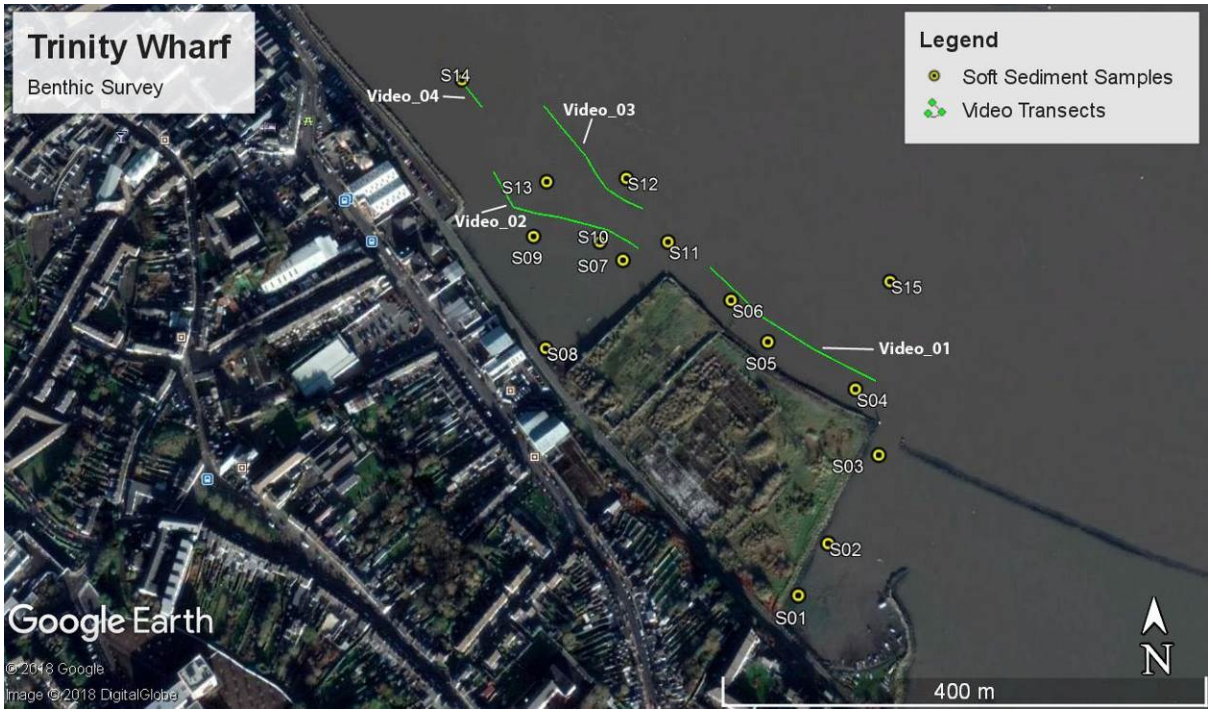

Figure 1: Map showing the positions of sediment samples (yellow dots) and video transects (green lines).

All samples were processed within 24 hours of collection. Samples were sieved through a 1mm mesh sieve and preserved in 4% formalin (buffered with sea water). All fauna were identified to the lowest taxonomic level possible using standard keys to north-west European fauna by specialist taxonomists.

A number of biotic indices were calculated from the species / abundance matrix from the benthic samples. Epifaunal taxa marked present/absent were removed from this analysis. These indices included Simpson's Dominance Index (where values range from low dominance [0] to high dominance [1]), Shannon-Wiener Diversity Index (Values ranging from low diversity [0] to high diversity [4]) and Pielou's Evenness Index (values ranging from low i.e. dominated by a few species [0] to high evenness i.e. a more even spread of species [1]).

Granulometric Analysis

Granulometric analysis was carried out on oven dried sediment samples from each station using the protocols described by Holme & McIntyre (1984). The sediment was passed through a series of nested brass test sieves with the aid of a mechanical shaker. The sediments were analysed to determine three fractions: % Gravel (>2mm), % Sand (<2.0mm >63µm) and % Silt-Clay (<63µm).

Organic Matter Analysis

Organic matter was estimated using the Loss on Ignition (LOI) method. One gram of dried sediment was ashed at 450˚C for 6 hours and organic carbon was calculated as % sediment weight loss.

2.1.2 Subtidal Video Survey

Four video transects were undertaken within, and adjacent to, the footprint of the proposed marina development. Fieldwork was carried out on the 24th October 2018. The precise location of each sampling station was collected using a Trimble Geo-XM GPS. A complete list of stations sampled are presented in Table II and these stations are displayed on a map (Figure 1).

Station	Co-ordinates (ITM)		Station	Co-ordinates (ITM)	
	Easting (m)	Northing (m)		Easting (m)	Northing (m)
	In			Out	
Vid_01	705536.7	621451.9	Vid_01	705621.4	621361.8
Vid_02	705343.1	621538.9	Vid_02	705461.1	621472.7
Vid_03	705375.9	621591.6	Vid_03	705463.2	621507.8
Vid_04	705305.1	621623.4	Vid_04	705322.0	621609.4

Table II: Positions of shallow water sub-tidal video survey stations. All locations given in Irish National Grid.

A total of 4 stations were sampled using a drop down video camera system. Data was recorded as MPEG4 format files. At each station a single recording was taken at each location. The video camera was lowered to above the sediment surface, and video imagery was recorded.

2.1.3 Intertidal Survey

The rocky intertidal shores in and adjacent to the Trinity Wharf development were assessed during a walkover survey on November 8th 2018 during low spring tide. During the survey, the weather was mostly dry with little or no wind. The area surveyed is within the Slaney River Valley SAC although none of the hard benthic habitats surveyed are included in the sites Conservation Objectives falling instead into the general habitat type ‘Estuaries’.

3 Results

3.1 Soft Sediment Benthos

3.1.1 Particle Size and Loss on Ignition Assessment

Results from the sediment grainsize analysis indicates the subtidal area is dominated by muddy shell gravel, consisting primarily of mussel shell and muds. The intertidal areas located adjacent to the Trinity Wharf consist of soft muds (Fig. 2 & Table III)

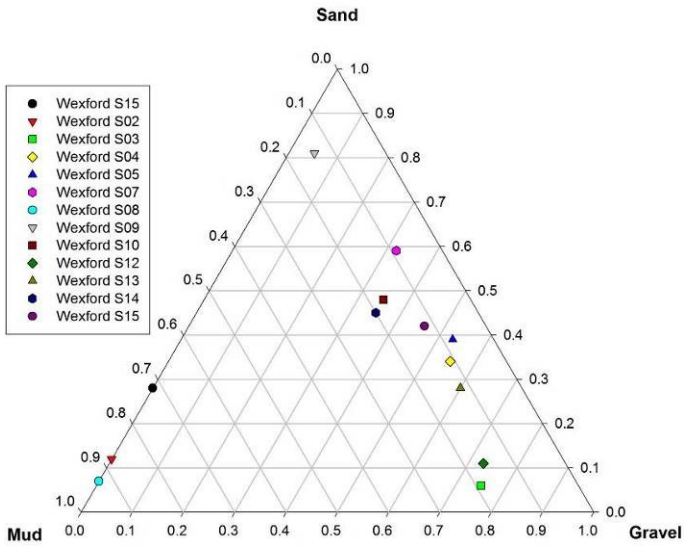

Figure 2: Ternary Plot of granulometric results from Trinity Wharf.

	Wexford_01	Wexford_02	Wexford_03	Wexford_04	Wexford_05
% Gravel	0.1%	0.1%	75.3%	55.8%	52.9%
% Sand	27.6%	11.9%	6.1%	33.5%	38.7%
% Mud	72.3%	88.0%	18.6%	10.7%	8.4%
% LOI	8.17%	10.53%	5.70%	2.05%	2.57%
Textural Group	Sandy Mud	Sandy Mud	Muddy Gravel	Muddy Sandy Gravel	Muddy Sandy Gravel
	Wexford_06	**Wexford_07**	**Wexford_08**	**Wexford_09**	**Wexford_10**
% Gravel	100%	31.8%	0.0%	4.7%	34.8%
% Sand	0%	59.2%	7.3%	81.7%	48.2%
% Mud	0%	9.0%	92.7%	13.6%	17.0%
% LOI	No Sample	1.40%	10.73%	1.73%	4.39%
Textural Group	Gravel*	Muddy Gravelly Sand	Mud	Slightly Gravelly Muddy Sand	Gravelly Muddy Sand
	Wexford_11	**Wexford_12**	**Wexford_13**	**Wexford_14**	**Wexford_15**
% Gravel	N/A	73.6%	60.7%	35.2%	45.8%
% Sand	N/A	10.6%	27.8%	44.9%	42.4%
% Mud	N/A	15.8%	11.5%	19.9%	11.8%
% LOI	No Sample	3.64%	2.80%	1.56%	1.59%
Textural Group	Live Mussels*	Muddy Gravel	Muddy Sandy Gravel	Muddy Gravelly Sand	Muddy Sandy Gravel

Table III Granulometric and Loss on Ignition results from samples taken within the survey area adjacent to Trinity Wharf. * Indicates no grainsize and LOI sample was collected at this site

3.1.2 Infaunal Assessment

A total of 38 taxa were recorded in the benthic samples collected from Trinity Wharf (Table IV & Table V). The highest number of species were recorded at Wexford_06 (19 taxa) and the highest numbers of individuals were recorded at Wexford_03 (1,400 individuals) and Wexford_13 (1,140 individuals). The lowest numbers and diversity were recorded at the intertidal stations; Wexford_01 (2 taxa, 2 individuals), Wexford_02 (1 taxa, 1 individual) and Wexford_08 (1 taxa, 1 individual).

All species identified in the present survey (Table V) are typical of shallow subtidal communities, and all are common in Irish coastal waters. The oligochaetes *Tubificoides benedii* (12 sites) & *Tubificoides pseudogaster* (11 sites), the polychaetes *Tharyx* sp. A (12 sites), *Streblospio shrubsolii* (11 sites), *Nereis diversicolor* (11 sites) & *Polydora cornuta* (10 sites) and the amphipod *Melita dentata* (11 stations) were present in most subtidal stations. The mollusc *Mytilus edulis* was present in 9 sites, although it was present in high numbers (≥50) at only 2 stations; Wexford_S11 returned 232 mussels and Wexford_S13 returned 50 mussels.

	Wexford_01	Wexford_02	Wexford_03	Wexford_04	Wexford_05	Wexford_06	Wexford_07	Wexford_08
No. of Species	2	1	13	13	14	19	9	1
No. of Individuals	2	1	1400	1150	911	226	117	1
Shannon-Wiener	0.693	0	1.89	1.96	2.08	2.26	1.68	0
Pielou's Evenness	1	****	0.739	0.765	0.79	0.767	0.764	****
Simpson's Dominance	0.5	1	0.193	0.17	0.148	0.145	0.24	1

	Wexford_09	Wexford_10	Wexford_11	Wexford_12	Wexford_13	Wexford_14	Wexford_15
No. of Species	3	6	8	15	15	16	16
No. of Individuals	5	7	477	450	1140	750	456
Shannon-Wiener	1.05	1.75	1.14	2.01	2.02	1.47	1.94
Pielou's Evenness	0.96	0.976	0.55	0.744	0.745	0.529	0.699
Simpson's Dominance	0.36	0.184	0.391	0.166	0.17	0.353	0.212

Table IV Diversity indices derived from the benthic samples collected from the survey area.

Table V: Species / abundance matrix for fauna identified within the survey area at Trinity Wharf.

	S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	S13	S14	S15
Tharyx sp. A	-	-	144	252	64	4	41	-	2	1	4	56	24	418	168
Tubificoides benedii	-	-	204	284	208	14	12	-	2	2	2	12	184	114	42
Melita dentata	-	1	-	40	40	62	1	1	1	-	183	112	276	32	22
Nereis diversicolor	-	-	108	36	8	5	6	-	-	1	6	6	28	73	8
Streblospio shrubsolii	-	-	168	132	152	34	35	-	-	1	6	72	64	53	20
Tubificoides pseudogaster	-	-	492	184	124	8	13	-	-	1	5	42	292	38	16
Polydora cornuta	-	-	152	152	160	19	3	-	-	-	39	100	100	11	104
Mytilus edulis	-	-	6	12	35	35	-	-	-	-	232	2	50	3	18
Nereis virens	-	-	16	4	4	3	-	-	-	1	-	-	28	1	2
Carcinus maenas	-	-	2	5	7	1	-	-	-	-	-	1	5	-	5
Spirobranchus lamarcki	-	-	-	16	4	21	-	-	-	-	-	26	4	1	40
Heterochaeta costata	1	-	92	28	92	7	-	-	-	-	-	10	82	-	-
Cerastoderma edule	-	-	2	1	-	-	2	-	-	-	-	1	1	-	1
Microdeutopus versiculatus	-	-	-	-	12	4	-	-	-	-	-	6	-	-	4
Parvicardium exiguum	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-
Mya truncata	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-
Harmothoe indet.	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-
Sthenelais boa	-	-	4	-	-	-	-	-	-	-	-	2	-	-	-
Eteone longa	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2
Heteromastus filiformis	-	-	8	-	-	1	-	-	-	-	-	-	-	-	-
Janira maculosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Hyas araneus	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Pisidia longicornis	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Crangon crangon	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Pomatoschistus minutus	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Sphaeroma serratum	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Corophium volutator	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Lepidonotus squamatus	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Glycera alba	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Autolytus langerhansi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Malacoceros vulgaris	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Capitella capitata (complex)	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-

	S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	S13	S14	S15
Paranais litoralis	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Semibalanus balanoides	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Elminius modestus	-	-	P	-	-	-	-	-	-	-	-	-	P	-	P
Balanus crenatus	-	-	P	-	P	P	-	-	-	-	-	P	P	-	P
Membranoptera alata	-	-	-	-	-	P	-	-	-	-	-	P	-	-	P
Flustra foliacea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P

3.1.3 Video Assessment

Drop 1:

A large mussel bed is present across large parts of the video transect (Plate 1 – a & d). These beds consist of live mussels in muddy sand/sandy mud. Occasional areas of shell gravel are present across the transect (Plate 1 – b & c)

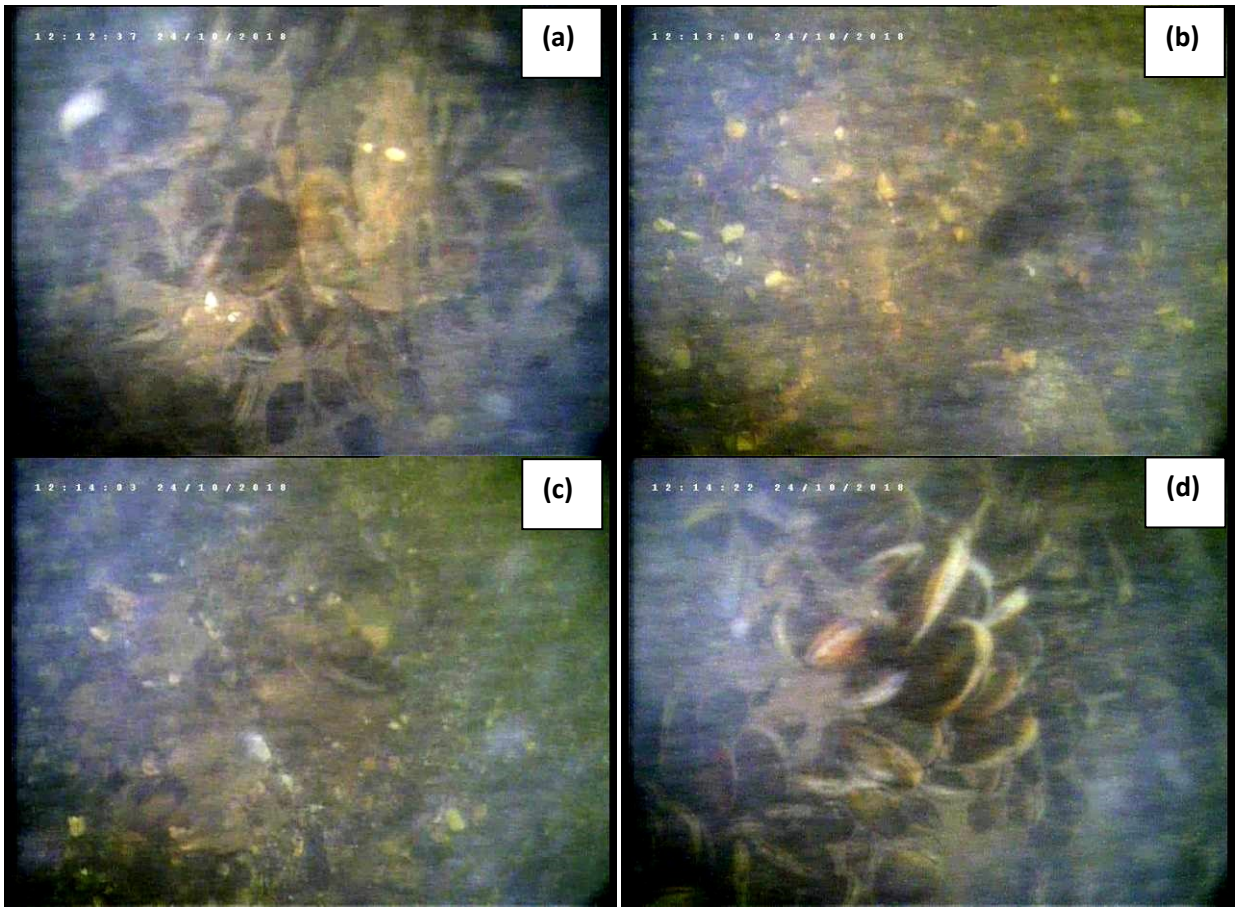

Plate 1: Video frame grabs from Video Transect 1. (a) Live mussels with a common shore crab *Carcinus maenas* present. (b) Shell gravel in muddy sand matrix. (c) Shell gravel with occasional live mussel present in muddy sand matrix. (d) Live mussels.

