APPENDIX 10.1

NRA CRITERIA FOR RATING THE MAGNITUDE AND SIGNIFICANCE OF IMPACTS AT EIA STAGE

VOLUME III

APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

APPENDIX 10.1

NRA CRITERIA FOR RATING THE MAGNITUDE AND SIGNIFICANCE OF IMPACTS AT EIA STAGE

Impact Ratings and Assessment Criteria (Soils, Geology and Hydrogeology)

The NRA criteria for rating the magnitude and significance of impacts at EIA stage on the geological related attributes are also relevant in determining impact assessment and area presented in Table 2 below.

Table 1 Criteria for rating site importance of Geological Features (NRA)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying route is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/or high fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance or value on a local scale Degree or extent of soil contamination is moderate on a local scale Volume of peat and/or soft organic soil underlying route is moderate on a local scale	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying route is small on a local scale	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral resource.

Table 2 Criteria for rating impact magnitude at EIS stage – Estimation of magnitude of impact on soil / geology attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Loss of small proportion of future quarry or pit reserves
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

The NRA criteria for estimation of the importance of hydrogeological attributes at the site during the EIA stage are summarised below.

Table 3 Criteria for rating Site Attributes - Estimation of Importance of Hydrogeology Attributes (NRA)

Magnitude of Impact	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple well fields Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Inner source protection area for
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes

Table 4 Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Hydrogeology Attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident <0.5% annually.

Table 5 Rating of Significant Environmental Impacts at EIS Stage (NRA)

Importance of Attribute	Magnitude of Importance			
	Neglible	**Small Adverse**	**Moderate Adverse**	**Large Adverse**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

Table 6 Criteria for rating impact magnitude at EIS stage – Estimation of magnitude of impact on hydrology attributes (NRA, 2009)

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Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and/ or quality and integrity of attribute	Loss or extensive change to a water body or water dependent habitat
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Calculated risk of serious pollution incident >1% annually2
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level >10mm1
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Negligible change in predicted peak flood level1
Minor Beneficial	Results in minor improvement of attribute quality	Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually2
Moderate Beneficial	Results in moderate improvement of attribute quality	Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually2
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100mm1

Additional examples are provided in the NRA Guidance Document

1 Refer to Annex 1, Methods E and F, Annex 1 of HA216/06

1 Refer to Appendix B3 / Annex 1, Method D, Annex 1 of HA216/06

Source: 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' by the National Roads Authority (NRA, 2009)

Table 7 Criteria for Rating Impact Significance of Hydrological Attributes (NRA, 2009)

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local scale	Salmon fishery Locally important potable water source supplying >1000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2- 3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Source: 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' by the National Roads Authority (NRA, 2009)

APPENDIX 10.2

SERVICES DESIGN REPORT

VOLUME III

APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

ROCKWOOD LTD
CHARTERED ENGINEERS

DESIGN PACKAGE

FOR

Alterations & Extensions to Store Buildings at Greenore Port, Greenore Co.Louth

SERVICES DESIGN REPORT

18th March 2020

Address: Rockwood Engineers Ltd
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Project No: 18-016

Issue No.:	01				
Date:	Mar 20				
Prepared by:	C.D.				
Approved by:	C.D.			Revision	A

ROCKWOOD LTD
CHARTERED ENGINEERS

Job: Alterations & New Store Buildings at Greenore Port, Greenore Co. Louth

Job Ref: 18016

Calcs by: C.D.

Date: March 2020

CONTENTS

1.0 Introduction

Rockwood Engineers Ltd have been instructed by Doherty Build Ltd on the client's behalf to complete the Engineering Services Design for Proposed Alterations & New Stores at Greenore Port Ltd.

The following document details the design aspects of main infrastructure for including surface water, foul sewer drainage for the above works. It is acknowledged that the existing site has existing infrastructure and that the proposed extensions and new build stores will involve relocation of same.

Consultations have been held with the local authority (Louth County Council) to discuss the preliminary design proposals and agree the criteria for the development.

2.0 Site Location

The site is in Greenore Port, Greenore, Co. Louth. The site is bounded within the Port confines at Greenore. Vehicular access is through Port Entrance, access to Pedestrians is prohibited. See site location below.

3.0 Proposed Works & Layout

The development will consist of:

i) the construction of 2 no. extensions (Proposed Extension No.1 & Proposed Extension No.2) to the existing former OpenHydro building (1,686 sq.m) at the southwest and the northeast elevations of the building. The new store area following completion of the proposed extensions will be 3,185 sq.m. Identified as thus;

ii) the raising of the roof of existing Store 0 (1,645 sq.m) by 2.4m; Identified as thus;

4.0 Storm Water Drainage

Please refer to drawing No. 18016-DR-01 for layout details.

The port currently has an existing stormwater drainage network in place. This serves as a drainage network for both yard surface water and roof water from buildings. The system drains via gravity and discharges via two different existing outlets. These are identified as Storm Water Outfall 1&2 – indicated on drawing 18016-DR-01.

The proposed new extension areas of stores are being constructed on the existing yard areas of the port. These new roof areas will be taken in place of existing concrete yards areas which are currently being drained by gullies into the surface water drainage system. These impermeable concrete yard areas are now being reclassified as roof rainwater areas and will be connected into the existing network as before. As such, the proposal does not affect or alter the impermeable areas involved or discharge points of the current storm network.

Impermeable areas generating run-off pre-development and post-development remain the same. The outfall points also remain the same. No increased volumes will be discharged via either Storm Outlet.

The design primarily involves the interception and relocation of some existing storm drainage network lines around the footprint and extremities of the new extension areas. Areas currently drained by yard gullies will be converted into new roof area drainage via downpipes into the same stormwater drainage network before discharge.

The lowest existing or proposed floor level for the stores within the works is 4.60m. This is well above the predicted extreme water level of 4.22m AOD.

5.0 Foul Drainage

Please refer to drawing No. 18016-DR-01 for layout details.