Drop 2:

Coarse and shell gravel sediment dominates this transect, with a thin layer of fine sediment visible on the surface of the gravel. Occasional live mussels are presetn in the area, and dead mussel shells are present within the gravel matrix.

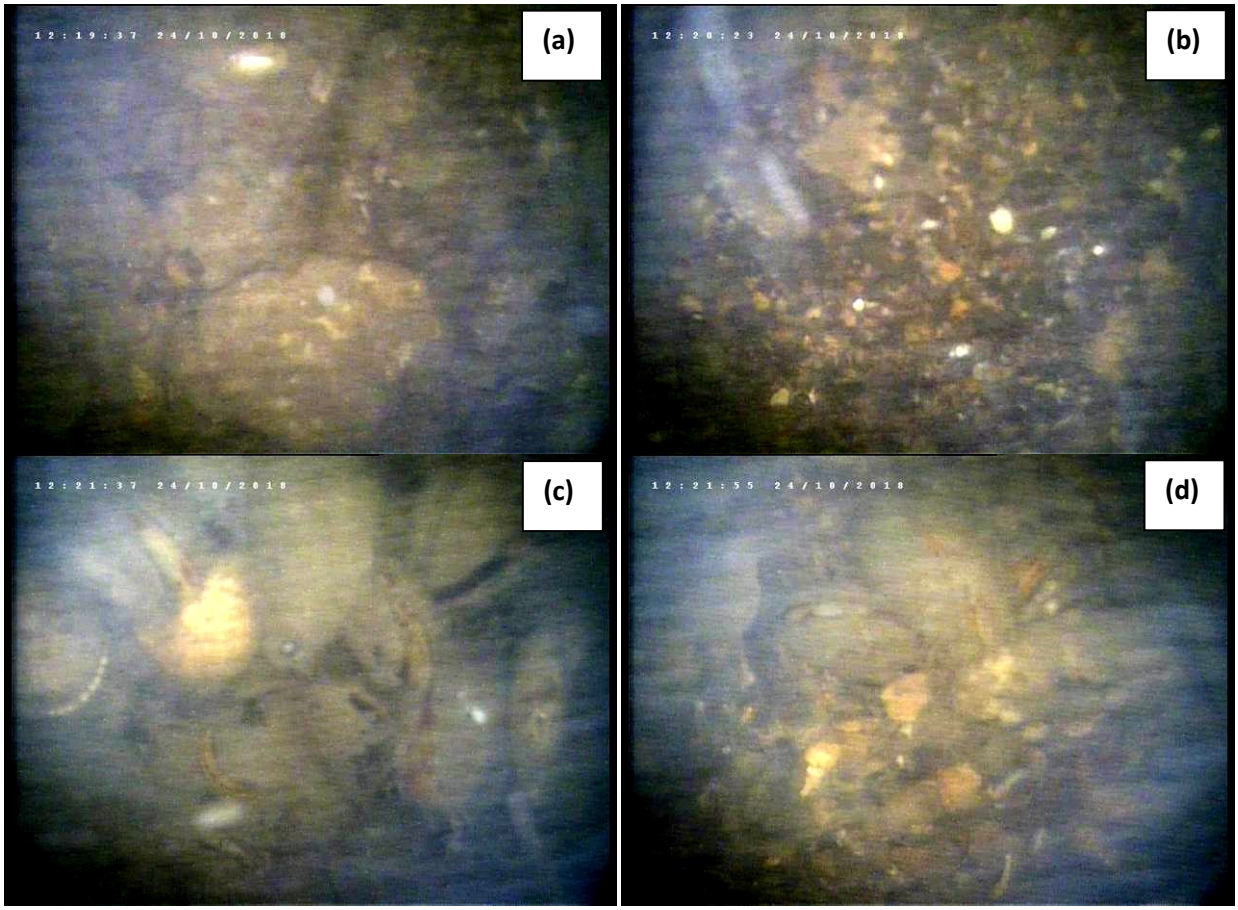

Plate 2: Video frame grabs from Video Transect 2. (a) – Coarse gravel with epifauna – keelworms (*Spirobranchis lamarcki*) and barnacles. (b) Shell gravel in muddy sand matrix. (c) Live mussels in sandy mud. (d) Live mussels in shell gravel and sandy mud.

Drop 3:

The area consists of live mussels interspersed with shell gravel and coarse gravel.

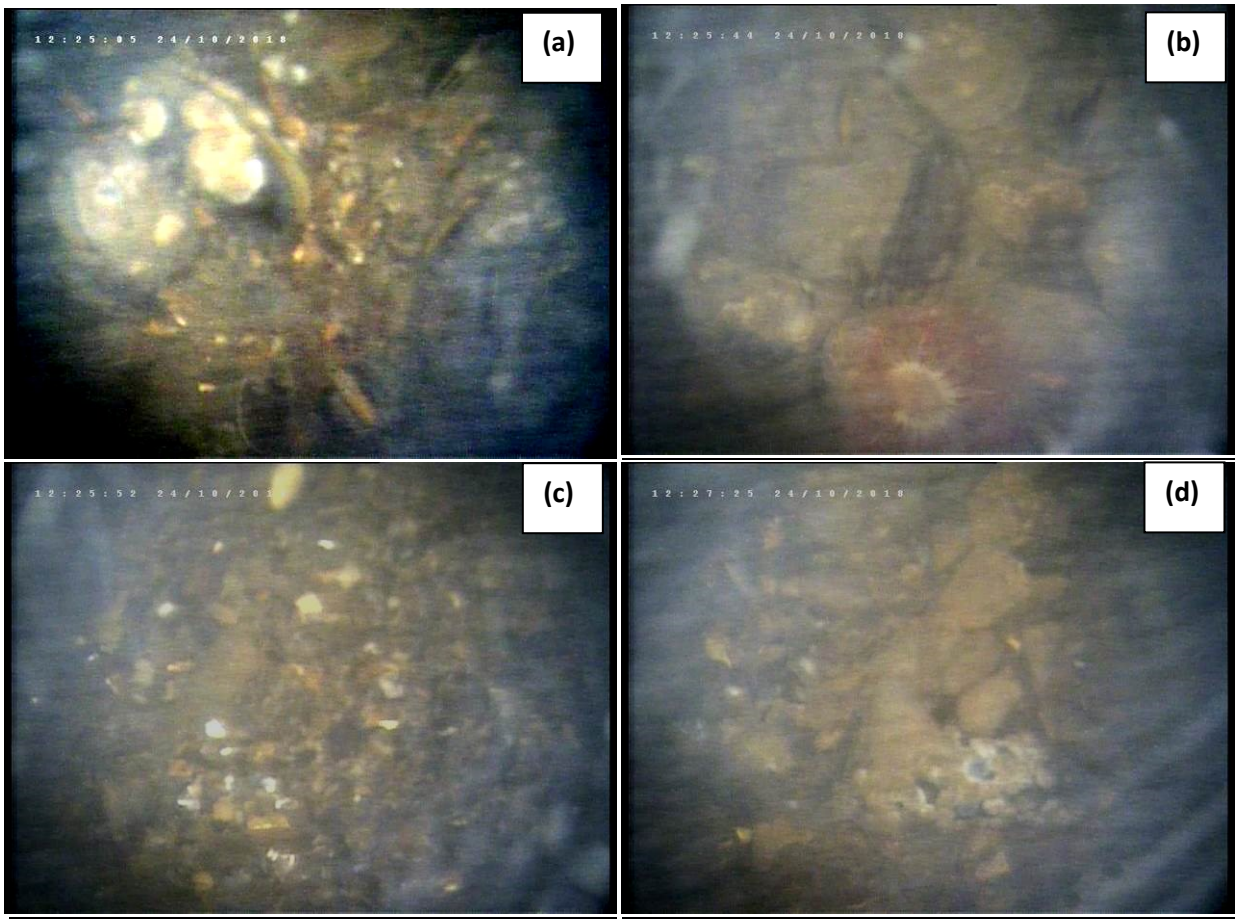

Plate 3: Video frame grabs from Video Transect 3. (a) – Live mussels with barnacles (possibly *E. modestus*) in coarse gravel on muddy sand. (b) Coarse gravel with anemones, possibly *Haliplanella lineata*, in a muddy sand matrix. (c) Shell gravel present in muddy sand matrix. (d) Coarse gravel with barnacles and keelworm present on hard surfaces.

Drop 4:

The area consists primarily of shell gravel in a muddy sand sediment. Occasional live mussels were identified in parts.

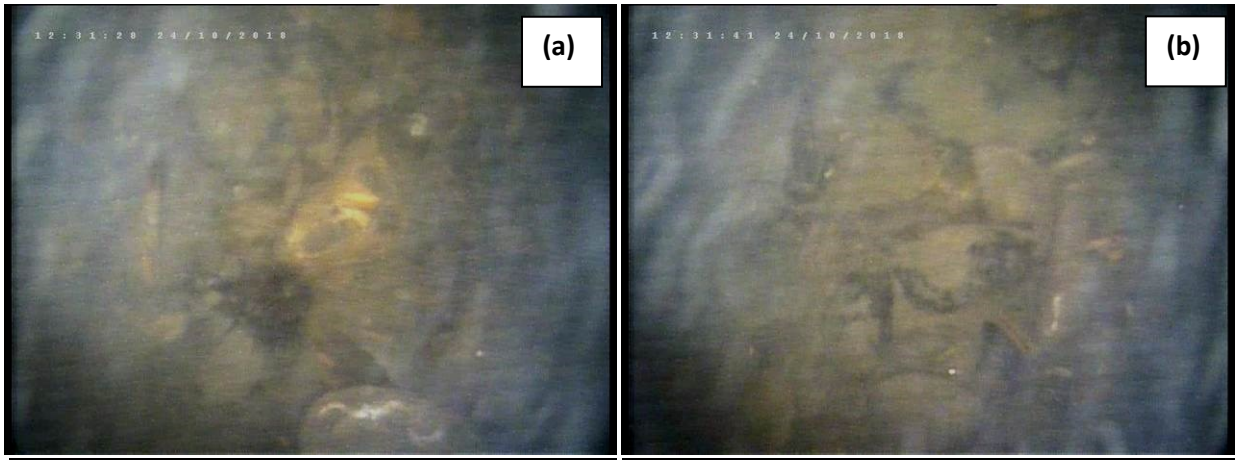

Plate 4: Video frame grabs from Video Transect 4. (a) – Coarse gravel with keelworms (*S. lamarcki*) and barnacles. (b) Coarse gravel in muddy sand matrix.

3.1.4 Habitat Assessment

Surveys by NPWS identified a single faunal community in the vicinity of the Trinity Wharf complex. This '*Estuarine muds dominated by polychaetes and crustaceans community complex*' is recorded along the shore from Ferrycarrig Bridge to Wexford Bridge and covers 1,269ha of subtidal benthos within the SAC. It also identified a Mixed sediment community complex along the northern parts of Wexford Harbour, and this makes up 200ha of the subtidal benthos within the SAC (NPWS, 2011).

Additional surveys undertaken in 2005 and 2007 (Aquafact 2007) which reported similar species and abundances to those identified in the present survey. This highlights the relatively stable nature of the benthos in this area. In addition, intertidal samples collected from the mudflats immediately adjacent to Trinity Wharf returned little or no fauna, which is reflected in the present survey.

The benthos in the vicinity of the proposed development consists primarily of mixed sediments, dominated by shell and coarse gravels. Occasional patches of mussels are present in the area, and mussels were present in 9 of the 12 subtidal sampling locations. However, it should be noted that large number of mussels were present at only 1 location indicating the scattered nature of these mussel aggregations. This is confirmed in the video data which highlights the presence of scattered clusters of mussels interspersed with shell gravel on muddy sands / sandy muds.

The subtidal community identified in the survey area conforms well to the Estuarine mud complex, although there are also elements of the mixed sediment community complex present. This agrees with NPWS findings on the distribution of this community complex within Wexford Harbour (NPWS 2011).

The soft sediment intertidal community is typified by low faunal densities and diversity at all intertidal sites. The sediment consists of fine muds, with diatoms present on the sediment surface. Bird tracks were present on site during the time of sampling.

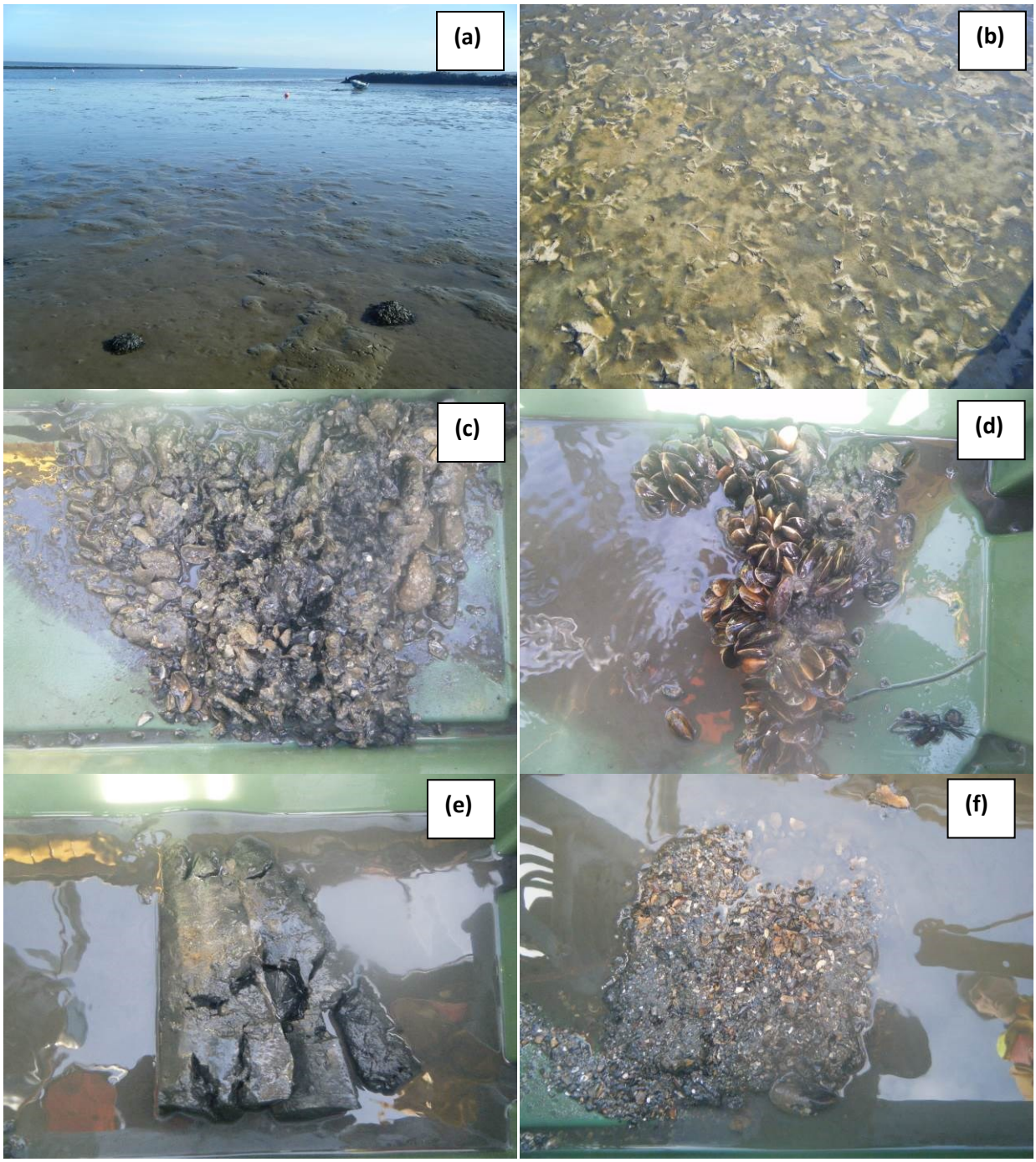

Plate 5: (a) View of the soft sediment flats located adjacent to the South Easter wall of Trinity Wharf; (b) View of the sediment surface at Wexford_S08; (c) Shell gravel from Wexford_S03; (d) Wexford_S11 showing grab full of live mussels; (e) Sediment taken at Wexford_S10; (f) Muddy Shell gravel from Wexford_S14.

3.2 Intertidal Hard Benthos

The survey area can be divided into 3 areas for convenience (i) the small boat harbour to the south, (ii) the main reclaimed Trinity Wharf area in the centre and (iii) the Wexford town shore to the north of the survey area (Figure 3).

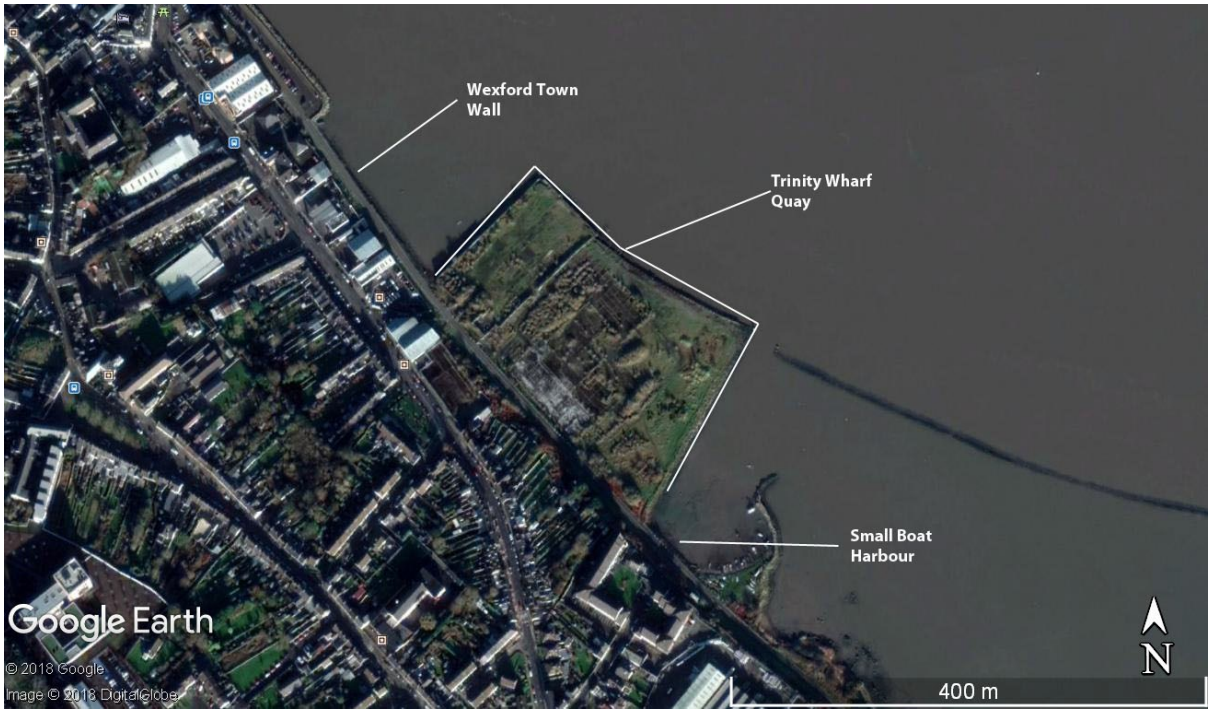

Figure 3: Map showing indicative locations for the Intertidal Hard Benthos survey.

3.2.1 Southern Boat Harbour

This small embayment is bounded to the south and east by a crescent-shaped rock-armour breakwater, to the west by the railway embankment and to the north by the Trinity Wharf southern shore (Plate 6a). The outside of breakwater which faces south and east comprises an upper shore and supra-littoral of mainly bare rock armour elements with a scattered grey and yellow lichen zone, below which is a short shore dominated by fucoid seaweed, mainly *Ascophyllum nodosum* with scattered epiphytic *Polysiphonia lanosa*, some scattered *Fucus vesiculosus* and at the base of the shore some *Fucus serratus* (Plate 6b). On the border between the fucoid dominated zone and the mainly bare rock of the supralittoral, there are scattered stunted plants of *Pelvetia canaliculata* and *Fucus spiralis* and above these are scattered rock armour elements with a light covering of *Ulva intestinalis*. In the mid to lower shore there is a patchy understorey of reds such are *Rhodothamniella floridula*, *Gelidium, Hlidenbrandia* and *Mastocarpus stellatus* (Plate 6c). The faunal diversity was very low with scattered or locally dense barnacle cover dominated by *Elminius modestus* and with very occasional *Littorina obtusata/mariae* and scattered large blue mussels (*Mytilus edulis*) between large cobbles/rock armour. Inside the harbour the breakwater was above the tidal level and associated mainly with higher plants typical of marine areas including sea beet rock samphire, sea aster and red fescue (Plate 6d). On the western side of the harbour the shore was bounded above by the railway embankment with a short intertidal dominated by the sloped stone of the embankment at the base followed by scattered cobble on muddy gravel merging seaward into soft flocculent mud. This shore was dominated by *Ulva intestinalis,* especially toward the upper part of the shore and by scattered clumps of *F. spiralis*, *F. vesiculosus* and *Ascophyllum*

larger substrate elements (Plate 6e). The shore was very silted and the dominance of *Ulva intestinalis* points to a freshwater influence from the embankment.

3.2.2 Trinity Wharf Quay

The large reclaimed area of land which will form the terrestrial footprint of the proposed development is here referred to as the Trinity Wharf quay for ease of presentation. The southern shore of the Trinity Wharf quay forms the northern shore of the small southern harbour. It comprises a low narrow shore of dilapidated stone and rock armour elements about 3-5m wide merging into the main muddy sand area of the southern harbour (Plate 7a). The upper section of the shore has a loose scattered grey and yellow lichen zone merging abruptly into a fucoid covered shore dominated by *Ascophyllum* cover with scattered *P. lanosa* and a lesser amount *of Fucus vesiculosus*. Apart from *E. modestus* barnacles no intertidal fauna was in evidence. The top of the shore merges into terrestrial habitat with sea beet, sea spurrey, sea aster and red fescue.

The longer eastern side of the Trinity Wharf quay consists mainly of a vertical concrete wall, which in places toward the southern end is breached by what appear to be small solidified concrete slopes (Plate 7b). The lower 1-2m of wall is dominated by fucoid seaweed either dropping immediately into the shallow subtidal or extending for about 2m horizontally to the subtidal. At the top of the vegetated zone zone *F. spiralis*, formed a very narrow 'zone' followed below by *F. vesiculosus* and *Ascophyllum* covering most of the shore's substrate and with a small scattered zone of *F. serratus* at the base as the shore merges into the shallow subtidal. In crevices in the upper part of the shore there were very occasional small pockets of the red alga *Catenella caespitosa*, and occasional patches of the encrusting *Hildenbrandia rubra* (Plate 7c) Below this there were patches of *Rhodothamniella floridula* and also large patches of *Cladophora rupestris* and *Ceramium virgatum* in places (Plate 7d). Scattered plants of *Mastocarpus stellatus* were present in the *F. serratus* zone often on silted concrete or bedrock. Fauna comprises very scattered *Littorina obtusata/mariae*, *Elminius modestus* which were locally common in patches, and hydroids epiphytic on *Ascophyllum* mainly and other fucoid seaweeds also. Some bryozoans were encrusting on *F. serratus* fronds and bedrock.

The northern shore of the Trinity Wharf quay was very similar to the eastern shore but had no horizontal extension, i.e. all of it dropped vertically into the shallow subtidal (Plate 7e). The top of the wall was concreted in places but all of the intertidal comprised cut stone, with localised gaps. The top of the intertidal had a very narrow intermittent zone of *Pelvetia* with a similarly patchy and narrow *F. spiralis* zone. The main area of the shore was dominated by *Ascophyllum* with scattered cover *of F. vesiculosus*. The understorey was very and silted and comprised patches of *Hildenbrandia*, *Rhodothamniella floridula* and barnacles (*Eminius modestus*). (Plate 7f)

3.2.3 Wexford Town Wall

The Wexford town shore to the north of the Trinity Wharf quay is faced with very large rock armour elements forming a vertical coastal barrier facing east. This drops vertically into the subtidal and is dominated in the mid to lower intertidal by *F. vesiculosus* and *Ascophyllum* with scattered clumps of *Pelvetia* and *F. spiralis* above and *F. serratus* at the water's edge (Plate 8a). The red alga, *P. lanosa* was common on *Ascophyllum* and there was a silted understorey with scattered patches of *R. floridula*, occasional plants *Ulva lactuca* and *Mastocarpus stellatus* and frequent localised clumps of blue mussels in crevices (Plate 8b). There was localised high cover values of *Elminius modestus*, which was the only barnacle recorded in this section of the intertidal.

3.2.4 Habitat Evaluation and Classification.

The shore is typical of a sheltered rocky intertidal with an estuarine influence. It is dominated by a small range of plant and animal species none of which is rare or threatened and all of which are tolerant of silty and turbid waters. The dominant habitat present is closest to the JNCC Classification of LR.LLR.FVS.AscVS (Ascophyllum nodosum and Fucus vesiculosus on variable salinity mid eulittoral rock) which is described as follows: *Very sheltered to extremely sheltered mid eulittoral bedrock, boulders or cobbles subject to variable salinity characterised by an impoverished community dominated by a mixture of the wracks Ascophyllum nodosum and Fucus vesiculosus. Underneath the canopy are a few green seaweeds including Enteromorpha intestinalis and Cladophora spp., while the red seaweed Polysiphonia lanosa can be found as an epiphyte on A. nodosum. On the rock and among the boulders are the winkles Littorina littorea and Littorina saxatilis, the crab Carcinus maenas, the barnacles Semibalanus balanoides and Elminius modestus and even the occasional mussel Mytilus edulis. Among the seaweeds and underneath the boulders a variety of gammarids can be found.*

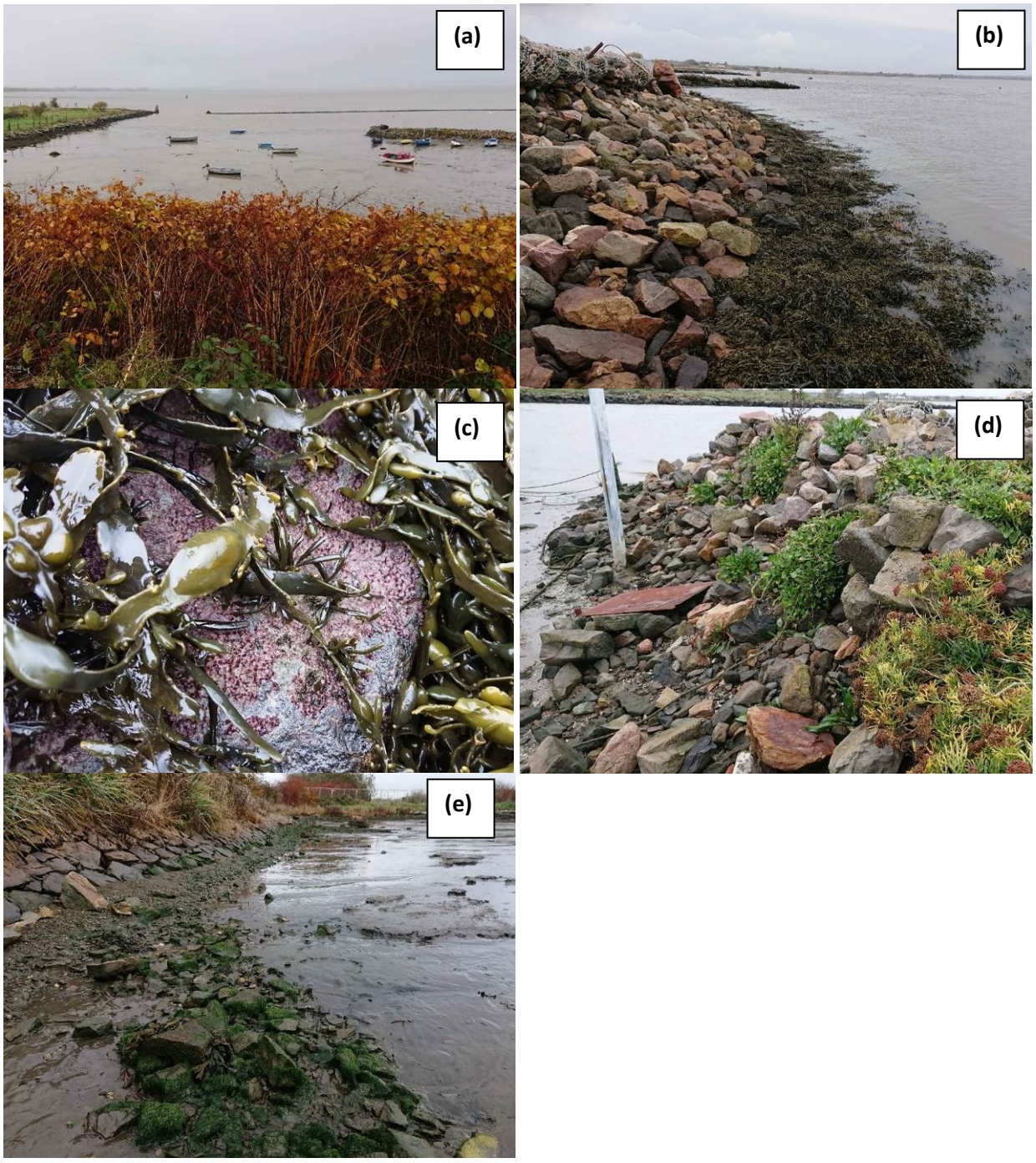

Plate 6: (a) View of southern harbour facing east with Trinity Wharf southern shore to the left and the crescent shaped breakwater on the right mid ground; (b) Outer face of crescent-shaped breakwater of southern harbour – facing north; (c) *Rhodothamniella floridula* on boulder beneath *Ascophyllum*; (d) Sea beet and rock samphire on inner side of southern harbour breakwater; (e) Heavy coating of *Ulva intestinalis* along the western side of the southern harbour.

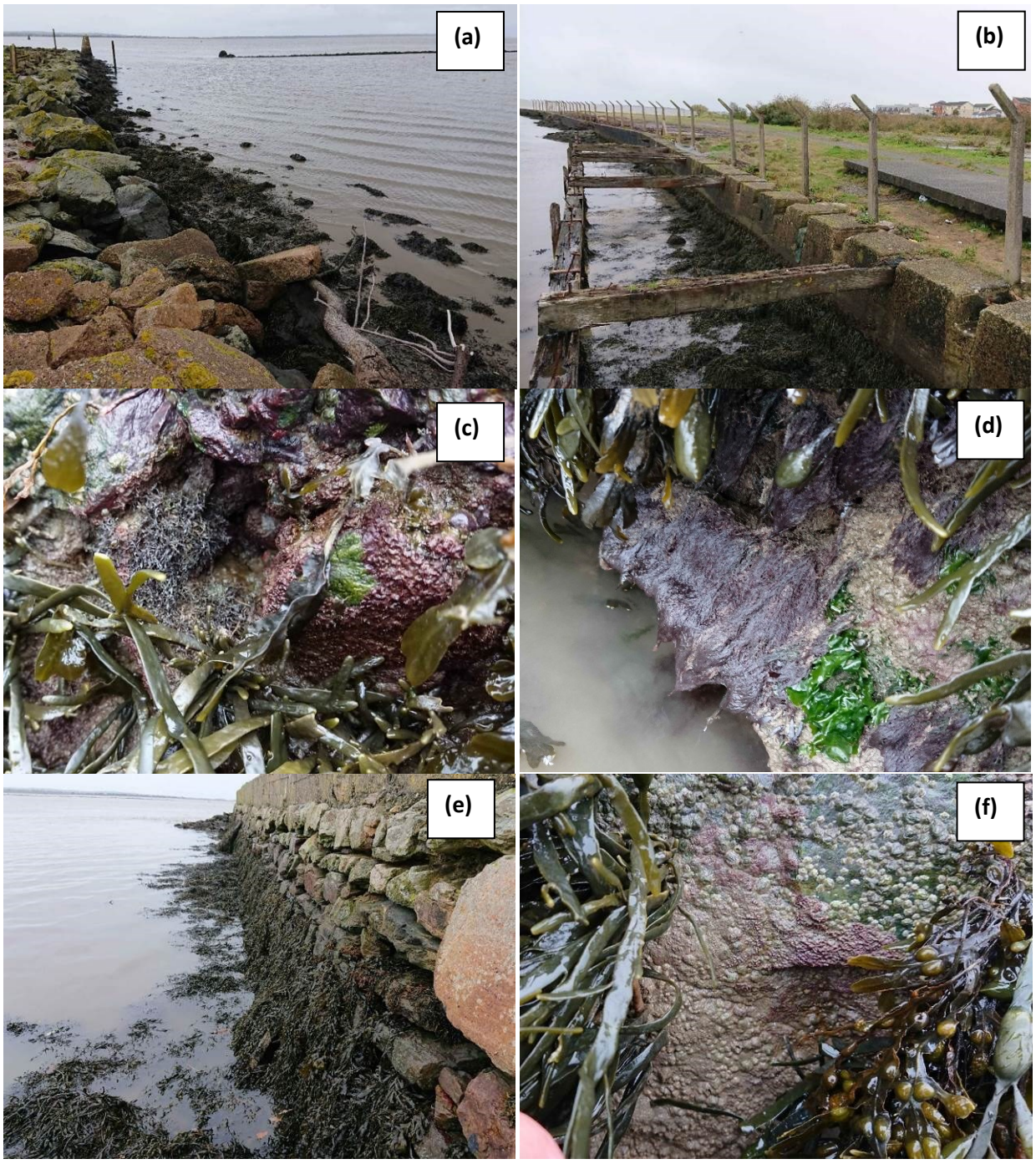

Plate 7: (a) Southern shore of trinity wharf facing east showing rock armour elements with yellow and grey lichens above and a fucoid dominated intertidal below; (b) Eastern side of Trinity Wharf looking south with concrete wall face dominated by fucoid seaweeds and with horizontal extension in places at the base; (c) *Catenella*, *Hildenbrandia*, *Rhodothamniella* and *Ascophyllum* at top of eastern quay wall; (d) *Ceramium* and *Ulva* as understorey beneath fucoid alga in lower shore of Trinity Wharf eastern shore; (e) Trinity Wharf northern shore –looking toward north eastern corner of the quay; (f) Trinity Wharf northern shore –silted understorey with red algae and barnacles.

Plate 8: (a) Wexford Town shore showing very large rock armour elements covered with fucoid seaweed in mid to lower shore – view to the north; (b) Wexford Town with mussels (*Mytilus edulis*) and barnacles (*E. modestus*) in crevices in the rock armour.

4 Impact Assessment

4.1 Relevant Characteristics of the Proposal

The proposed development at Trinity Wharf involves the construction of a *c.* 60 berth marina, with a series of floating breakwaters and the construction of a sloping revetment along parts of Trinity Wharf. A number of elements of this proposal will have potential to impact on the marine habitats within the survey area.

The floating breakwater will be anchored to the seabed using *c.* 600mm circular piles grouted into *c.* 900mm sockets. It is expected that there will 42 socket/pile combinations installed, resulting in the net loss of 26.72m^2 of subtidal benthos.

In addition, it proposes the construction of an access bridge from Trinity Wharf to Wexford Town. This will require the infilling of 582m^2 of subtidal habitat adjacent to the Northern corner of Trinity Wharf. In addition, it will require the installation of 11 steel piles with a diameter of 750mm to support the walkway along its length resulting in a loss of *c.* 4.m^2.