The port currently has an existing foul drainage network in place comprising of a foul septic tank and foul lines servicing buildings in the port. The foul collection tank is located under the floor of existing store 0 collecting foul effluent from the port and a number of local housing units. Consultation has taken place with Irish Water and there is an agreed procedure in place with Greenore Port for cyclical emptying of the tank, see Appendix B. The proposed works will have no impact or require alterations to the foul network. The proposed new extension areas do not require a foul connection.

6.0 Watermain

The proposed works does not require a foul line connection.

7.0 Methodology

<u>Program of Works:</u> Start date for new works is yet to be confirmed.

<u>Existing Services:</u> Any existing Watermain, underground ESB and Eircom cables and existing foul/storm lines are services that may be encountered during the work. These services will be encountered in the existing yard and will be located before works commence, by existing services drawings, hand digging and "cat-scan". The services through the works area are well documented presently but all normal safe works procedures and risk control will be implemented as standard practice.

<u>Procedure/Method of work:</u> All work will be carried out within the closed-off sections of the port. Existing yard concrete will be cut with a road saw. The concrete material in the track will be broken prior to digging with a rock hammer. Excavated spoil will be loaded and disposed off-site. Trench boxes with access ladders are not expected to be required due to

the shallow trench depth. These will be available on site if required. Laser Guidance is to be used for all pipe laying to correct Invert Levels and manhole cover installation. The backfill of the track will be done in accordance with the "Specifications for Road Works" published by The Department of Environment & Requirements of Louth County Council.
In addition, all trenches opened to lay pipes in vehicular areas, in excess of 600mm wide, to be backfilled above pipe bedding with CL. 804 compacted stone.
Manhole lids are to be grade D400.
A road opening licence will not be acquired as services are not on public roads.

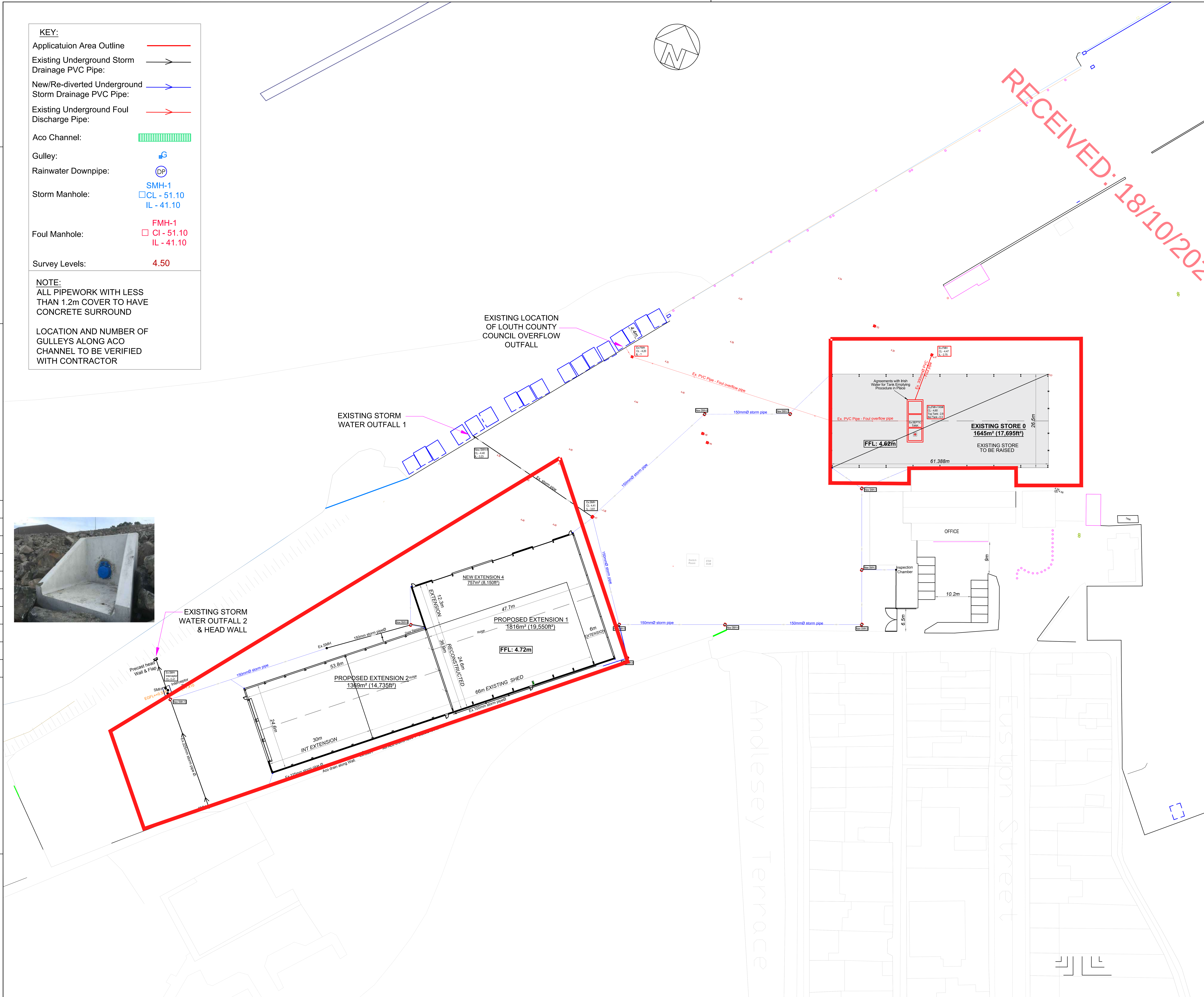
Appendix A

KEY:

Applicatuion Area Outline	
Existing Underground Storm Drainage PVC Pipe:	
New/Re-diverted Underground Storm Drainage PVC Pipe:	
Existing Underground Foul Discharge Pipe:	
Aco Channel:	
Gulley:	G
Rainwater Downpipe:	DP
Storm Manhole:	SMH-1 CL - 51.10 IL - 41.10
Foul Manhole:	FMH-1 CI - 51.10 IL - 41.10
Survey Levels:	4.50

NOTE:
ALL PIPEWORK WITH LESS THAN 1.2m COVER TO HAVE CONCRETE SURROUND

LOCATION AND NUMBER OF GULLEYS ALONG ACO CHANNEL TO BE VERIFIED WITH CONTRACTOR



RESIDUAL DESIGN HAZARDS

(The following information has been collected from Preconstruction Information – Hazard Management for Designers.)

1. Lifting of Steelwork
2. Working at Height

GENERAL NOTES:

1. Do not scale this drawing - work to figured dimensions only.
2. This drawing is to be read in conjunction with all relevant Architect's, and Service Engineer's drawings.
3. Refer to Architects drawings for overall set-out of the building footprint.
4. The Main Contractor is responsible for the stability of the construction work at all stages.
5. The Contractor shall verify all existing conditions and dimensions prior to beginning construction and/or ordering materials. Any discrepencies shall be brought to the attention of the engineer immediately.

DRAINAGE NOTES

Existing Drainage

Contractor to establish exact depth and location of all existing main services on site the contractor shall check the invert levels of existing drains, sewers and manholes before laying new pipes and shall notify the architect immediately if the declared invert levels are found to be inaccurate.

All redundant inspection chambers / manholes and drains to be removed or filled using a weak concrete mix 10-15N/mm².

All connections into existing drainage are to be at the same level and in the direction of flow.

All existing manholes to which connections are to be made are to be thoroughly cleaned out and all benching and channels to be repaired as necessary.

Trenching

Trenches for all drains to comply with the 'Building Regulation Technical Booklet N' and to be excavated to the satisfaction of the Architect and Building Control Authority, in depths to suit manhole invert levels and to widths recommended for nominal pipe diameters.

Trench bottoms to be kept free from water and hard or soft spots and provide an even bedding for the pipe barrels.

Pipes and Fittings

P.V.C. pipes and fittings to be 'Wavin' P.V.C. or other equal and approved and to comply with B.S.4660, B.S.5481, B.S.4962 and are Kite marked.

Sealing Rings and gaskets to comply with B.S.2494.

Pipe diameters to be as marked on drawings with connecting drains from gullies, floor drainage channels, fittings etc. to be 100mm diameter laid to a gradient of not less than 1:40 unless otherwise directed.

Provide 75mm deep seal traps to all wash hand basins and sinks.

Waste from shower trap shall be fitted with a trap incorporating a removable waste dip tube.

The upper end of soil stack shall terminate either in the external air at least 900mm above any opening into a building within 3.0m and be fitted with a cage or cover, which does not restrict the air flow or with an air admittance valve, which is the subject of a B.B.A. Certificate and is issued in accordance with the terms and conditions of that certificate.

Laying of Pipes

Pipes to be laid, tested and backfilled strictly in accordance with manufacturers instructions and to the satisfaction of the Building Control Authority.

Vertical bends, gullies and shoes to be bedded and surrounded in concrete with all gullies and traps to be back inlet type having galvanised cast iron gratings 150mm square.

Gully Traps

Back inlet gully traps shall be roddable type 'Wavin Drain Bottle Gully' Ref: 4D 900 or other equal and approved.

All gullies to have galvanised cast iron gratings 150mm square.

Drawn:	.	For comment	
Design:	.	For Planning	✓
Appd:	.	For construction	
Date:	.	As constructed	
		Other	

Rev	Revision details	Appd	Date
P1	Text	.	.

Drawing Title

Proposed modifications & extensions to the Former OpenHydro Building and proposed modification to existing Store 0 - Drainage Layout

Client

Greenore Port Ltd

Date : March 2020

Scale : 1/500 @ A1

Drawing No 18016-DR-01

Rev .

ROCKWOOD LTD

CHARTERED ENGINEERS

Appendix B

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Greenore Port Unlimited
Greenore Port
Greenore
Co. Louth

26th November 2019

Re: Proposed Development at Greenore Port

To Whom It May Concern,

The proposed plans for the redevelopment of an existing warehouse at Greenore Port have been reviewed by Irish Water. Within the warehouse there are three access cover manholes that provide access to the underlying septic tank chamber that serves the village of Greenore. Below is a short summary of the history of this sewerage treatment system and Irish Water's interest in same.

An Indenture from 10th September 1952 between the Dundalk, Newry and Greenore Railway Company transferred the Greenore water supply and drainage system, including the septic tank, into the ownership of Louth County Council. A Planning Application was lodged with Louth County Council in 1995 (ref. 95136) by Greenore Ferry Services Ltd. for the building of a warehouse over the septic tank. The planning application was granted, with several conditions relating to the wastewater treatment system, essentially re-asserting Louth County Councils ownership of the septic tank and underground assets and ensuring continued unfettered access to it for desludging and maintenance purposes. On 1st January 2014, responsibility for the public wastewater treatment system transferred from Louth County Council to Irish Water. Irish Water continues to require access to the septic tank chamber for maintenance and desludging purposes.

Irish Water has met with the Greenore Port Company on a number of occasions in relation to their proposed development, most recently on 30th September 2019. Irish Water has no objection in principle to the proposed development, on condition that; our legal interest in the sewerage treatment system is protected, that nothing relating to the use of the store causes a deleterious effect on the operation of the sewerage treatment system and that unrestricted access to it for maintenance purposes is maintained.

Yours sincerely,

PP Kathleen Gun

Donal Heaney

Regional Asset Operations Lead

APPENDIX 10.3

HYDROLOGICAL RISK ASSESSMENT

VOLUME III

APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

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HYDROLOGICAL & HYDROGEOLOGICAL QUALITATIVE RISK ASSESSMENT

GREENORE PORT OPERATIONS AND MAINTENANCE (O&M) FACILITY GREENORE, CO. LOUTH

Technical Report Prepared For

Greenore Port Unlimited Company

Technical Report Prepared by

Marcelo Allende
BSc, BEng, Senior Environmental Consultant

Our Reference

MA/237501.0452WR01

Date of Issue

27 May 2024

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Directors: F Callaghan, C Dilworth,
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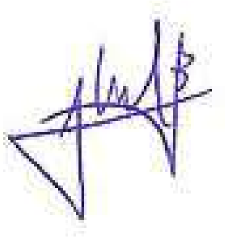
Record of Approval

Details	Written by	Approved by
Signature		
Name	Marcelo Allende	Teri Hayes
Title	Senior Environmental Consultant	Director
Date	27May 2024	27May2024

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FIGURES

TABLES

1.0 INTRODUCTION

1.1 Background

AWN have been requested by Greenore Port Unlimited Company to carry out a Hydrological and Hydrogeological Qualitative Risk Assessment for a development on a 4.88-hectare site at Greenore Port, Greenore, Co. Louth.