The Trinity Wharf quay will be strengthened around its entire northern, eastern and southern perimeters by insertion of a vertical sheet pile wall. The installation of the revetment requires the placement of 0.5T rock armouring along two stretches of Trinity Wharf. The full area of the South Eastern shoreline will be reinforced, covering an area of 1,200m^2 of intertidal habitat. A smaller area along the North West perimeter of Trinity wharf will also be reinforced, covering 330m^2 of intertidal habitat. The eastern shore will not have a rock armour facing. In addition the area to be reclaimed on the north eastern corner of the quay will be delineated by a sheet pile facing.

The proposed marina is located within the Slaney River Valley SAC (site code: 0781) and is within the priority listed habitat '*Estuaries*'. This habitat area has been estimated as 1,905ha.

4.2 Impact Assessment

4.2.1 Habitat Disturbance

The construction of the marina and associated walkway will result in the placement of 42 number 900mm diameter and 11 number 750mm piles into the seabed immediately north of Trinity Wharf. It is thought that the placement of these piles will require the use of a jack-up barge, which will need to be manoeuvred into place to facilitate the installation of the piles. This use of a jack-up barge will result in a temporary displacement of benthos during construction.

Habitat disturbance as a result of the placement of the legs from the jack-up barge will result in the temporary displacement of fauna within the direct footprint of these legs. These impacts would be considered localised with slight adverse effects on the benthos. The impacts will be temporary, with recovery occurring rapidly following the completion of all construction works.

4.2.2 Habitat Loss

The placement of piles into the seabed will result in the permanent loss of *c.* 31m^2 of subtidal benthos (26.72m^2 from the marina development and 4.2m^2 from the walkway construction). An additional 582m^2 of subtidal benthos would be reclaimed as part of the construction of the walkway. This would result in a total net loss of *c.* 0.0613ha of subtidal habitat.

The loss of this habitat would be considered permanent. However, due to the overall size and extent of the area to be impacted, in relation to similar habitat throughout the SAC, this impact is assessed as slight due to the loss of <0.005% of the overall habitat within the Slaney River Valley SAC.

The loss of soft-sediment benthos will be off-set by the creation of new hard-benthos structures to which epifauna and seaweeds will attach once the piles are inserted. This is likely to increase diversity within the area.

The replacement of all the eastern side of the Trinity Wharf quay and two thirds of the northern side with sheet piles rather than rock armour or concrete will probably reduce the density of brown seaweeds on these structures, although species such as barnacles, mussels and other encrusting fauna are likely to become more prominent along with some green and red algae such as *Ulva intestinalis* higher up and *Ceraminum, Cladophora* and other species closer to the base of the piles. These changes will be in species dominance more than in presence/absence of current species. However, some reduction in fucoid alga production is likely. This will be substantially offset by the provision of a rock armour facing along the southern shore and part of the northern shore which will considerably increase the hard substrate surface area in these areas for colonisation by brown seaweeds and associated faunal species. In addition, the placement of these rock armour revetments will result in overlay by the rock armour of a narrow strip of soft sediment of approximately 2 meters wide along the southern quay side and about 4-5 meters wide along northern quay. This will result in a change of habitat type, from soft sediment habitat with very low species diversity and abundances to hard benthos with increased levels of algae and associated epifauna once these have been recolonised. Overall, these changes are considered permanent, and slight negative.

4.2.3 Oil Leaks and Spills

There is a possibility of hydrocarbon leaks and spills associated with poorly maintained construction vehicles or during re-fuelling of plant on-site. Considering the volumes of fuel involved, and taking into consideration that a good environmental management plan will be in place, the likelihood of this happening is considered very low.

The release of hydrocarbons into the environment would have adverse effects on the benthos in the vicinity of the proposed development, resulting in the temporary removal of benthic fauna from the impacted area. Due to the volumes involved, and considering the implementation of an environmental monitoring plan and suitable mitigation, the likely extent of the effects of hydrocarbon leaks on the benthos would be localised and considered temporary and slight. Such impacts can be readily avoided however through basic mitigation.

4.2.4 Cement Spills

Cement is expected to be used on site. The circular piles required for the floating breakwater and marina will require the pouring of cement through the centre of the pile into the socket. In addition, concrete is to be poured for the capping beam to the sheet piled walls. Cement spilled into the environment would have adverse effects on the benthos in the vicinity of the proposed development, resulting in the removal of biological communities within the footprint of the affected area. The extent of this would be expected to be localised due to the low likelihood of large volumes of cement being lost in a supervised site. The impact of cement spills on the benthos has the capacity to be significant with the benthos suffering temporary to short-term effects.

4.2.5 Hydrodynamic changes

Modelling undertaken by RPS in relation to the proposed development indicate that there would be virtually no detectable impact on the tidal regime, and no significant changes in the sedimentation levels in the immediate vicinity of the proposed marina.

4.2.6 Marina operations

The mooring of up to 60 vessels has the potential to impact on the water quality in the immediate vicinity of the marina through the release of BOD and nutrients in bilge water during pump-out operations and the potential for hydrocarbon spillage during fuelling of vessels is possible without proper environmental management procedures. If this were to occur it could see a localised changes in the benthic community favouring more pollution tolerant species such as the polychaete worm *Capitella capitata*. It can classified as a moderate, negative, long-term impact, without mitigation.

4.3 Mitigation Measures

It is recommended that where feasible, any boulders, cobble or bedrock present along the Trinity Wharf shores should be included in the rock armour portion of the proposal and/ or placed at the toe of the sheet pile wall along the eastern boundary of the quay as these will re-colonise more rapidly than new rock armour and will also provide an increase in habitat diversity, especially along the eastern side of Trinity Wharf.

All plant and construction vehicles should be inspected for oil leaks on a daily basis and a full service record of all plant and machinery used should be maintained.

Measures should be made in the Environmental Management Plan prior to commencement of the project with regard the storage of fuel and lubricants for all plant and construction vehicles. All fuels, oils and lubricants should be stored in a fully bunded area in the construction site compound.

Spill kits should be made available across the site works during the course of all construction works, including on the jack-up barge during piling operations.

Vehicles and plant should be refuelled off site where possible. Where re-fuelling on-site is necessary, precautions on the re-fuelling will need to be made to ensure that no fuel is released into the environment.

Standing plant and machinery should be placed on drip-trays.

All surface run-off from the site should be directed into a hydrocarbon interceptor before discharge.

Clear construction best practice guidelines should be drawn to prevent the spilling of any concrete or fuel oil or oil-based hydraulic fluids into the marine environment during the construction phase.

All shuttering works must be securely installed and inspected for leaks prior to cement being poured. All pouring operations should be supervised monitored for spills and leaks at all times.

Fuelling of vessels should be undertaken in specially bunded areas. All fuelling equipment should be regularly inspected and serviced.

Sewage pump-out facilities should be available to all vessels which use the marina. All pump-out equipment should be regularly inspected and serviced.

5 Residual Impacts

Provided all the mitigation measures recommended are implemented in full, residual impacts are expected to be confined to temporary disturbance of sub-tidal benthic habitats and short-term disturbance of intertidal hard benthos habitats associated with construction phase activities. Long-term changes associated with soft and hard benthos will be largely offset by the provision of additional hard benthic surfaces on piles and rock-armour for fauna and flora re-colonisation. Taken in total these changes can be described as a slight negative – permanent impact.

6 Conclusion

The design of the Trinity Wharf marina is open, thereby allowing a continuation of the existing active water movement within the study area, as the footprint of permanent structures within the open water area is confined to well-spaced small diameter circular piles. The extension of the north east corner of Trinity Wharf to facilitate the construction of the suspended walkway will result in the reclamation of just over 600m^2 of soft benthos. In addition a further approximately 800m^2 of soft sediment adjoining the new rock armour revetments will be overlaid by new rock armour elements resulting in a change of habitat type from soft to hard benthos. None of these will result in an adverse impact on the integrity or functioning of the Slaney River SAC, nor will it cause any habitat fragmentation. Within that area of the SAC the only habitat designated as a Conservation Objective is Estuaries (1130) and the habitat alterations arising from the development (i.e. mainly changing from soft to hard benthos) will not change this habitat designation. During the operation phase of the development, the provision of pump-out facilities coupled with the continued good water movements at the site, will insure no significant adverse impacts from this phase of the project. Overall, therefore the proposed development can be classified as having a slight, negative, permanent impact associated with the alterations to the permanent structures associated with the developments and their effects on the benthic habitats present.

7 References

Aquafact (2007) Sublittoral Survey of a Select Area of Wexford Harbour in Relation to a Marine Development. April 2007. A Report to Deerland Construction Ltd.

Holme, N.A. and McIntyre, A.D. (1984): Methods for the Study of Marine Benthos. Second Edition IBP Handbook 16.–399 pp. Oxford-London-Boston: Blackwell Scientific Publications.

NPWS (2011) Slaney River Valley SAC (site code: 0781). Conservation objectives supporting document – marine habitats and species. Version 1, August 2011.

Appendix 7.2 Bird Survey Report

ROD
ROUGHAN & O'DONOVAN

TRINITY WHARF WEXFORD HARBOUR

WINTER BIRD SURVEYS 2015/16

DRAFT REPORT

March 2016

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1. INTRODUCTION

Natura Environmental Consultants was commissioned by Wexford County Council to carry out a survey of waterbirds in the vicinity of Trinity Wharf, Wexford Town during the winter 2015/16. The area below High Water Mark is included within the Wexford Harbour and Slobs Special Protection Area (SPA) is legislated for under the Birds Directive (Council Directive 79/409/EEC on the Conservation of Wild Birds).

2. METHODOLOGY

Study area

The study area for these surveys was the tidal area within a 1km radius of Trinity Wharf (Figure 1). The shoreline is largely artificial sea wall to the north of Trinity Wharf. To the south of the Wharf there is a small area of intertidal mudflat at Batt Street Harbour. The remainder of the coast to the south of the Wharf is rocky shore with dense seaweed cover.

Figure 1: Study area for waterbird counts

Count methods

Surveys of the entire study area were carried out within 2 hours of low tide and 2 hours of high tide on five separate dates between November 2015 and March 2016 (Table 1). All waterbirds in this area were mapped and counted using 10x binoculars and 35x telescope.

Table 1. Survey dates and tide times

Date	High Water time	HW Survey times	Low Water time	LW Survey times
19/11/2015	11:06	11:30-13:00	17:25	15:00-16:20
10/12/2015	17:33	15:30-16:40	11:15	10:30-12:00
07/01/2016	16:34	14:25-15:55	10:50	10:00-11:30
15/02/2016	11:10	11:15-12:30	17:26	16:00-17:00
08/03/2016	18:30	17:00-18:15	12:40	13:00-14:30

3. RESULTS

A summary of results of the winter bird surveys is given in Table 2. A total of 23 species of waterbirds were recorded in this survey. Of these, 15 species are qualifying interests of Wexford Harbour and Slobs SPA (NPWS 2012).

Trinity Wharf itself does not hold any waterbirds. The northern and eastern edges are steep concrete walls and have no suitable foraging or roosting habitat. The southern side of the wharf is bordered by intertidal mudflat at Batt Street Harbour. This generally holds very small numbers of waders including Oystercatcher, Bar-tailed Godwit, Curlew, and Redshank at low tide. Single Grey Heron and Little Egret also occur in Batt Street Harbour at low tide.

The most important features for waterbirds in this area are the North and South training walls one either side of the mouth of the River Slaney. These areas are used at both low tide and high tide especially by roosting Lapwing (peak 552), Oystercatcher, Cormorant, Black-headed Gull and Herring Gull. The walls also provide foraging habitat at low tide for Oystercatcher and Turnstone.

The other main high tide roost site approximately 500m to the north-west of Trinity Wharf is the ballast structure in the centre of the river. This artificial structure is used at high tide by significant numbers of roosting Oystercatcher (peak 120) as well as Lapwing, Black-tailed Godwit, Turnstone and Black-headed Gull.

The shallow waters lying to the south of the South Training Wall and north of the North Training Wall are used for foraging by several species of waterbirds including Great Crested Grebe (peak 27), Red-breasted Merganser (peak 78), Goldeneye (peak 4) and Cormorant.

Table 2. Peak numbers of waterbirds within 1km of Trinity Wharf at high tide and low tide 2015/16 and average peak numbers for the entire Wexford Harbour and Slobs SPA.

Species	Scientific name	Peak Population High Tide	Peak Population Low Tide	Mean Peak Population Wexford Harbour & Slobs SPA[1]
Mute Swan	*Cygnus olor*	2	2	129
Light-bellied Brent Goose*	*Branta bernicla hrota*	10	10	2445
Goldeneye*	*Bucephala clangula*	1	4	43
Red-breasted Merganser*	*Mergus serrator*	78	25	90
Cormorant*	*Phalacrocorax carbo*	31	47	17
Shag	*Phalacrocorax aristotelis*	3	0	91
Little Egret	*Egretta garzetta*	1	5	320
Grey Heron*	*Ardea cinerea*	6	9	2
Little Grebe*	*Tachybaptus ruficollis*	1	2	17
Great Crested Grebe*	*Podiceps cristatus*	27	27	11
Oystercatcher*	*Haematopus ostralegus*	155	81	474
Lapwing*	*Vanellus vanellus*	355	552	3602
Black-tailed Godwit*	*Limosa limosa*	13	1	1944
Bar-tailed Godwit*	*Limosa lapponica*	0	3	838
Curlew*	*Numenius arquata*	3	12	498
Redshank*	*Tringa totanus*	12	10	13
Greenshank	*Tringa nebularia*	0	2	335
Turnstone	*Arenaria interpres*	29	15	33
Black-headed Gull*	*Chroicocephalus ridibundus*	351	331	1414
Common Gull	*Larus canus*	3	3	299
Lesser Black-backed Gull*	*Larus fuscus*	4	5	11
Herring Gull	*Larus argentatus*	60	35	194
Great Black-backed Gull	*Larus marinus*	16	4	97

1. Mean of peak counts over three winters 2011/12 to 2013/14. Data were supplied by the Irish Wetland Bird Survey (I-WeBS), a joint scheme of BirdWatch Ireland and the National Parks and Wildlife Service of the Department of Arts, Heritage & the Gaeltacht.

*Qualifying interest of Wexford Harbour and Slobs SPA.

4. CONCLUSIONS

A total of 23 species of waterbirds were present within 1km of Trinity Wharf in winter 2015/16. The most abundant species here were Black-headed Gull, Oystercatcher and Lapwing. The most important habitats are the training walls on either side of the river mouth. The bird numbers present in this area represent a small proportion of the total numbers in the Wexford Harbour and Slobs SPA. Very few individuals occurred within the immediate vicinity (200m) of the Wharf because there is limited suitable habitat here.

5. REFERENCE

NPWS (2012) Conservation Objectives: Wexford Harbour and Slobs SPA 004076. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Appendix 7.3 Marine Mammal Risk Assessment

ROD
ROUGHAN & O'DONOVAN

MARINE MAMMAL RISK ASSESSMENT OF A PROPOSED DEVELOPMENT AT TRINITY WHARF, WEXFORD

Prepared by
Dr Simon Berrow

IWDG Consulting, Merchants Quay, Kilrush, Co Clare

1 | INTRODUCTION

The Irish Whale and Dolphin Group (IWDG) were contracted by the engineering and environmental consultants Roughan & O'Donovan to carry out a Marine Mammal Risk Assessment of the potential impact on marine mammals of the proposed Trinity Wharf Development in Wexford. The proposed construction site is within the Slaney River Valley SAC, which includes harbour seal as a qualifying interest. The proposed works will take place over a maximum of 80 months, with the works within the marine environment expected to be 10.5 months in duration, with potential for it to be condensed into less if the marina and boardwalk works are undertaken at the same time.

Figure 1. Trinity Wharf, Wexford, showing location

Proposed works

The main construction elements and activities of the development relevant to this MMRA are as follows:

- **Sea wall and revetment works:** the construction of the replacement sea wall will consist of driving steel sheet piles around the entire coastal boundary of the site with the addition of rock armour revetment placement along the south-east edge.
- **Increased boat traffic from the marina:** and potential to cause disturbance to seals, especially those hauled out in the vicinity.

The first main element of work to be constructed will be the sea wall around the coastal edge of the site. The sea wall will comprise the installation of steel sheet piles and a rock armour revetment along the south-east edge of the site with a smaller section along the northern section. The construction of the boardwalk / pedestrian link bridge from Paul Quay to the northern corner of Trinity Wharf will require the driving of 11 No. 700 mm diameter vertical tubular steel piles which will support the deck. The piles for the boardwalk (and potentially marina and breakwater) will be driven by impact hammer. This will overlap in programme with the sheet piling of the new sea wall.

A pile-driving rig will mobilise and begin vibro-piling sheet piles immediately in front of the existing sea wall to approximately -10.5mOD into the stiff gravelly clay. The design of the wall considers the use of granular fill material being compacted behind the sheet piles. Upon installation of the sheet piles, the existing sea wall will be broken up in-situ and left in place with granular backfill material being placed around this. Construction of sheet piling wall and rock armour revetment is planned to last 4 months with sheet piling will be continuous but piling for the foundations could be intermittent for this period.

Along the south east edge of the site, a rock armour revetment is required to be constructed immediately in front of the sheet pile wall. Rock armour consisting of rocks of approximately 0.5 to 1 tonne will be placed on the sea bed to the required profile in parallel with the installation of the sheet pile wall such that at no point during the construction can waves reflecting off the vertical wall significantly affect the moored vessels at Goodtide Harbour. The marina and floating breakwater units may also be restrained by vertical steel piles, but this has not yet been confirmed.

The design of the sheet pile sea wall requires the use of tie backs, consisting of tie-bars and a row of smaller sheet piles to be installed approximately 12m behind the sea wall. Installation of the earthworks, drainage and services and sheet pile wall anchorage walk is planned to last 6 months. Once all sheet piles are installed around the boundary of the site, the tie-bars will be installed between the two rows and the reinforced concrete capping beam will be constructed to the sea wall. Once the sheet piles and associated anchorage system is in installed correctly, backfilling works can commence.

2 | METHODS

The risk assessment was based on a review of the available literature and data sources. Maps of the distribution of cetacean sightings inside the sand dunes at the mouth of the Wexford Harbour, were prepared using data from the Irish Whale and Dolphin Group's casual sightings database (IWDG, accessed 25 November 2018).

3 | LEGAL STATUS

Irish cetaceans and pinnipeds are protected under national legislation and under a number of international directives and agreements which Ireland is signatory to. All cetaceans, as well as grey and harbour seals, are protected under the Wildlife Act (1976) and amendments (2000, 2005, 2010 and 2012). Under the act and its amendments, it is an offence to hunt, injure or wilfully interfere with, disturb or destroy the resting or breeding place of a protected species (except under license or permit). The act applies out to the 12 nml limit of Irish territorial waters.

All cetaceans and pinnipeds are protected under the EC Habitats Directive. All cetaceans are included in Annex IV of the Directive as species 'in need of strict protection'. Under this Directive, the harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) are designated Annex II species which are of community interest and whose conservation requires the designation of Special Areas of Conservation.

Ireland is also signatory to conservation agreements such as the Bonn Convention on Migratory Species (1983), the OSPAR Convention for the Protection of the Marine Environment of the northeast Atlantic (1992) and the Berne Convention on Conservation of European Wildlife and Natural Habitats (1979).

In 2007, the National Parks and Wildlife Service (NPWS) of the Department of Culture, Heritage and the Gaeltacht produced a '*Code of Practice for the Protection of Marine Mammals during Acoustic Seafloor Surveys in Irish Waters* (NPWS, 2007). These were subsequently reviewed and amended to produce '*Guidance to manage the risk to marine mammals from man-made sound sources in Irish waters*' (NPWS, 2014) which include mitigation measures specific to dredging. The guidelines recommend that listed coastal and marine activities (including dredging) be subject to a risk assessment for anthropogenic sound-related impacts on relevant protected marine mammal species to address any area-specific sensitivities, both in timing and spatial extent, and to inform the consenting process.

Once the listed activity has been subject to a risk assessment, the regulator may decide to refuse consent, to grant consent with no requirement for mitigation, or to grant consent subject to specified mitigation measures.

4 | BASELINE ENVIRONMENT

4.1 | Ambient Noise Levels

The ambient noise levels at the site are not known. Ambient noise in Wexford Harbour is expected to be dominated by environmental noise (e.g. tidal movement of water and sediment) and shipping noise, especially with peaks in noise due to recreational and fishing vessels transiting the harbour between Wexford town and the Irish Sea. Mussel fishing vessels are particularly common in Wexford Harbour with a large area of the harbour licenced under active Aquaculture licences.

The harbour is also known for recreational use, with the Wexford Harbour Boat and Tennis Club being located 2km north of the Trinity Wharf site and the Wexford Quays being a popular recreation area for locals. A weekend long Maritime Festival is held every year during the summer with multiple events being held on the water.

4.2 | Cetaceans

A review of cetacean (whale, dolphin and porpoise) records submitted to the IWDG provided only three validated records (Table 1). This consisted of one harbour porpoise sighting and one common dolphin *(Delphinus delphis)* sighting. A third sighting of a large group on 5 July were reported as harbour porpoise but the group size is large and were most likely dolphins, probably common dolphins (Table 1). Both of these latter sightings were closer to Rosslare Harbour.

Table 1. Cetacean sightings (including IWDG downgrades) recorded in Wexford Harbour and adjacent waters from 2000-2018.

Date	Species	No. animals	Observer
18 March 2017	harbour porpoise	1	Richie Conroy
05 July 2012	dolphin species, possibly harbour porpoise	15-20	Charlotte Steele
01 March 2004	common dolphin	2	Kevin McCormick

Figure 2. Map of all cetacean sightings submitted to the IWDG between 2000 to present (blue dots are harbour porpoise, green dots are dolphins)

Harbour porpoise are the most widespread and abundant cetacean in inshore Irish waters, with highest abundances in the Irish Sea (Berrow et al. 2010). Harbour porpoise are frequently sighted off southeast Wexford and are known to particularly associate with areas of strong tidal currents for foraging (Berrow et al. 2014). Common dolphins are distributed around the entire Irish coast with highest concentrations are off the south west

and west coasts (Berrow et al. 2010). However, in the winter large numbers of common dolphins enter the Celtic sea to feed on schools of pelagic fish such as herring and sprat. Spawning grounds for herring occur off south Wexford with fish moving into inshore waters in December to February (Volkendandt et al. 2014).

4.3 | Pinnipeds

Grey and harbour seals are distributed around the entire Irish coast with grey seals being generally more abundant along the western seaboard and off the southwest coast (Cronin *et al.* 2004; O'Cadhla *et al.* 2007; O'Cadhla and Strong 2008). The conservation status of grey and harbour seals in Ireland has been assessed as favourable (NPWS 2008, 2013).

Harbour Seal (Phoca vitulina)

Wexford Harbour

Harbour seals have been reported in Wexford Harbour during National Parks and Wildlife Service (NPWS) surveys in 2003. Lockley (1966) reported an average of 10 Harbour (Common) seals in Wexford Harbour between 1964 and 1965. Cronin et al. (2004) reported 17 seals hauled out at two sites in Wexford Harbour on 19 August 2003 during an aerial survey.

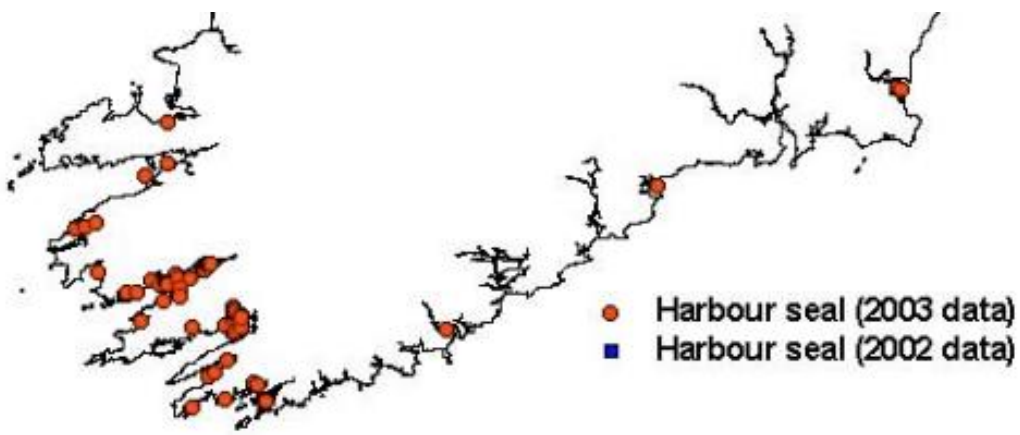

Figure 6. Map of the locations of groups of harbour seals recorded on the south coast of Ireland, August 2003 (from Cronin et al. 2004).

Slaney River Valley SAC

The Slaney River Valley SAC (Site Code 000781) hosts regionally significant numbers of Harbour Seal. Harbour seal occurs year-round in Wexford Harbour where several sandbanks are used for breeding, moulting and resting activity (NPWS 2011). NPWS report in their site synopsis that at least 27 individuals regularly occur within the site (Lockley 1966, Cronin et al. 2004) and unpublished National Parks and Wildlife Service records.

The Conservation Objectives for Harbour Seal in the Slaney River Valley SAC are:

- Species range within the site should not be restricted by artificial barriers to site use.
- The breeding sites should be maintained in a natural condition.
- The moult haul-out sites should be maintained in a natural condition.

- The resting haul-out sites should be maintained in a natural condition.
- Human activities should occur at levels that do not adversely affect the harbour seal population at the site.

According to NPWS (2011) haul out sites for harbour seals occur up to 2km from the proposed development (Figure 7).

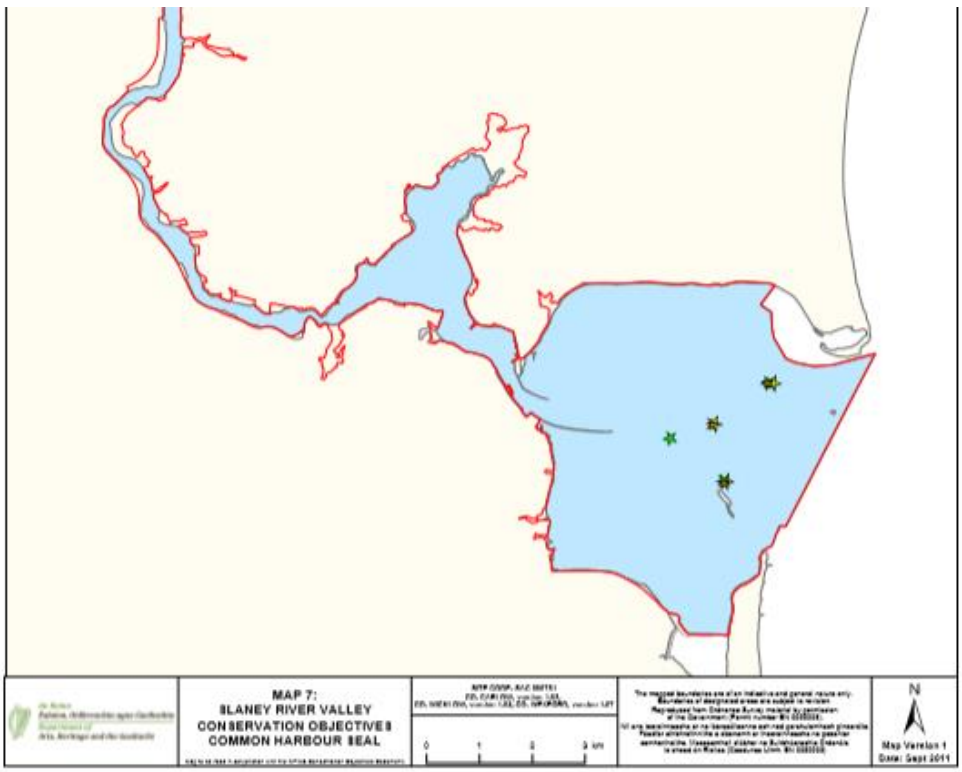

Figure 7. Harbour seal haul out sites (from NPWS 2011)

Grey Seal (*Halichoerus grypus*)

Grey seals are regularly reported hauled out on sandbanks in the mouth of Wexford Harbour and on the Raven sandbar. Kiely et al. (2000) carried out 14 surveys of the Raven Point between June 1997 and December 1998 and counted a mean of 75 grey seals hauled out. Numbers peaked in the summer but were consistently high during the breeding season and female moult period.

Cronin et al. (2004) reported 25 seals hauled out on 19 August 2003 during an aerial survey for harbour seals. A further 30 grey seals were reported at Carnsore Point and 17 on Tuskar Rock on the same day. O'Cadhla *et al.* (2007) reported 130 hauled out on the Raven spit and banks on 6 March 2007 during an aerial survey during the moulting period, which are numbers of national significance. Only 1 grey seal pup was reported during an aerial survey of grey seal breeding sites in 2005, suggesting the site is more important for moulting and resting than breeding.

The nearest protected site for seals in Great Saltee SAC off the south Wexford coast over 50km by sea from Wexford Harbour. Grey seals forage locally and may also range long distances and may occasionally swim upriver when foraging. Kiely et al. (2000) reported individual grey seals moving between colonies off southwest Wales

and the Raven Point, suggesting some of the seals recorded during the high counts in the moulting period could originate from colonies outside Ireland.

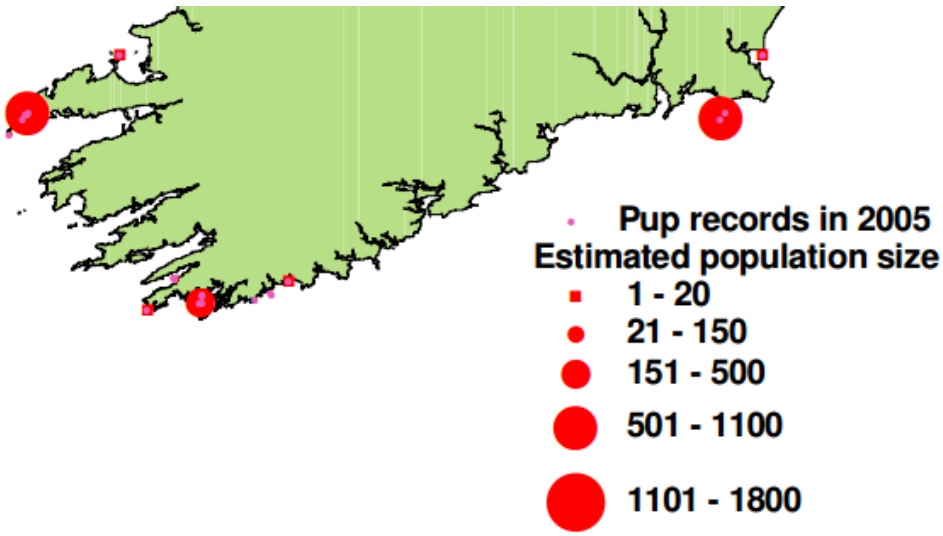

Figure 8. Map of the locations of grey seals pupping locations recorded on the south coast of Ireland in 2005 (from O'Cadhla et al. 2007).

5 | IMPACT ASSESSMENT

5.1 | Description of Activities

As part of the proposed site works piling and rock armour activities are most likely to impact on marine mammals, especially when considering the potential for acoustic trauma.

5.1.1 Piling Impacts

Pile driving is classed as a multi pulse source of impulsive sound. The potential impacts on marine mammals from piling activity include Permanent Threshold Shift (PTS), Temporary Threshold Shift (TTS) and behavioural disturbance; each of which have varying degrees of severity for exposed individuals.

If a marine mammal's received sound exposures, irrespective of the anthropogenic source (pulse or nonpulse), exceed the relevant criterion, auditory injury (PTS) is assumed to be likely. It is measured effects on marine mammals are largely based on work by Southall *et al.* (2007), who proposed a dual criterion based on peak sound pressure level (SPL) and sound exposure level (SEL), where the level that is exceeded first is what should be used as the working injury criterion (i.e. the precautionary of the two measures).

As all marine mammals do not hear equally across all frequencies, the use of frequency weightings is applied to compensate for differential frequency responses of their sensory systems. The M-weighting (for marine mammals) is similar to the C-weighting for measuring high amplitude sounds in humans. At present there are no data available to represent the onset of PTS in marine mammals but Southall *et al.* (2007) estimated it as 6 dB above the SPL (unweighted) and 15 dB above the SEL (M-weighted according to the relevant marine mammal functional group, see Figure 1) based on the onset of TTS. Therefore, Southall *et al.* (2007) proposed SPL criteria of 230 dB

re 1 µPa (peak broadband level) for PTS onset in cetaceans and 218 dB re 1 µPa for pinnipeds. They also recommended TTS can occur at 224 dB re 1 µPa (peak broadband level) for cetaceans and 212 dB re 1 µPa for pinnipeds (Southall *et al.* 2007; Bailey *et al.* 2010) (Table 2). While, the SEL criteria proposed by Southall et al. (2007) include TTS onset at 183 dB re 1 µPa^2 -s for cetaceans and 171 dB re 1 µPa2 -s for pinnipeds, and PTS onset is expected at 15 dB additional exposure (Bailey *et al.* 2010) (Table 3).

Table 2. M-frequency weightings for pinnipeds from Southall et al. (2007)

Functional hearing group	Estimated auditory bandwidth	Genera represented (Number species/subspecies)	Frequency-weighting network
Pinnipeds in water	75 Hz to 75 kHz	*Arctocephalus, Callorhinus, Zalophus, Eumetopias, Neophoca, Phocarctos, Otaria, Erignathus, Phoca, Pusa, Halichoerus, Histriophoca, Pagophilus, Cystophora, Monachus, Mirounga, Leptonychotes, Ommatophoca, Lobodon, Hydrurga,* and *Odobenus* (41 species/subspecies)	M_{pw} (pw: pinnipeds in water)
Pinnipeds in air	75 Hz to 30 kHz	Same species as pinnipeds in water (41 species/subspecies)	M_{pa} (pa: pinnipeds in air)

Table 3. Proposed injury criteria for seals from Southall et al. (2007)

Marine mammal group	Sound type		
	Single pulses	Multiple pulses	Nonpulses
Pinnipeds (in water)	Cell 10	Cell 11	Cell 12
Sound pressure level	218 dB re: 1 µPa (peak) (flat)	218 dB re: 1 µPa (peak) (flat)	218 dB re: 1 µPa (peak) (flat)
Sound exposure level	186 dB re: 1 µPa^2-s (M_{pw})	186 dB re: 1 µPa^2-s (M_{pw})	203 dB re: 1 µPa^2-s (M_{pw})
Pinnipeds (in air)	Cell 13	Cell 14	Cell 15
Sound pressure level	149 dB re: 20 µPa (peak) (flat)	149 dB re: 20 µPa (peak) (flat)	149 dB re: 20 µPa (peak) (flat)
Sound exposure level	144 dB re: (20 µPa)^2-s (M_{pa})	144 dB re: (20 µPa)^2-s (M_{pa})	144.5 dB re: (20 µPa)^2-s (M_{pa})

Most concerns of the effects of pile driving on marine mammals has been around the construction of offshore wind farms (Richardson *et al.* 2011). There has been limited work on the effects of piling during coastal and harbour works. Attenuation of sound pressure levels at coastal sites will be more rapid depending on the topography and nature of the bedrock. Recently, Graham *et al*. (2017) modelled the source levels estimated for impact piling from a single-pulse sound exposure level of 198 dB re 1 lPa2 s and, for a 192 dB re 1 lPa source level for vibration piling during harbour construction works. Predicted received broadband SEL values 812 m from the piling site were markedly lower than source level due to high propagation loss (133.4 dB re 1 lPa2 s (impact) and 128.9 dB re 1 lPa2 s (vibration). Simultaneous acoustic monitoring of bottlenose dolphins and harbour porpoises at the site showed they were not excluded from sites in the vicinity of impact or vibration piling; nevertheless, some small effects were detected with bottlenose dolphins spending a reduced period of time in the vicinity of construction works.