This report was prepared by Marcelo Allende (BSc, BEng), and Teri Hayes (BSc MSc PGeol EurGeol). Marcelo is a Water Resources Engineer with over 15 years of experience in environmental consultancy and water resources studies. Marcelo is a Senior Environmental Consultant (Hydrologist) with AWN Consulting, a member of the International Association of Hydrogeologists (Irish Group) and a member of Engineers Ireland (MIEI). Teri is a hydrogeologist and an environmental consultant with over 30 years of experience. managing environmental impact assessment, water resource assessment, contaminated land and licencing projects. Teri has led and contributed to many projects which have successfully achieved planning and licencing. Teri is a member and former President of the International Association of Hydrogeologists (IAH) and is a professional member of the Institute of Geologists of Ireland (IGI) and European Federation of Geologists (EurGeol). Her experience includes expert witness at public hearings, lecturing in EIA and risk assessment and providing expert advice for planning authorities and An Bord Pleanála.

The development describes as follows:

Greenore Port Unlimited Company intend to apply for a 10-year permission for development at Greenore Port and site of dwelling house on Shore Road (A91DD42), Greenore, Co. Louth, (total site area c.4.88 hectare). The development comprising of Operation and Maintenance (O&M) Facilities will serve as the support base for future offshore wind arrays in the Irish Sea.

The proposed development will comprise of:-

(i) Three standalone buildings, each with a gross floor area (GFA) of 1,670 sqm, comprising 681 sqm warehouse floor space, 322 sqm office space and 667 sqm plant, welfare, storage, ancillary and circulation space per unit. The height of each unit ranges from 7.2m for the warehouse (single-storey / double-height space) to 13.5m max for the office 3-storey element. 76 car parking spaces are proposed distributed adjacent to the units including 6 no. disabled parking spaces and 15 no. electric vehicle (EV) charging spaces. Each building includes an internal bike storage room, with 20 spaces per building. Each building includes rooftop solar photovoltaic panels.

(ii) Nearshore works including dredging of harbour sediments to -4m Chart Datum to provide navigable water depths, new quay wall (70m), a 40m anti-slip access ramp, floating pontoon for berthing crew transfer vessels (CTV's). 9 no. berths are proposed, with an additional 2 no. layby berths and a push-on / service berth adjacent to the new quay wall.

(iii) Improvement works to the quay deck including installation of a new reinforced concrete deck with surface water management system incorporating silt traps and hydrocarbon interceptors, and berth infrastructure including bollards, fenders, ladders, lifesaving equipment, power outlets and fire hydrants.

(iv) Surface car park at the Residential site on Shore Road comprising 135 car parking spaces, including ducting for 30 no. EV charging spaces, relocation of existing entrance on Shore Road by c.6m to the east, new boundary wall to Shore Road and a pedestrian access route from the car park through port lands to the O&M Units crossing improved public realm at top of Euston Street.

(v) Re-instatement of former Open Hydro carpark (62 spaces) until the surface car park on Shore Road is operational.

(vi) Upgrade to public/private realm in the foreground of the existing Greenore Port Office building, including upgrade of existing entrance to former open hydro carpark, new pedestrian gate, new feature wall entrance, removal of 6 port car parking spaces, link to new pedestrian route from surface carpark including new opening in port boundary wall, and hard and soft landscaping. Works are partially located within the Greenore Architectural Conservation Area (ACA).

(vii) Replacement of existing 25m mast with new 40m mast to facilitate communications with CTV's while offshore.

(viii) Demolition works to facilitate the above development including:-

a. The former "Open Hydro" warehouse (c. 1,607 sqm GFA);

b. Part of single storey office building (c.38sqm GFA) located adjacent to the entrance to former Open Hydro carpark;

c. ESB substation and associated switch room;

d. Dwelling house (c. 192sqm GFA) and boundary wall on Shore Road.

(ix) And all associated site and development works including single storey ESB substation, above-ground fuel storage tank (c. 200m3), drainage and utilities, landscaping and boundary treatments, security fencing, lighting and signage, etc.

The potential impacts on the receiving water environment considered are:

- Management of foul, surface water run-off and accidental oil leaks during construction.
- Connection to foul sewer and stormwater sewer during operation.

1.2 Hydrological Setting

The application site is located at Greenore Port. The port currently has an existing stormwater drainage network in place. This serves as a drainage network for both yard surface water and roof water from buildings. The system drains via gravity and discharges via two different existing outlets which in turn discharge directly into the Carlingford Lough coastal waterbody; it should be noted that this system includes hydrocarbon interceptors.

Carlingford Lough hosts Natura 2000 Sites (refer to Figure 1.1 and Figure 1.2 below) and there is a direct spatial overlap with the SPA and SAC.

Currently, there is a direct hydrological linkage between the proposed development sites and these sites through the existing stormwater drainage network, which outfalls into the Carlingford Lough. In addition, foul water from the site is eventually treated in

Dundalk WWTP, which in turn discharges into Dundalk Bay, which also hosts Natura 2000 sites (Dundalk Bay SAC/SPA).