The maximum TTS in harbour seals, measured 1-4 minutes after exposure for 120 minutes to the 148 dB re 1 µPa noise band (187 dB SEL), was around 10 dB (i.e. hearing was 10 dB less sensitive than normal). Recovery to the

pre-exposure threshold was estimated to be complete within one hour post-exposure. Significant TTSs (in this study of > 3 dB) occurred at SELs of ~170 and 178 dB re 1 µPa2s (Kastelein et al., 2011). Kastelein et al. (2011) also showed that the two young harbour seals used in this study were more vulnerable to noise-induced TTS than another older animal using a noise band centered at 2.5 kHz, found a TTS onset at a higher SEL of 183 dB re 1 µPa2s). To assess the effects of pile driving sounds on TTS, harbour seals were exposed to low-repetition rate pulses (playbacks of pile driving sounds) with an energy peak at 630 Hz (most energy was between 0.4 and 5 kHz) and with 90% of their energy within a 124 ms period. No measurable TTS was induced, probably because the received level was too low. If TTS did occur it was of such low magnitude that hearing probably recovered during the interval between the pulses. Behavioural observations showed that one of the seals swam away from the sound source during the first two sessions, and hauled out at a 2 dB higher level. The other seal did not swim away from the transducer when the pile driving sounds were played back, which demonstrates individual variation between animals in behavioural reactions to sounds. Behavioural response studies should involve as many animals as possible to gain insight into natural variation in responses to sounds (Kastelein et al, 2011). Harbour seal auditory threshold is at around 1 kHz and would ranges up to around 40 kHz (Richardson et al., 2011).

As the likelihood of any cetaceans being in the vicinity of the construction site is extremely low there is an insignificant risk of sound exposure and impact, however the likelihood of seals being in the water close to the site is high.

Although no modelling of attenuation has been carried out at the current site, McKeown (2014) carried out modelling of piling in Dublin Bay and the River Liffey associated with the Dublin Port ABR project. SPL averaged 140 dB whereas 500m upriver the SPL was 108 dB which was at background levels. The SEL at this location was 156 dB. 300m downriver the SPL was 127 dB and the SEL was 173 dB suggesting that noise from piling reduced to background levels somewhere between 300 and 500m from the source in Alexandra Basin. The predicted loss compared to the measured loss along the modelled transect indicate an over-estimate in the order of 12 dB at ranges in excess of 1 km. While the values are in general agreement, the relative transmission loss at ranges beyond 1 km are in good agreement. Given the complex environment that exists in Dublin Bay, the model can be used to provide accurate transmission loss estimates at long ranges. The modelling data is supported by site specific measurements confirming the relative transmission loss (McKeown, 2014).

Each site has different characteristics but given that Wexford Harbour is quite shallow attenuation would be expected to be greater. However, this study shows that the risk of disturbance to seals hauled out 2-5km away is very low, but the risk to seals in the water <500m away is high.

5.1.2 Rock armour and construction activities

Placement of rock armour at the revetment could produce sound into the intermediate to the site, but this noise will be of short duration and dominated by low frequencies to which seals are less sensitive. Sound exposure levels from construction activities are below that expected to cause disturbance, from the noise generated or from the physical presence of land and sea-based craft. Construction activities have the potential to cause lower level disturbance, masking or behavioural impacts, for example (NPWS, 2014). The construction activities may lead to a very localised increase in noise levels and due to the long duration of construction activities, could have cumulative effects.

5.1.3 Increased marine traffic

Increased vessel traffic during construction is restricted to local craft inspecting and surveying the site will be an insignificant increase over existing traffic. Small work vessels produce low frequency sounds (Table 4). After construction it is envisaged that around 50% of the berths will be occupied by vessels already within the harbour. This leaves the other half available for visiting vessels. Trinity Wharf Marina will be competing with other marinas in nearby towns and the long navigational channel that is required to travel through coming into Wexford Harbour, may discourage some vessels passing along the coast. However, an increase in the volume of boats and boating activity adjacent to the marina and its approaches should be anticipated.

Small vessels tend to produce broadband low frequency sound from 10 Hz to 2.5 kHz (Wyatt, 2008) which harbour seals would detect as their auditory sensitivity ranges from around 1-40 kHz (Richardson et al., 2011). Seals in the area are already accommodated to existing boat traffic, including recreational and fishing activity, and seals are known to be quite tolerant to boat traffic especially if it slowly builds up over time (Richardson et al., 2011).

Table 4. Estimated noise emissions from small workboat / tug (Wyatt, 2008)

Vessel Type	Displacement Tonne	Length m	Propulsion	Activity	Measurement	Measurement band kHz	Extrapolation dB re 1 µPa m peak to peak	Reference
Tug with Barge[55]	Tug Gross tonnage 104	19.5 (64 ft)	Main engine 1095 hp diesel	Unloaded Speed 7.4 knots	173 dB re 1 µPa @ 1 m Source level	0.01 to 20	182 Broadband 10 to 2500 Hz with broad peak between60 and 600Hz	(Zykov and Hannay 2006)

5.2 | NPWS Guidance and Assessment

The NPWS (2014) '*Guidance to manage the risk to marine mammals from man-made sound sources in Irish waters – January 2014*' recommends that listed coastal and marine activities, undergo a risk assessment for anthropogenic sound-related impacts on relevant protected marine mammal species to address any area-specific sensitivities, both in timing and spatial extent, and to inform the consenting process. It is required that such an assessment must competently identify the risks according to the available evidence and consider (i) direct, (ii) indirect and (iii) cumulative effects of anthropogenic sound (NPWS, 2014). Excavation of coastal structures is not specifically listed in the NPWS (2014) guidelines but piling is covered and is of concern if large piles are to be driven and there is a risk of exposure to marine mammals.

The works are assessed for their potential to create increased noise disturbance and the receiving environment. A risk assessment, following NPWS Guidelines, was conducted based on the published literature, data from the IWDG sightings databases and knowledge of the study area.

5.3 | NPWS Assessment Criteria

1. Do individuals or populations of marine mammal species occur within the proposed area?

The likelihood of cetaceans being in the area is very low. Only harbour porpoise and common dolphin have been reported from the area and only very occasionally. There are important haul out sites for both harbour and grey seal in the mouth of Wexford Harbour and on the Raven. The proposed development occurs wholly within a SAC with harbour seal as a qualifying interest. These haul out sites are typically >5km away from the construction site but individual seals are likely to forage within the harbour and thus occur in the water near the construction site. All cetaceans and grey seals are part of a larger population and very mobile, with records of movements of grey seals between southeast Ireland and west Wales. Harbour seals are more sedentary and generally forage within 20km of their haul out sites (Cronin *et al*. 2008); however, studies in the UK have shown that harbour seals travel further distances from haul out sites (over 100km) (Cunningham *et al*. 2009).

2. Is the plan or project likely to result in death, injury or disturbance of individuals?

The project will not cause injury or death but could cause disturbance to seals in the water from noise associated with the project, especially from piling.

Noise Impact

The activities proposed during this project consist of demolition and piling operations. TTS could occur to seals in the water if they were very close to the site when piling started. There is no risk of TTS from rock armour or general construction activities, but disturbance could occur. The construction of this marina is expected to increase boat traffic but slowly over an extended period, allowing for seals adjacent to the site to accommodate to this increase. Wexford Harbour is already a busy site with recreational and fishing activity, thus any increase in recreational traffic is against a back drop of current use and will not significantly increase long term disturbance of the haul-out sites.

Physical Impact

The risk of injury or mortality is considered very unlikely as marine mammals are rarely in the vicinity of the site.

3. Is it possible to estimate the number of individuals of each species that are likely to be affected?

No abundance estimates for cetaceans in Wexford Harbour are available but their presence is rare and intermittent. An abundance estimates for harbour porpoises from Carnsore Point of 87±36.3 calculated from a density estimate of 0.58 harbour porpoise per km^2 (Berrow et al., 2014).

NPWS (2011) report up to at least 27 harbour Seals regularly occur within the site. Up to 130 grey seals have been reported hauled out on the Raven and on sand spits in the mouth of the harbour and its likely some 10s of seals use the harbour for foraging.

4. Will individuals be disturbed at a sensitive location or sensitive time during their life cycle?

Construction work is planned to last for 80 months and thus spans all seasons for marine mammals. Marine works are expected to occur for 10.5 months within this construction period. As cetaceans are rarely recorded at the site and there is no potential for disturbance but both grey and harbour seals are present throughout the year. The site is used by a small number of harbour seals for both pupping and resting/moulting and grey seals more for moulting than breeding with foraging in the harbour likely to occur throughout the year. There is no particular season or aspect of a seals life-cycle when they will be more vulnerable to disturbance.

5. Are the impacts likely to focus on a particular section of the species' population, e.g., adults vs. juveniles, males vs. females?

There is no data to suggest that any particular harbour or grey seal gender or age group are more likely to forage at the site compared to other ages/sex and thus all must be expected to occur vicinity at the site.

6. Will the plan or project cause displacement from key functional areas, e.g., for breeding, foraging, resting or migration?

While harbour porpoise and common dolphins have been reported in the area, they are rare and intermittent and thus, the harbour does not provide any important habitats. Wexford Harbour is designated as a SAC for harbour seals and a nationally important site for grey seals which occur mainly hauled out at the Raven and on sand banks in the mouth of the harbour. Seals are known to forage in the harbour and could be exposed to risk, especially from noise associated with piling.

7. How quickly is the affected population likely to recover once the plan or project has ceased?

While there may be temporary disturbance all seals in the immediate vicinity of the harbour and construction area are accommodated to human activities and are likely to recover quickly from any temporary disturbance within hours.

5.4 | Mitigation

Both harbour and grey seals could potentially be affected by the proposed operations, especially from the noise associated with piling. They regularly occur in small numbers adjacent to the construction site and in the mouth of Wexford Harbour and are the marine mammals most at risk from the proposed works. The mitigation measures recommended by the NPWS are for the presence of a trained and experienced Marine Mammal Observer (MMO) and the use of "ramp up" procedures for noise and vibration emitting operations. The proposed mitigation measures (Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters) recommended by the Department of Culture, Heritage and the Gaeltacht in 2014 are designed to mitigate any possible effects.

5.4.1 NPWS Guidelines

The following mitigation measures consistent with NPWS (2014) are proposed to minimise the potential impacts on seals and to allow animals to move away from the construction area:

1. A qualified and experienced marine mammal observer (MMO) shall be appointed to monitor for marine mammals and to log all relevant events using standardised data forms.
2. Unless information specific to the location and/or plan/project is otherwise available to inform the mitigation process (e.g., specific sound propagation and/or attenuation data) and a distance modification has been agreed with the Regulatory Authority, pile driving activity shall not commence if marine mammals are detected within a 500m radial distance of the pile driving sound source, i.e., within the Monitored Zone, following the recommendations in McKeown (2014).

Pre-Start Monitoring

3. Pile driving activities shall only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved. Where effective visual monitoring, as determined by the MMO, is not possible the sound-producing activities shall be postponed until effective visual monitoring is possible.
4. An agreed and clear on-site communication signal must be used between the MMO and the Works Superintendent as to whether the relevant activity may or may not proceed, or resume following a break (see below). It shall only proceed on positive confirmation with the MMO.

5. The MMO shall conduct pre-start-up constant effort monitoring at least 30 minutes before the sound-producing activity is due to commence. Sound-producing activity shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO.

6. This prescribed Pre-Start Monitoring shall subsequently be followed by an appropriate Ramp-Up Procedure which should include continued monitoring by the MMO.

Ramp-Up Procedure

7. In commencing a pile driving operation where the output peak sound pressure level (in water) from any source including equipment testing exceeds 170 dB re: 1µPa @1m an appropriate Ramp-up Procedure (i.e., "soft-start") must be used. The procedure for use should be informed by the risk assessment undertaken giving due consideration to the pile specification, the driving mechanism, the receiving substrate, the duration of the activity, the receiving environment and species therein, and other information (see section 3).

8. Where it is possible according to the operational parameters of the equipment and materials concerned, the underwater acoustic energy output shall commence from a lower energy start-up (i.e., a peak sound pressure level not exceeding 170 dB re: 1µPa @1m) and thereafter be allowed to gradually build up to the necessary maximum output over a period of 20-40 minutes.

9. This controlled build-up of acoustic energy output shall occur in consistent stages to provide a steady and gradual increase over the ramp-up period.

10. Where the measures outlined in steps 8 and 9 are not possible, alternatives must be examined whereby the underwater output of acoustic energy is introduced in a consistent, sequential and gradual manner over a period of 20-40 minutes prior to commencement of the full necessary output.

11. In all cases where a Ramp-Up Procedure is employed the delay between the end of ramp-up and the necessary full output must be minimised to prevent unnecessary high-level sound introduction into the environment.

12. Once an appropriate and effective Ramp-Up Procedure commences, there is no requirement to halt or discontinue the procedure at night-time, nor if weather or visibility conditions deteriorate nor if marine mammals occur within a 500m radial distance of the sound source, i.e., within the Monitored Zone.

Breaks in sound output

13. If there is a break in pile driving sound output for a period greater than 30 minutes (e.g., due to equipment failure, shut-down or location change) then all Pre-Start Monitoring and a subsequent Ramp-up Procedure (where appropriate following Pre-Start Monitoring) must be undertaken.

14. For higher output pile driving operations which have the potential to produce injurious levels of underwater sound (see sections 2.4, 3.2) as informed by the associated risk assessment, there is likely to be a regulatory requirement to adopt a shorter 5-10 minute break limit after which period all Pre-Start Monitoring and a subsequent Ramp-up Procedure (where appropriate following Pre-Start Monitoring) shall recommence as for start-up.

Reporting

15. Full reporting on MMO operations and mitigation undertaken must be provided to the Regulatory Authority.

5.4.2 Monthly Seal Surveys

Monthly seal surveys of known and potential seal haul-out sites will be carried out immediately prior to and during the marine works. This is to ensure there are no changes in use of these sites and to provide the NPWS with useful monitoring data. These seal surveys will be carried out by the site MMO concurrent with implementing NPWS guidelines.

5.4.3 Voluntary Code of Conduct for recreational boat-users

The new facility at Trinity Wharf will provide the opportunity to educate recreational boat users on the potential for disturbance of seals hauled out. A centralised facility, which does not exist at present, enables a voluntary code of conduct to be developed in collaboration with the marina, informing boat users of minimum distances to haul-out sites, signs of disturbance (such as head-up) and promote best practice. Provision of such information will ensure disturbance is minimised and the importance of the site for seals disseminated leading to increased environmental awareness.

5.5 | Residual Impacts

With implementation of the above mitigation measures, it is very unlikely that there will be negative residual impacts from the proposed construction activity on marine mammals in the area. It is also very unlikely that any animals will be injured or killed as a result of the proposed works. Seal haul out sites are between 2 and 5km from the proposed construction site. Seals using the inner harbour will be accommodated to vessel noise and resident individuals will have habituated to current vessel traffic. No significant increase in traffic is expected post construction and any animals which might be displaced from the vicinity of the construction site can be expected to quickly re-establish use of the area following cessation of the works.

Cetaceans are not present within the harbour and are occur occasionally outside the harbour and are therefore very unlikely to be impacted on by the works.

5 | SUMMARY

Sightings of cetaceans are extremely rare at or adjacent to the proposed site but the harbour is an SAC with harbour seals as a qualifying interest. The proposed construction site is adjacent to important seal haul out and pupping sites. Due to extended time period (up to 10.5 months) during which activities such as pile driving are scheduled, the potential impacts on seals exposed to this is activity could be significant.

Mitigation is required during piling activities. The proximity of the proposed works to important haul out sites and the likelihood of seals foraging near the construction site requires mitigation during all piling activities, which could have a significant impact on marine mammals in the absence of mitigation. Recommended mitigation involves the use of a Marine Mammal Observer to ensure no seals are within an agree mitigation zone on start-up and regular seal surveys are carried out to monitor use of known seal haul out sites in the area.

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Appendix 7.4 Invasive Species Management Plan

ROD
ROUGHAN & O'DONOVAN

Invasive Alien Species Management Plan

Trinity Wharf, Wexford

[Nov, 2017]

Prepared by Envirico on behalf of Wexford County Council

www.envirico.com

Action	Personnel	Company	Date
Revision: 1 (Jan, 2018)			
Report Prepared By:	Dr. Amanda Greer	Envirico	Nov, 2017
Reviewed By:			

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1. INTRODUCTION

Envirico have been engaged by Wexford County Council to carry out an invasive alien species survey and prepare an invasive species management plan for Trinity Wharf and the footprint of the proposed Trinity Wharf Development. The survey was conducted as a walkover by land on 3rd November, 2017. Two invasive alien species listed in the Third Schedule of S.I. 477/2011 were recorded during the course of the survey – **Japanese Knotweed** (*Fallopia japonica*; 1,377m^2), and **Three-Cornered Leek** (*Allium triquetrum*; 245m^2).

This invasive alien species management plan (IASMP) has been prepared in accordance with current Irish best practice guidelines such as 'The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads' – NRA (2010); Best Practice for Control of Japanese Knotweed *Fallopia japonia* – Inland Fisheries Ireland; Best Practice Management Guidelines Japanese Knotweed *Fallopia japonia* – Invasive Species Ireland (2008).

1.1 Site Manager/Owner: Wexford County Council

1.2 Site Address: Trinity Wharf

Wexford

1.3 Site Description:

The survey area covered the both the Trinity Wharf itself and the section of Dublin to Rosslare railway track running along the southwestern boundary of the wharf, up to the boundary with residential and commercially owned properties. GPS co-ordinates are from N: 52.334411, E; -6.452088 at the north corner to N: 52.331829, E: -6.451053 in the south. The site is earmarked for significant development, with commercial units, hotel, and outdoor public amenity space planned. Access to the wharf is likely to be across the railway line at the north-western corner of the wharf.