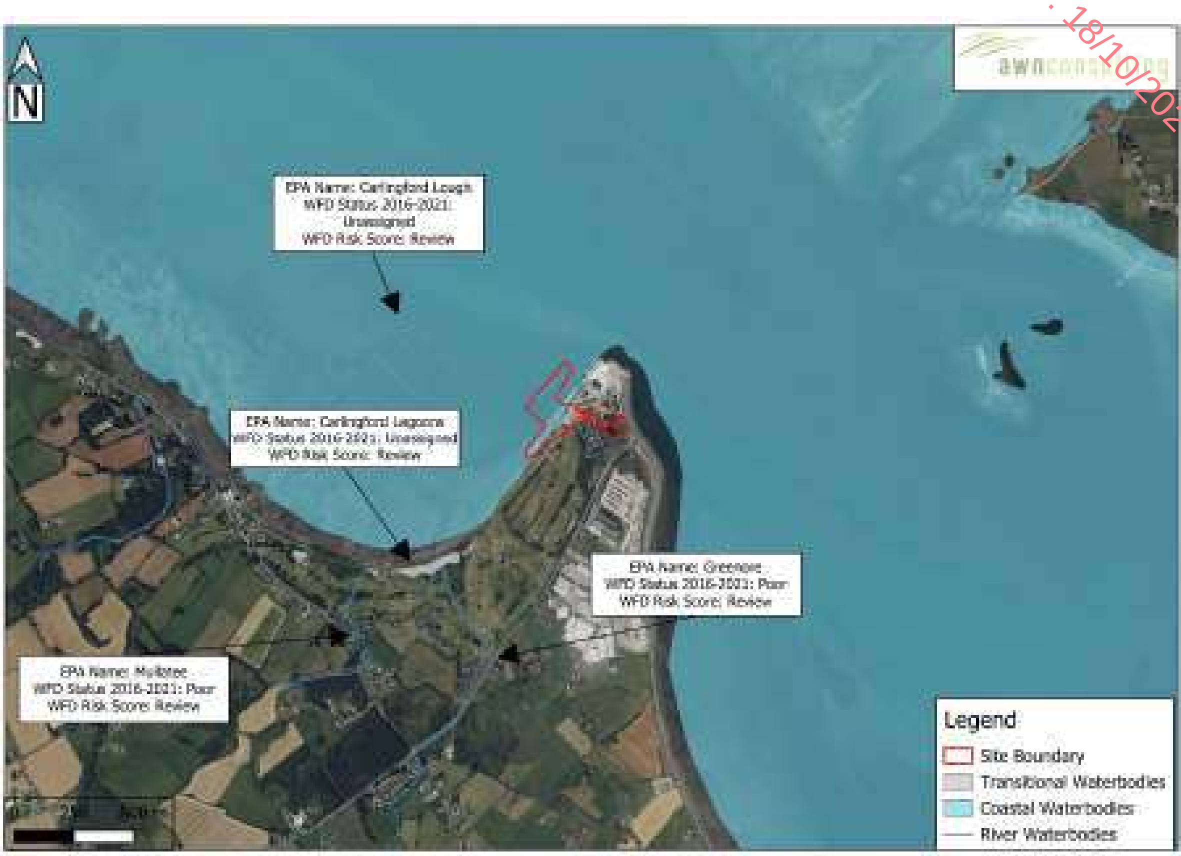

Figure 1.1 *Site Location with Hydrological Environment*

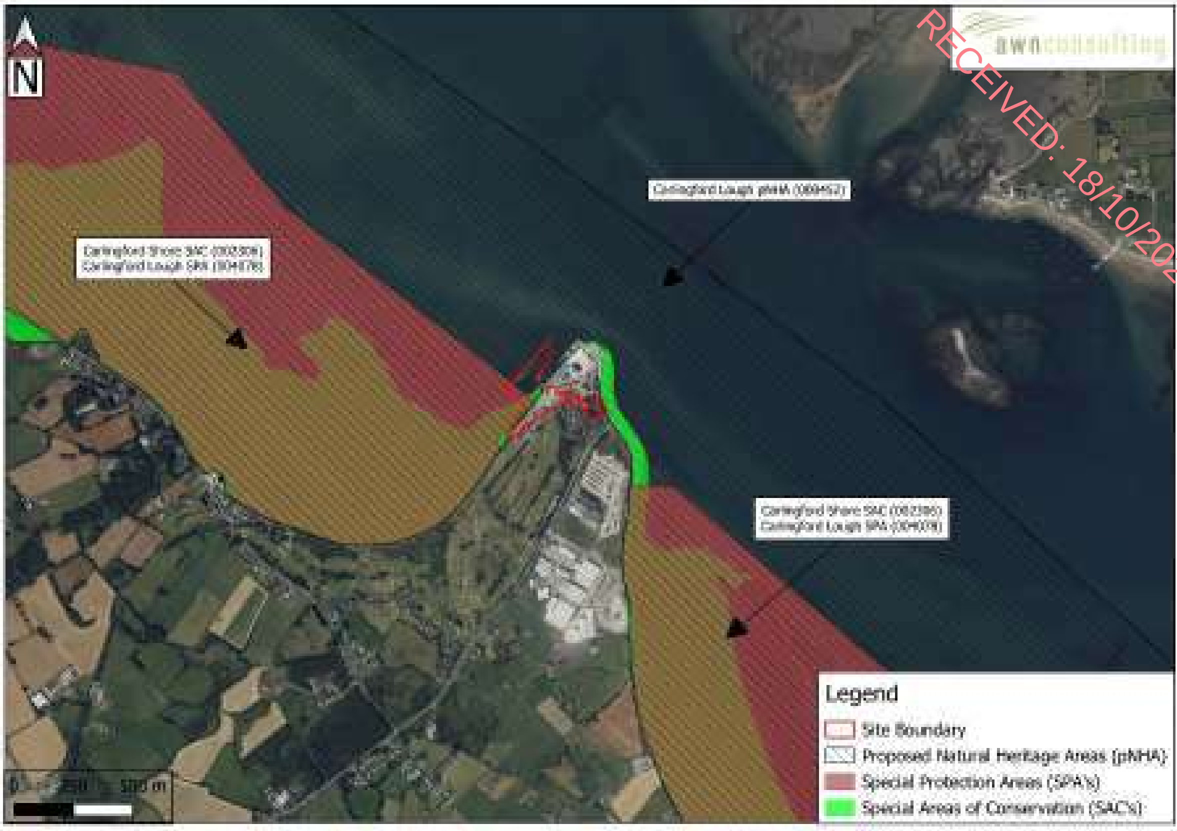

Figure 1.2 *Site Location with Natura 2000 Sites*

1.3 Objective of Report

The scope of this desktop review is to assess the potential for any likely significant impacts on receiving waters and protected areas during construction or post development, in the absence of taking account of any measures intended to avoid or reduce harmful effects of the proposed project (i.e., mitigation measures).