1.4 Site Management Objectives and Threats to Objectives:

The site management objectives, threats to achieving those objectives and the planned strategies for minimising these threats are outlined in Table 1.

Table 1. Site management objectives, threats and mitigation for these threats.

Objective	Threat(s)	Mitigation
1. To prevent the spread of invasive species as a result of the construction works.	Movement of equipment and personnel throughout areas contaminated with invasive species Digging amongst invasive species or areas containing propagules Movement of contaminated clay	Before works begin, Japanese knotweed and Three-Cornered Leek will be treated with herbicides to the reduce their regenerative capacity. Strict biosecurity protocols will be implemented, as outlined in the IASMP. All machinery that is working in infested areas must be thoroughly washed down and certified as clean before leaving a designated zone. Japanese knotweed will be left in-situ wherever possible and subjected to ongoing treatment with herbicides. All contaminated clay will be treated according to the procedures outlined in the IASMP.
2. To enable construction to go ahead in a timely fashion without compromising objective 1.	Works may be delayed due to the implementation of biosecurity protocols, licence applications, waste classification, on-site treatment of or removal of contaminated spoil offsite.	Delays will be minimised by following the protocols laid out in this management plan.
3. To reduce the likelihood of the reintroduction of Japanese knotweed onto the site.	There is a significant amount of Japanese knotweed present close to the site along the Dublin to Rosslare railway line that forms a likely source of reintroduction to the site.	Iarnród Éireann will be engaged with and the merits of a comprehensive survey and treatment programme to all involved will be stressed. The aim is to establish an ongoing treatment and monitoring programme for this line to minimise the risk of reintroduction of Japanese Knotweed onto the Trinity Wharf Development Site.

2.1 Japanese Knotweed

Japanese Knotweed (*Fallopia japonica*) was introduced to Europe by the horticultural activities of Philippe von Siebold, who plucked the plant from the side of a Japanese volcano in the 1840s. It is a fast growing, perennial, herbaceous plant, native to East Asia (Japan, northern China, Taiwan and Korea). In its home range, the plant is not a threat because a host of native predators, fungi and herbivorous insects keep it in check. However, outside Japan it is classified as one of the World's Worst Invasive Species (World Conservation Union). The date of its first introduction to Ireland is not known, but is believed to be in the mid to late 19th century.

Japanese Knotweed can grow >3m high, with young shoots in spring growing up to 10 - 30cm per day, quickly resulting in dense stands that shade out other species. The leaves are a distinctive shape with a tapered tip and a flat base (up to 18cm long) and the mature hollow stems have nodes and look somewhat like bamboo canes. The underground rhizome system can be vast, extending up to 3m deep and 7m horizontally from the nearest visible growth. Japanese Knotweed produces small cream or white flowers in late summer or early autumn. There are only female plants in the UK and Ireland so sexual reproduction is negligible; however, hybrids with related plants can be produced (e.g. Giant knotweed; Russian Vine) and are found occasionally.

Even without sexual reproduction, the plant spreads at a rapid rate by rhizome extension. New plants can also grow from tiny fragments of rhizome (as little as 0.7 grams) or stems, which means that traditional control methods such as cutting or strimming will actually further spread a knotweed infestation. Some of the most likely routes for knotweed spread are via our roads, rivers and railway lines as tiny fragments are dragged along these routes enabling them to quickly colonise new areas. Knotweed is also often spread by the movement of contaminated soils offsite and the improper disposal of the weed in garden clearings. It can grow on a wide range of soil types, pH and salinity; has the ability to withstand droughts, heat, cold, sulphurous soil; and is tolerant towards heavy metals. This hardiness ensures a wide distribution across habitat types.

Japanese Knotweed's massive rhizome system and vigorous growth can seriously damage walls, foundations, roads and buildings, including historic sites. The plant can also disrupt the integrity of man-made flood defense structures, increasing costs in repair and maintenance. Railway tracks, roads, pavements, and other constructions are also frequently affected.

Other highly invasive knotweeds that occur in Ireland are Giant Knotweed, *Fallopia sachalinensis*, Himalayan Knotweed *Persicaria wallichii* and Bohemian Knotweed *Fallopia x bohemica*, which is a hybrid between Japanese and Giant Knotweed. These other knotweeds are increasingly found in Ireland, though still to a much lesser extent than the Japanese Knotweed.

In Ireland, Japanese Knotweed is classified as a High-Impact Invasive Species with a Risk Assessment Score of 20. It is listed in Part 1 of the Third Schedule of Statutory Instrument 477/2011 (Birds and Natural Habitats Regulations) and spoil contaminated with Japanese Knotweed waste is classified as a vector material in Part 3 of the Third Schedule (see Section 3 for details of this legislation).

2.2 Three-Cornered Leek

Three-Cornered Leek (AKA Three-Cornered Garlic, White Bluebell) *Allium triquetrum* is a bulbous, perennial herb native to Mediterranean countries. It was introduced to the British Isles for cultivation in the 1750s and had become established in the wild on Guernsey & Jersey Islands by the 1850s. In Ireland, it is particularly prevalent along the south-eastern seaboard. This species thrives along road verges, at the base of hedges and in disturbed ground and is easily identified in springtime by its strong garlicky smell and pretty white flowers. Its green leaves are long and slender.

All parts of Three-Cornered Leek are edible, from flowers to leaves to bulbs, and all are strongly reminiscence of garlic. This plant can reproduce by dividing its bulbs or setting seed. Interestingly, its seeds are ant-dispersed. Three-Cornered Leek seeds have an appendage with oil attached, and the ants carry the seeds away in order to eat the oil. Then they discard the seed. Three-Cornered Leek is also sometimes planted by humans in the wild or can be spread accidentally by the movement of contaminated soil and garden waste. Where it becomes established this species can reduce biodiversity by growing earlier in the season than its native competitors and shading these native species out.

In Ireland, Three-Cornered Leek is classified as a Medium-Impact Invasive Species with a Risk Assessment Score of 15. This species is listed in Part 1 of the Third Schedule of Statutory Instrument 477/2011 (Birds and Natural Habitats Regulations; see Section 3 for details of this legislation).

3. INVASIVE ALIEN SPECIES LEGISLATION

The Invasive Species Ireland project identified Japanese Knotweed as one of the highest risk (most un-wanted) non-native invasive species in Ireland. There is strict legislation surrounding Japanese Knotweed and Three-Cornered Leek in Ireland – namely under Irish Statuory Instrument 477/2011 and the Wildlife Acts (1976-2000). We have also ratified a number of international conventions that oblige the Government to address the issue of non-native invasive species, including the Convention on Biological Diversity, the Bern Convention and the International Plant Protection Convention

Irish Statutory Instrument 477/2011

The EC Birds and Natural Habitats Regulations introduced important legislation concerning invasive species in the Republic of Ireland. Japanese Knotweed and Three-Cornered Leek are both listed in Part 1 of the Third Schedule.

Article 49 prohibits the introduction, breeding, release or dispersal of certain species; and Article 50 prohibits dealing in and keeping certain species.

Article 49 (2) "Save in accordance with a licence granted under paragraph (7), any person who plants, disperses, allows or causes to disperse, spreads or otherwise causes to grow in any place specified in relation to such plant in the third column of Part 1 of the Third Schedule, any plant which is included in Part 1 of the Third Schedule, shall be guilty of an offence."

Article 49 (3) states that you can defend against allegations that you committed an offence under Article 49 (1) or (2) by proving that you took all reasonable steps and exercised all due diligence to avoid committing the offence:

Article 49 (3) "Subject to paragraph (4), it shall be a defence to a charge of committing an offence under paragraph (1) or (2) to prove that the accused took all reasonable steps and exercised all due diligence to avoid committing the offence.

Article 50 (2) "Save in accordance with a licence granted under paragraph (7), a person shall be guilty of an offence if he or she imports or transports –

(a) an animal or plant listed in Part 1 or Part 2 of the Third Schedule

(b) anything from which an animal or plant referred to in Part 2 of the Third Schedule can be reproduced or propagated, or

(c) a vector material listed in Part 3 of the Third Schedule,

into or in or to any place in the State specified in relation to such an animal or plant or vector material in relation to that animal or plant or vector material in the third column of the Third Schedule."

The *Wildlife Amendment Act (2000)* of ***The Wildlife Act (1976)*** made it an offence to cause an exotic species of flora to grow in the wild anywhere in the state**:**

"Any person who plants or otherwise causes to grow in a wild state in any place in the State any (exotic) species of flora, or the flowers, roots, seeds or spores of flora, otherwise than under and in accordance with a licence granted in that behalf by the Minister shall be guilty of an offence."

4. SURVEY FINDINGS

A walkover survey was conducted on 3rd Nov, 2017. This survey confirmed the presence of two Third Schedule S.I. 477/2011 invasive alien species –Japanese Knotweed and Three-Cornered Leek. A significant amount of another medium invasive species - *Buddleia davidii* was noted to be present throughout the site; however, this species is not listed in S.I. 477/2011.

4.1 Japanese Knotweed

In total, nine distinct stands of Japanese Knotweed (JK) were recorded during the survey (see Appendix I – Drawings). Each knotweed stand was given a unique identifier or JK number. The details of each stand recorded are outlined in Table 2, including length, width, the average height of the canes, the maximum cane diameter, and any other notable features.

The total above ground area covered by Japanese Knotweed was 1,377m^2, with 1,030m^2 of this recorded along the railway lines and only 347 m^2 growing within Trinity Wharf. All of the JK surveyed appeared to have been growing at the same location for a number of years. JK01 to JK07 were all growing along the Dublin to Rosslare railway line on the western side of the tracks, while JK08 & JK09 were growing within Trinity Wharf. It was noted during the course of the survey that there was a substantial amount of Japanese knotweed present along the western side of the railway tracks continuing further east of the site and that this poses a significant threat for reintroduction (see Appendix II – Photographic Record).

Table 2. Details of each stand of Japanese Knotweed within the survey area

ID	Length (m)	Width (m)	Growth Stage	Avg. Stem Height	Max. Stem Diameter	Close to Water	Likely to Require Excavation
JK01	8.5	3	Dying Back	>2.5m	>2.5cm	No	Yes
JK02	17.4	3	Dying Back	>2.5m	>2.5cm	No	Yes
JK03	2.5	2	Dying Back	>2.5m	>2.5cm	No	No
JK04	15	5	Dying Back	>2.5m	>2.5cm	No	No
JK05	106	Up to 20m	Dying Back	>2.5m	>2.5cm	No	No
JK06	6	2	Dying Back	>2.5m	>2.5cm	No	No
JK07	6	2	Dying Back	1 – 2.5m	1 – 2.5m	No	No
JK08	49	5 to 15m	Dying Back	>2.5m	>2.5cm	Yes	Yes
JK09	9 to 4	10	Dying Back	>2.5m	>2.5cm	No	Yes
Total Coverage of Japanese Knotweed: 1377m^2							

*Areas may differ from length x width due to irregular polygon shapes

4.2 Three-Cornered Leek

There were two stands of Three-Cornered Leek (TCL) recorded on the site (see Appendix I – Drawings & Appendix II – Photographic Record). TCL01 was a 30m long and 1m wide strip of TCL running along the western edge of Trinity Wharf by the fence separating the Wharf from the railway tracks. The plants were approx. 20cm high and flowering/ in leaf. TCL02 ran in a 1 or 2m wide strip for 102m along the western side of the railway line. Most of these plants were 20cm high and in leaf.

5. MANAGEMENT PLANS

Please Note: Although medium-impact invasive species Buddleia was noted during the survey, as this species is not listed in the Third Schedule of S.I. 477/2011 there is no special legal requirement surrounding this species other than not to cause it to grow in the wild.

5.1 Management Plan for Japanese Knotweed

5.1.1 Summary

In order to reduce the regenerative capacity of the Japanese Knotweed present on-site, and the likelihood of reintroduction, all stands should be subject to an on-going herbicide treatment program.

Wherever possible, JK should be treated in-situ with a herbicide programme for a minimum of 5 years by a professional contractor.

Where excavation of JK is necessary due to the proposed works, strict biosecurity protocols must be adhered to. Haulage routes must be clearly defined and lined with an appropriate geo-textile to avoid ground contamination; and wash-down areas and procedures must be in place.

Two different options for the disposal of JK contaminated clay are outlined (subject to licenses/approval): 1. Off-Site Disposal; 2. Soil Screening and Bunding.

We strongly recommend that the client engage in a discussion with Iarnród Éireann and Envirico about the best strategy to tackle the significant Japanese knotweed infestations further along the railway lines in order to minimise the risk of reintroduction.

5.1.2 Herbicide Treatment

Wherever possible, JK should be treated in-situ with herbicides. For all JK stands to be left in-situ a comprehensive treatment programme should be carried out for a minimum of 5 years by a professional contractor. However, even stands that are planned for excavation should have herbicide treatment applied to them at each available opportunity before works commence, in order to reduce their regenerative capability.

All works must be carried out by a professional contractor with specialist knowledge of invasive species.

The Environment Agency (UK, 2013) recommends that wherever possible JK is treated in-situ using herbicides. In-situ treatment is the most environmentally-friendly option, and does not pose the same biosecurity risk as mechanical removal. A herbicide treatment programme is also the most cost-effective option; however, it can take 5 or more years to be completely effective and even after such time, the rhizomes cannot be assumed dead without undertaking viability testing. Therefore, not all JK stands recorded here will be suitable for treatment with herbicides alone.

Legislative Framework

All professional formulation plant protection products must only be applied by a Professional Pesticide User that is registered with the Department of Agriculture, Food and the Marine (as required by the Sustainable Use of Pesticides Directive, 2012). All herbicides will be applied in accordance with current legislation (Sustainable Use of Pesticides Directive, 2012), in compliance with the label, in appropriate weather conditions and following an environmental risk assessment. Application of pesticides near water must have prior approval from Inland Fisheries Ireland, be applied by appropriately trained personnel (PA6AW) and use only aquatic approved products.

Herbicides Effective Against Japanese Knotweed

Currently, the following active ingredients are considered to be the most effective treatment for Japanese knotweed available in the EU. Table 3 outlines some key features of these products.

Table 3. Herbicides currently licenced in Ireland that are effective against Japanese Knotweed. All herbicides are systemic (translocated).

Herbicide	*Licensed Product	PCS No.	Selectivity	Persistence	Timing of 1st Application	Aquatic Approved Product
Glyphosate	Roundup Biactive XL	04660	Non-selective	Non-persistent	Aug-Oct	Yes
Aminopyralid + Triclopyr	Icade Grazon Pro	04249 05182	Selective	Not assessed (not for use on animal feed for 1 year)	Apr-May	No
2-4D Amine	Depitox	02365	Selective	1 month	May	No

***** Only example licence products are displayed, others may be available.

Any chemical treatments for infestations close to water e.g. JK08 should use an aquatic-approved product.

In order for a chemical treatment programme to be successful, it is important that the initial leaves and stalks, and any regrowth remain as healthy as possible until the product is applied. A translocated herbicide is drawn into the plant from where it is applied, and moved to other plant organs incl. roots/rhizomes. Because of this mode of action, a translocated herbicide applied via a foliar spray will be most effective if it has a larger leaf area to cover, and the translocation of the product from the leaves down to the rhizomes will be most efficient if the plant is not damaged or water-stressed.

Table 5. Treatment Schedule

Site Visit	Action	Time	Year
1	Monitor for growth and apply systemic herbicide as necessary	*Apr - Jun*	*2018*
2	Monitor for growth and apply systemic herbicide as necessary	*Jul - Oct*	*2018*
3	Monitor for growth and apply systemic herbicide as necessary	*Apr - Jun*	*2019*
4	Monitor for growth and apply systemic herbicide as necessary	*Jul - Oct*	*2019*
5	Monitor for growth and apply systemic herbicide as necessary	*Apr - Jun*	*2020*
6	Monitor for growth and apply systemic herbicide as necessary	*Jul - Oct*	*2020*
7	Monitor for growth and apply systemic herbicide as necessary	*Apr - Jun*	*2021*
8	Monitor for growth and apply systemic herbicide as necessary	*Jul - Oct*	*2021*
9	Monitor for growth and apply systemic herbicide as necessary	*Apr - Jun*	*2022*

This schedule of works is an estimate only, as it may take fewer or additional site visits to ensure that eradication (no regrowth for 2 years) is achieved.

5.1.3 Excavation

In total there are four JK stands that *may* require excavation as part of the proposed works – JK01, JK02, JK08 & JK09. The above ground area covered by these stands totals 434m^2. When a 7m buffer is placed around these stands, there is a total area of 2,425m^2 that is potentially contaminated. The maximum lateral extent of rhizomes is typically considered 7m with a maximum depth of 3m. Therefore, the maximum volume of JK contaminated material if JK01, JK02, JK08 & JK09 require complete excavation is 7,275m^3. This figure is likely to be a gross over-estimation of the amount of clay containing JK material. A Certified Surveyor of Japanese Knotweed (CSJK) should supervise all excavations within contaminated areas and can restrict the material classified as contaminated to that which actually contains JK material. Under typical conditions, the JK rhizome network does not expand to its maximum possible extent. It is more usual to find the rhizome network contained within 3m lateral spread and 1.5m depth. Therefore, it is more likely that the amount of contaminated clay to be removed if JK01, JK02, JK08 & JK09 require complete excavation would be in the region of 2,718m^3 (calculated from typical rhizome extent of 3m, depth of 1.5m) if done under the supervision of a CSJK.

The volume of material to be excavated will depend on the final development plan and the extent of the development works that take place between the Iarnród Éireann and Wexford County Council boundaries. Depending on the final development plan, it may be that only a portion of the Japanese knotweed requires excavating. In this case, built structures can be protected by the installation of a root barrier membrane in order to keep the amount of excavated material down to a minimum.

Should it be necessary to obtain an accurate estimation of the amount of material to be removed, this can be provided by scraping back the top 25cm of top soil and digging a series of test pits within the buffer zone.