In particular, this review considers the likely impact of construction and operation impacts (construction run-off, domestic sewage and accidental spillage) from the proposed development on water quality and overall water body status within Natura 2000 Sites within Carlingford Lough (where the relevant European Sites are located). The assessment relies on information regarding construction and design provided by Greenore Port Unlimited Company for the proposed development including:

- Pre-Connection Enquiry Cover Note. P22034 Greenore Port OMF. McCarthy Browne Civil & Marine Consultants, July 2023 and subsequent Confirmation of Feasibility from Uisce Eireann.
- Flood Risk Assessment Greenore Port OMF. McCarthy Browne Civil & Marine Consultants.
- Outline CEMP Greenore Port OMF McCarthy Browne Civil & Marine Consultants.

In addition to project-specific reports, the following report prepared in support of an extant permission for port storage facilities was reviewed for information on the existing infrastructure: Services Design Report. Alterations & Extensions to Store Buildings at Greenore Port, Greenore Co.Louth. Rockwood Chartered Engineers, March 2020.

1.4 Description of Existing and Proposed Drainage

Existing and Proposed Surface Water Drainage

As mentioned in Section 1.3 above, the port currently has an existing stormwater drainage network in place. This serves as a drainage network for both yard surface water and roof water from buildings. The system drains via gravity and discharges via two different existing outlets which in turn discharge directly into the Carlingford Lough coastal waterbody.

The proposed surface water drainage will not include new outfalls into Carlingford lough as part of the development; the existing outfalls will be used, and their capacity will not be increased in size.

The collected runoff will be discharged through an existing outfall at Berth 3 and the discharge pipe will remain its size. The surface catchment area will increase in comparison with the existing situation; however, it is intended to attenuate storm volumes and ultimately outfall them at a restricted greenfield runoff rate. A petrol bypass interceptor is proposed before the discharge point at Berth 3 (refer to Figure 1.3 below).

All other surface water outfalls shall remain the same unaffected. The proposed surface water drainage system designed for this development includes a number of Sustainable Urban Drainage Systems (SuDS) measures which will be incorporated to reduce run-off volumes and improve run-off water quality. The SuDs mechanisms will comprise existing gullies, and the proposed underground attenuation tank together with flow control device and petrol interceptor. These features will be provided to cater for up to a 1-in-100-year rainfall event plus 20% allowance for climate change characteristics.

In addition, the catchment at the satellite carpark will be connected to the public Louth County Council surface water collection on the coast road which has sufficient existing capacity.

Refer to the Services Design Report for further details.

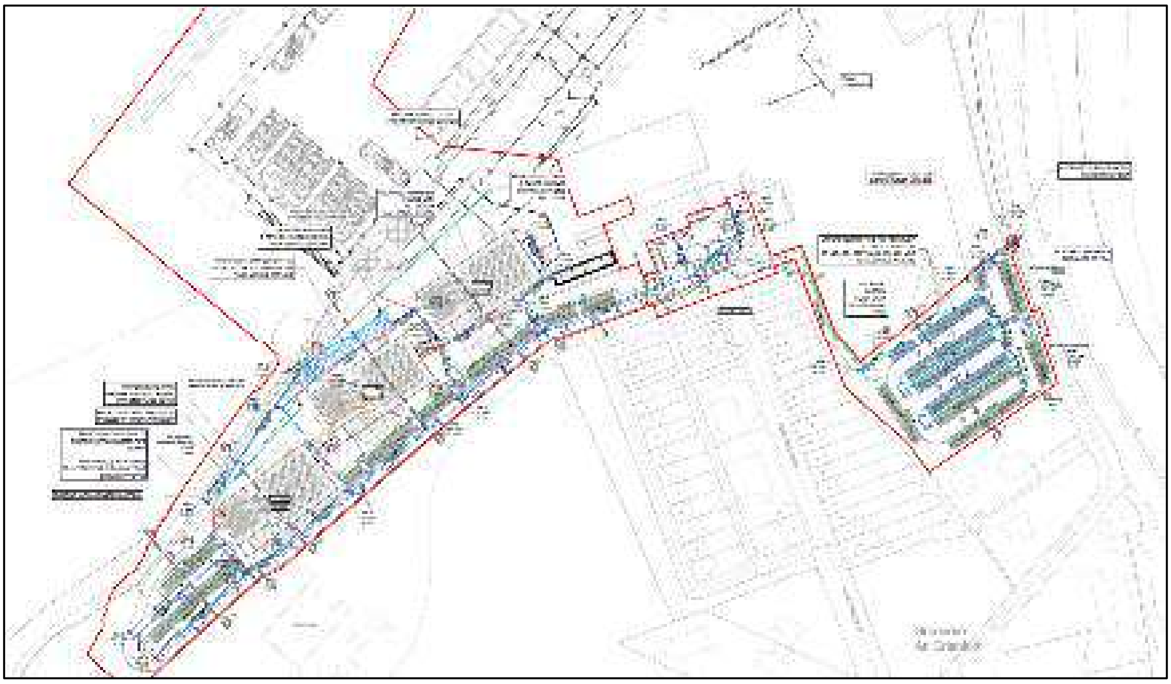

Figure 1.3 *Proposed Surface Water Drainage (Source: CSEA, 2023)*

Flood Risk Assessment

According to the Flood Risk Assessment carried out by McCarthy Browne, the location of the proposed development is predominantly within Flood Zone C (i.e., where the probability of flooding from rivers and coastal is less than 0.1% or 1 in 1000 years – probability of fluvial flooding is low risk). The final design has estimated a finished floor level of no lower than 5.05m OD which has considered a safe freeboard above the water level estimated for Flood Zone C. Therefore, any flood events will not cause flooding of the Proposed Development, and the development will not affect the flood storage volume or increase flood risk elsewhere.

Existing and Proposed Foul Water Drainage

The port currently has an existing foul drainage network in place comprising of a foul septic tank and foul lines servicing buildings in the port. The foul collection tank is located under the floor of an existing warehouse, 'Store 0' and collects foul effluent from the port and the village. The collection tank is a Uisce Eireann asset, and they are given access to the site to allow tankers enter and empty the chamber for off-site disposal.

There is an existing 150mm connection to the public Louth County Council/ Irish Water collection foul network from an existing building to be demolished. It is intended to continue this connection and repurpose it for the new development. This foul network in the port and the surround town and hinterland is collected in public network that terminates in the aforementioned Uisce Eireann collection tank in Greenore port (in the warehouse). This tank is then emptied with a tanker periodically and sent to Dundalk Waste Water Treatment Plant (WWTP). There will be no direct foul water discharge into Carlingford Lough.

2.0 ASSESSMENT OF BASELINE WATER QUALITY, RIVER FLOW AND WATER BODY STATUS

A reliable Conceptual Site Model (CSM) requires an understanding of the existing hydrological and hydrogeological setting. This is described below for the proposed development site and surrounding hydrological and hydrogeological environs.

2.1 Hydrological Catchment Description

The proposed development site lies within the Newry, Fane, Glyde and Dee Catchment 06 and Big [Louth]_SC_10 WFD sub-catchment 06-9 (Greenore_010 WFD River Sub Basin). According to the EPA river network (EPA maps, https://gis.epa.ie/EPAMaps/ accessed on 12-10-2023), the nearest surface water receptor is the Carlingford Lough coastal waterbody (WFD code: GBNIIE6NB030) which is located adjacet the proposed development site.

The Environmental Protection Agency (EPA, 2023) on-line mapping presents the available water quality status information for water bodies in Ireland. The most recent WFD Status score (2016-2021) states that the Carlingford Lough has an '*Unassigned*' status while its WFD risk score is '*Under Review*' (refer to www.catchments.ie).

Nevertheless, the Northern Ireland Environment Agency (NIEA) Catchment Data Viewer also presents the water quality status for water bodies in Northern Ireland. As such, the Carlingford Lough coastal waterbody has a '*Moderate*' status for the period 2016-2021.

As the proposed development will have no additional stormwater run-off, when compared with the greenfield situation, during a stormwater event, the development will, therefore, have no measurable impact on the water quality in any overflow situation at Dundalk WWTP apart from a minor contribution from foul sewage. As explained in Section 3.4 below, the maximum contribution of foul sewage (peak flow of 1.25 l/s) from the proposed development is 0.19% of the peak hydraulic capacity at Dundalk WWTP. According to the AER 2022 for the Dundalk WWTP, the maximum organic capacity (peak week) during 2022 was 55,507 PE, whilst the maximum organic capacity (as constructed) is 61,000 PE which means that currently the Dundalk WWTP would have a 9.0% of remaining capacity.

2.2 Aquifer Description & Superficial Deposits

Mapping from the Geological Society of Ireland (GSI, 2023 http://www.gsi.ie, accessed on 12-10-2023) classifies the bedrock beneath the site and the surrounding area as dominated by rocks from the Carboniferous system. The site is located over the Dinantian Limestones rock unit (Rock Unit new code: CDDIN) which is described as undifferentiated limestone. The GSI also classifies the principal aquifer types in Ireland as:

- Lk - Locally Important Aquifer - Karstified
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive
- Rkd - Regionally Important Aquifer (karstified diffuse)

Presently, from the GSI (2023) National Bedrock Aquifer Map, the GSI classifies the bedrock aquifer beneath the subject site as a *Locally Important Aquifer (Lm)*. The potential for vertical or horizontal migration within this type of aquifer could be significant in the presence of regional scale fractures. The GSI map does not identify structural faults underneath the area of the subject site.

The proposed development is within the '*Dundalk*' groundwater body (GWB) and is classified as '*Locally Important Aquifer*'. Presently, the groundwater body in the region of the site (Dundalk GWB) is classified under the WFD Status 2016-2021 (EPA, 2023) as having '*Good status'* and a WFD Risk Score of '*Not at risk of not achieving good status*'.

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. The GSI (2023) guidance presently classifies the bedrock aquifer in the region of the subject site as having '*High*' vulnerability which indicates a general overburden depth potential greater than 3m, suggesting a moderate to good natural protection of the aquifer by high permeability marine gravel and sands. The aquifer vulnerability class in the region of the site is presented as Figure 2.1 below.

Figure 2.1 *Aquifer Vulnerability*

The GSI/ Teagasc (2023) mapping database of the quaternary sediments in the area of the subject site indicates the principal subsoil type in the area Marine gravel and sands associated with high permeable granular marine deposits.

3.0 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is developed based on a good understanding of the hydrological and hydrogeological environment, potential sources of impact and knowledge of receptor requirements. This in turn allows possible Source Pathway Receptor (S-P-R) linkages to be identified. If no S-P-R linkages are identified, then there is no risk to identified receptors.

3.1 Assessment of Potential Sources of impact

Potential sources during both the construction and operational phases are considered. For the purposes of undertaking the potential of any hydrological/ hydrogeological S-P-R linkages, all potential sources of contamination are considered without taking account of any measures intended to avoid or reduce harmful effects of the proposed project (mitigation measures) i.e., a worst-case scenario. Construction sources (short-term) and operational sources (long-term) are considered below.

<u>Construction Phase</u>

The following potential sources are considered potential risk scenarios for the proposed construction site:

(i) Hydrocarbons or any hazardous chemicals will be stored in specific bunded areas. Refuelling of plant and machinery will also be carried out in bunded areas to minimise risk of any potential discharge from the site. As a worst-case scenario, a rupture of a 1,000-litre tank to ground is considered in this analysis which disregards the effect of bunding. This would be a single short-term event.

(ii) Leakage may occur from construction site equipment. As a worst-case scenario an unmitigated leak of 300 litres is considered. This would be a single short-term event.

(iii) Use of wet cement is a requirement during construction. Run-off water from recent cemented areas will result in highly alkaline water with high pH. As this would only occur during particular phases of work this is again considered as a single short-term event rather than an ongoing event.