5.1.4 Biosecurity

Exclusion Zones

Any personnel or machinery entering within 7m of a Japanese Knotweed stand is entering a potentially contaminated area and as such must be subject to strict biosecurity protocols. This 7m is designated because the maximum lateral extent of the JK rhizome network is 7m from the nearest visible growth. Exclusion zones must be set up a minimum of 7m away from the nearest visible JK growth. Maps depicting the 7m buffer zones are provided in Appendix I – Drawings.

Exclusion zones should be clearly marked or fenced off in order to prevent accidental incursion.

All PPE, equipment, plant or machinery to enter an exclusion zone must be thoroughly clean before entering.

Routes within the exclusion zone should be overlaid with a geotextile that has a layer of sand on-top to protect it from being damaged by heavy machinery. The geotextile will prevent potentially contaminated clay from being transferred onto tracks, tyres or boots.

A designated wash-down area(s) lined with appropriate geo-textile will be set-up within each exclusion zone. At this/these locations all PPE, plant and equipment must be thoroughly cleaned before leaving the exclusion zone. They should be certified as clean by personnel competent at recognizing JK material incl. rhizome. Any material that has been washed off PPE, plant and equipment will be treated as contaminated and added to material to be removed for disposal or further treatment. Equipment such as a power-washer, buckets with clean soapy water, stiff brushes, hoof-picks, cloths will be available at all times at all wash-down areas.

The amount of traffic in and out of exclusion zones should be kept to a minimum at all times. Machinery should remain outside the zone where possible. For example, long-reach excavators may be utilized to dig material out of an exclusion zone and load it into a truck without having to track inside the exclusion zone at any time. The bucket and arm of the

excavator that operated within the exclusion zone must be subject to the wash-down protocols out-lined above.

Loading Contaminated Material

All trucks to collect JK contaminated material should be lined with appropriate geotextile. Material will be loaded to within no more than 50cm of the top and then covered with geotextile for transport.

Banksmen should be in place during loading of contaminated material to watch for and immediately clean-up any material that is dropped during loading. This material will be added to the load to be transported.

Haulage routes should be lined with geotextile protected with a layer of sand on top and trucks will not deviate from these routes.

Trucks that have been used to transport contaminated material must be thoroughly washed down and certified as clean by a competent person before being put to an alternate use.

After Excavation

Following excavation of JK contaminated material, it must be disposed of appropriately. Currently Irish Waste legislation (Waste Management (Facility, Permit and Registration) Regulations 2007) only allows for disposal at a licensed landfill unless an exemption is granted by the EPA. However, this legislation is currently under review and may be altered in advanced of the proposed works commencing (EPA, *Pers. Comm*., 2017).

5.1.5 Option 1 – Disposal Off-Site

Disposal off-site is a quick and easy method to get rid of JK contaminated material. Currently, it is also the only way to remediate JK material without either obtaining a Waste license or an exemption from the EPA. However, it is very expensive, and the most environmentally damaging method of treating JK.

JK material that is removed off-site in Ireland is either taken to landfill and deep-buried – an unsustainable solution that uses valuable landfill space; or shipped to the Netherlands for incineration – another solution with a heavy carbon footprint.

Legislative Framework

Japanese Knotweed contaminated material can only be removed off-site by a licenced waste haulier and brought to a licenced waste facility. Under Statutory Instrument 477/2011 (Article 50(2)) it is an offence to transport Japanese knotweed contaminated material without first obtaining a licence from National Parks and Wildlife.

Documents Required for Removal of Japanese Knotweed Contaminated Waste

For disposal of Japanese knotweed material off-site two documents are required: a **licence from National Parks and Wildlife (NPWS)**; and a **Waste Classification document**.

Licence from National Parks and Wildlife Service

A licence application must include:

- As much information as possible on the removal, transportation and treatment of the species in question
- A detailed description of the biosecurity measures that will be in place
- A copy of the Knotweed Management plan
- Details of the timeframe for carrying out the work

Waste Classification Document

Japanese knotweed waste may only be transported offsite by a licenced haulier who will require a waste classification document. A soil test is required in advance. The soil can only be transported to a licenced waste facility that has been notified in advance of the nature of the waste and has agreed to accept the waste material.

5.1.6 Option 2 – Soil Screening & Bunding

*This option is subject to EPA approval.

Following excavation, trucks loaded with JK contaminated material will haul this materials along a pre-determined haulage route to a designated area on Trinity Wharf. Trucks will empty the contaminated material in an exclusion zone that is fenced off from the rest of the site and lined with geotextile. They will then move to a geo-textile lined wash-down area that has been set up adjacent to the unloading area for cleaning before they leave the exclusion zone.

The JK contaminated material will then be screened in a geo-textile lined designated area using a series of differently sized metal screens and conveyors that separate the plant material from the clay. Finally, a handpicking station will remove any remaining plant material. The screened clay will be used in the landscaping of a green area by being spread on top at a depth of no more than 0.5m. The plant material will be either removed off-site for incineration (license from NPWS required) by a licensed waste haulier; or incinerated on-site using a mobile incinerator (subject to EPA approval). This spoil used in the landscaping of the green area will be fenced off and subject to ongoing monitoring for 18 months to ensure that if any rhizomes remained after the screening process, they are eradicated as they grow. Following this time, if a layer of more suitable topsoil is required for planting, it can be added and sown.

Any machinery leaving the exclusion zone must be thoroughly washed and certified as clean by a competent person.

5.1.7 Preventing Reintroduction

Currently, there is a high likelihood that Japanese Knotweed will be reintroduced onto the site from further along the railway track if no action is taken to address the infestations present on the Dublin-Rosslare line. Given the significant investment Wexford County Council are making in the Trinity Wharf development, we strongly recommend that Wexford County Council and Iarnród Éireann arrange a meeting where stakeholders can express their concerns and come up with a mutually beneficial action plan. Envirico can attend to offer expert advice on the feasibility of measures discussed.

5.2 Management Plan for Three-Cornered Leek

5.2.1 Summary

Three-Cornered Leek should be left in-situ and subjected to an ongoing chemical treatment programme where possible. Where material that may contain this species needs to be excavated, this material must be removed to an EPA licenced waste facility. Strict biosecurity procedures (see Section 6) should be adhered to in order to minimise the risk of spread.

5.2.2 Herbicide Treatment

Three-Cornered Leek should be sprayed in April with a glyphosate-based herbicide. In order to increase the effectiveness of the herbicide application the leaves should be lightly bruised in advance of treatment. All herbicide treatments will need to be repeated every 2-3 months in order to treat whatever regrowth results from the seed and bulb bank left by this species.

5.2.3 Excavation

TCL01 will likely require excavation as part of the development works. The infestation and an area of up to 2m around and to a depth of 0.5m may contain TCL seeds and/or bulbs. This soil must be disposed of at an EPA licenced waste facility and not mixed with general spoil. It is not necessary to excavate TCL in order to prevent damage to structures that may be built. Placing concrete or any other significant structure on top of TCL will kill the plant.

6. BIOSECURITY PROTOCOLS

Persons entering an area infested with an invasive alien species must take certain precautions to prevent the spread of that species.

These guidelines are to be followed by all persons that enter an infested zone:

- All PPE, other equipment and machinery that enter an infested zone must be cleaned before entering.
- Before leaving an infested area, individuals must thoroughly inspect their clothing, PPE, any equipment and their footwear for rhizomes, or other plant fragments that may be stuck on.
- All personnel should carry a hoofpick or similar implement to thoroughly clean the treads of their footwear with. All footwear must be thoroughly cleaned before leaving an infested zone.
- All PPE, other equipment and machinery, clothing and footwear must be thoroughly cleaned with soapy water and a stiff bristled brush before leaving an infested zone.
- As good practice all staff should follow Inland Fisheries Ireland Biosecurity Protocols when they have entered water or a riparian zone.
- If machinery/plant has entered or worked in an infested zone, it must be thoroughly washed down before leaving the area or working in an uninfested location
- A power washer must be provided for effective cleaning of machinery, along with stiff bristled brushes.

7. CODES OF PRACTICE/SOURCES OF INFORMATION FOR INVASIVE KNOTWEED SPECIES

Ireland

- Invasive Species Ireland Horticultural Code of Good Practice (http://invasivespeciesireland.com/wp-content/uploads/2010/07/Horticulture-Code-Final.pdf)
- National Roads Authority – The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads (http://www.tii.ie/technical-services/environment/construction/Management-of-Noxious-Weeds-and-Non-Native-Invasive-Plant-Species-on-National-Road-Schemes.pdf)
- Invasive Species Ireland Japanese Knotweed Best Practice Management Guidelines (withdrawn since 1st Nov, 2016).
- Inland Fisheries Ireland – Best Practice Guidelines for the Control of Japanese Knotweed (http://invasivespeciesireland.com/wp-content/uploads/2012/01/Best-practice-control-measures-for-Japanese-knotweed.pdf)
- National Biodiversity Data Centre Invasive Species (http://www.biodiversityireland.ie/projects/invasive-species/)
- Invasive Species Ireland Website (http://invasivespeciesireland.com/)
- Sligo Institute of Technology Alien Species (http://staffweb.itsligo.ie/staff/dcotton/Alien_Species.html)
- Online Atlas of the British and Irish Flora (http://www.brc.ac.uk/plantatlas/) – *UK also*

UK

- Property Care Association Code of Practice for the Management of Japanese Knotweed (http://www.property-care.org/wp-content/uploads/2015/04/Code-of-Practice-for-the-Management-of-Japanese-knotweed_v2.7.pdf)
- Environment Agency – The Knotweed Code of Practice Version 3 (withdrawn since 11th Jul, 2016).
- Royal Institute of Chartered Surveyors – Japanese Knotweed and Residential Property (http://www.rics.org/uk/knowledge/professional-guidance/information-papers/japanese-knotweed-and-residential-property-1st-edition/)
- Department for Environment, Food and Rural Affairs Horticultural Code of Practice (http://www.botanicgardens.ie/gspc/pdfs/defra%20code%20of%20practice.pdf)
- GB Non-Native Species Secretariat (http://www.nonnativespecies.org)

8. ABOUT ENVIRICO

Envirico are an Irish ecological company that specialise in invasive species monitoring and control. We tackle invasive alien species found in domestic, commercial and amenity sites in terrestrial, riparian and freshwater habitats.

Our qualifications include:

- Ph.D. Ecology/Microbiology
- MSc Aquatic Ecology
- PCA Certified Surveyor of Japanese Knotweed
- PA1 – Safe use of chemicals
- PA6A – Operating hand-held pesticide equipment
- PA6AW – Operating hand-held applicators to apply pesticides near water
- PA6INJ – Operating hand-held pesticide injection equipment
- PA6MC – Operating other hand-held applicators
- Registered Professional Pesticide User of Pesticides
- SOLAS Safe Pass Certified
- CSCS Personnel
- PTS Certified
- Traffic Management
- HSE Commercial Divers
- National Powerboat Certificate (Level 2)

Our services include:

- Site-Specific, Best-Practice Management Plans
- Site Excavation and Management
- Chemical Control
- Post-Treatment Monitoring
- Completion Certificate
- Habitat Restoration
- Training in Biosecurity and Identification

APPENDIX I – Drawings

Client:
Wexford County Council
Carricklawn
Wexford
Y35 WY93
Tel: +353 53 9196000

Consultant:

Envirico
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Co. Kilkenny
R95 V2T4
Tel: +353 56 7801277
Email: info@envirico.com
Web: www.envirico.com

Drawing Title:
DRAWING 1: INVASIVE SPECIES

Project Name: Invasive Alien Species Survey (Trinity Wharf Development)

Project Code:	*Drawn:*	*Approved:*
00082	AG	MB

Date:	*Drawing Number:*
14th Nov, 2017	*0082.1/Trinity Wharf/2017*

Source Background Digital Orthophoto:
Google Maps, 2017

APPENDIX II – Photographic Record

Fig 1. JK01

Fig 2. JK02

Fig 3. JK03

Fig 4. JK04

Fig 5. JK05

Fig 6. JK06

Fig 7. JK07

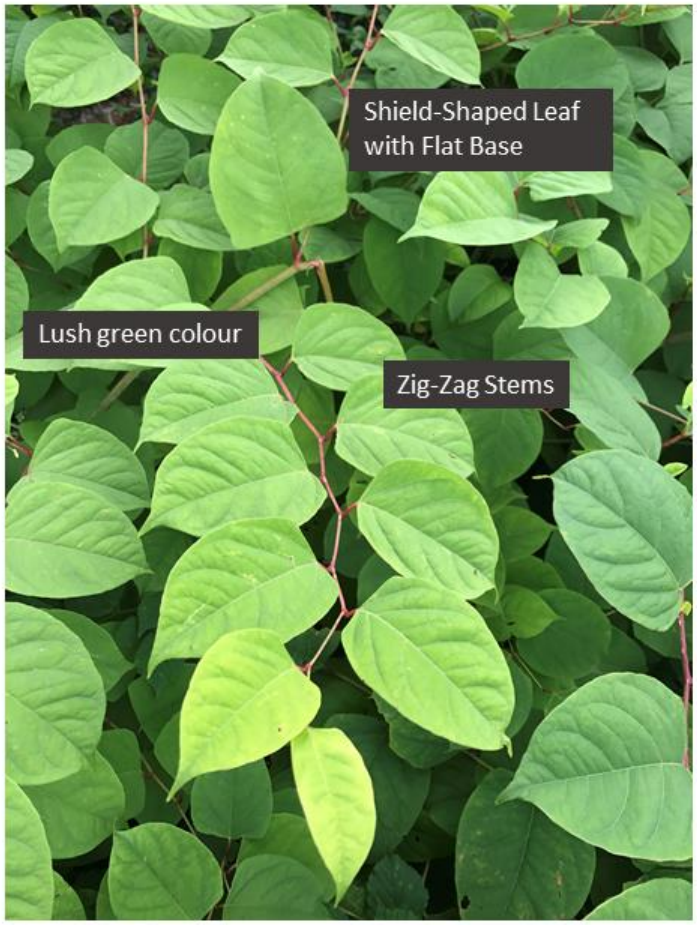
Fig 8. JK08

Fig 9. JK09

Fig 10. TCL01

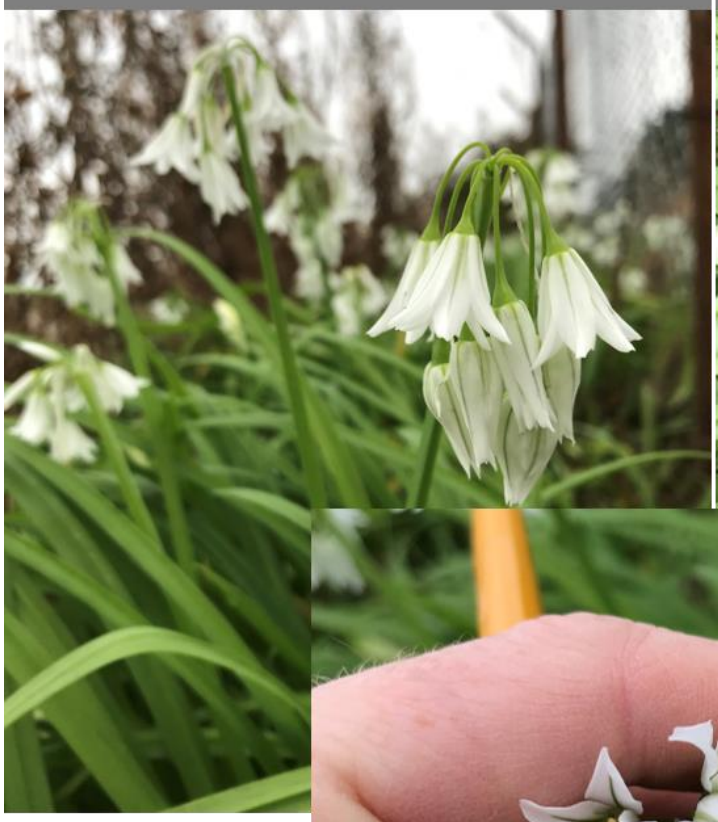
Fig 11. TCL02

JAPANESE KNOTWEED IDENTIFICATION SHEET

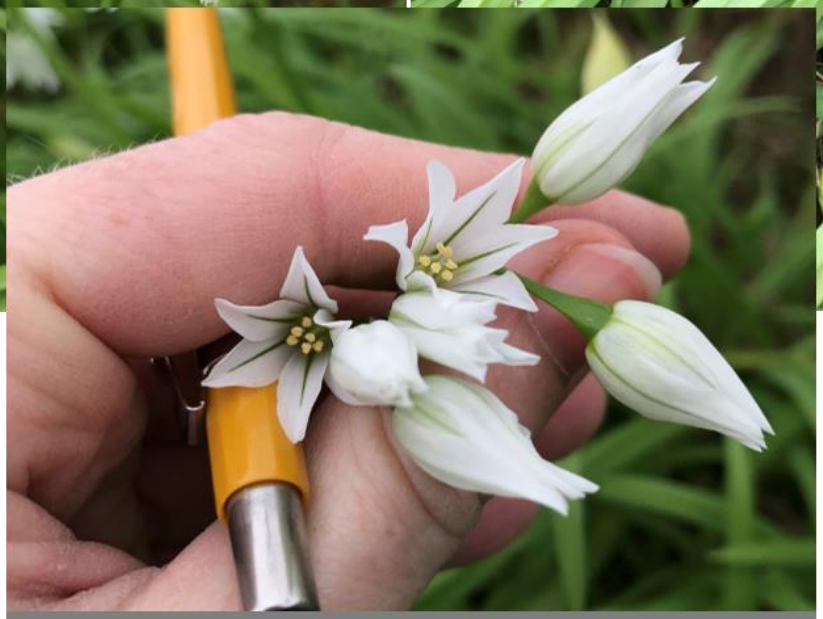


Three Cornered Leek Identification Sheet

White Flowers all pointing downwards



This herb has long, narrow green leaves



Flowers also have green lines inside