(iv) Construction requires dredging, piling and soil excavation and removal. Unmitigated run-off could contain a high concentration of suspended solids and contaminants. These could be considered intermittent short-term events, i.e., on the basis that adequate mitigation measures which will be included in the Construction Environmental Management Plan (CEMP) fail. It is not anticipated that rock will be encountered during the dredge.

(v) During the dredging, piling and ground works, no significant dewatering from the regional aquifer is expected. Bedrock would not be affected by excavations work given the expected depths of bedrock (>3-10 m).

<u>Operational Phase</u>

The following are considered potential sources of impact during the operation of the proposed development:

(i) The proposed development will require a 200m3 above ground fuel storage tank that can potentially affect the nearby water quality. This tank shall be double lined and located within a bounded area.

(ii) Leakage of petrol/ diesel fuel may occur from CTVs berths or from individual cars in parking areas; run-off may contain a worst-case scenario of 70 litres.

(iii) The proposed stormwater drainage system for the new building will follow SuDS measures which include swales, underground attenuation tanks and petrol interceptors. This system has been designed in order to discharge following the characteristics of a greenfield run-off into the Carlingford Lough. As such the potential for silt laden runoff is low. It should be noted that the worst-case scenario (70 litres) under consideration here disregards the effect of SuDS.

(iv) The proposed development will be fully serviced with separate foul and stormwater network which will have adequate capacity for the facility and discharge limits as required by Irish Water licencing requirements. Discharge from the site to the public foul sewer will be sewage and grey water only due to the nature of the Proposed Development. The foul discharge from the site will join the public sewer and will be collected and treated at the Irish Water Dundalk Wastewater Treatment Plant (WWTP) prior to subsequent discharge to Inner Dundalk Bay. This WWTP is required to operate under an EPA licence (D0053-01) and meet environmental legislative requirements as set out in such licence.

It is worth noting that even without treatment at the Dundalk WWTP, the design Dry Weather Flow (DWF) of the proposed development is found to be 19.80 m3/d. This volume equates to 23.6% of the septic tank capacity ($84m_3$)

estimated for the proposed development. The peak hydraulic capacity of Dundalk WWTP is currently 56,706 m3/d according to their 2018 Annual Environmental Report. Therefore the proposed developments maximum septic tank capacity that will be delivered to Dundalk WWTP equates to 0.0035% of Dundalk WWTP's peak hydraulic capacity..

3.2 Assessment of Pathways

The following pathways have been considered within this assessment with impact assessment presented in Section 3.4:

The potential for offsite migration due to any construction discharges is low as there is no significant pathway in the aquifer or through land ditches or streams.

(i) Vertical migration to the underlying Limestone is minimised somewhat due to the identified '*High*' vulnerability present at the site. The site is underlain by [generally low permeable] Limestone which the GSI classifies as a *Locally Important Aquifer (Lm)*. Given the absence of structural geological faults, it is expected that groundwater flow paths are not connected to the site and will be limited to within the upper weathered zones identified. As such any potential for offsite migration through the underlying subsoil limited is considered low; it is expected that during the construction phase flow paths will be generally local.

(ii) There will be a direct hydrological linkage for construction and operation run-off or any small hydrocarbon leaks from the site to the identified Natura 2000 sites in Carlingford Lough through the surface water drainage which will discharge directly into this waterbody.

(iii) There is no direct pathway for foul sewage to any receiving water body. There is however an 'indirect pathway' through the public foul sewer which ultimately discharges to the Dundalk WWTP prior to final discharge to Dundalk Bay post treatment.

3.3 Assessment of Receptors

The receptors considered in this assessment include the following:

(i) Underlying Limestone bedrock aquifer.
(ii) Natura 2000 sites within Carlingford Lough WFD coastal waterbody and Dundalk Bay: Carlingford Lough SPA (Code 4078) and Carlingford Shore SAC (Code 2306); Dundalk Bay SPA (code 4026) and Dundalk Bay SAC (code 455).

Other Natura 2000 Sites within Irish Sea coastal waterbody that may be hydrologically connected to the proposed development site but are located further away (e.g., North-West Irish Sea SPA (site code 4236)) were excluded from the assessment due to their distance from the subject site, the potential loading of contaminant from the site (risk scenarios presented in Section 3.1) and significant dilution through its pathway.

3.4 Assessment of Source Pathway Receptor Linkages

Construction Phase

The potential for impact on the aquifer is considered to be low based on the absence of any bulk chemical storage on site during construction. The overburden thickness, and a lack of fracture connectivity within the limestone bedrock aquifer will minimise the rate of off-site migration for any indirect discharges to ground at the site. As such there is no potential for a change in the groundwater body status or significant source pathway linkage through the aquifer to the Natura 2000 site within Carlingford Lough (Carlingford Lough SPA and Carlingford Shore SAC).

During construction phase, there will be a direct open-water pathway between the site and Natura 2000 sites within Carlingford Lough. Should any silt-laden stormwater from construction or hydrocarbon-contaminated water from a construction vehicle leak/tank leak manage to enter into this coastal waterbody, the suspended solids will naturally settle next to the leakage point; however, in the event of a worst case hydrocarbon leak of 1,000 litres and assuming an approximated thickness of 0.0002m (based on the Bonn Agreement Oil Appearance Code BAOAC), the potential affected area would be c.0.5 Ha which represents 0.084% and 0.095% of the Carlingford Lough SPA and Carlingford Shore SAC, respectively. However, it is expected that this potential leak would be confined to the leakage area and will be diluted to background levels (water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019) and therefore any effect will be temporary.

Operation Phase

During operation, the potential for a release is low as the projected 200m^3 fuel tank storage design will include double lining and will be located within a designed bounded area; additionally, no silt laden run-off is projected. Stormwater will be collected by a drainage system which includes SuDS measures, an attenuation system and oil/ petrol interceptors prior to discharge to the Carlingford Lough (albeit these measures have been disregarded for this analysis). In addition, the potential for hydrocarbon discharge is quite minimal based on an individual vehicle (70 litres) leak or a leak from a CTV berth (also 70 litres) being the only source for hydrocarbon release. However, even if the operation of the proposed SuDS and interceptor systems are excluded from consideration, there is no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019) in the worst-case scenarios described above at section 3.2 and there will be no significant effect on any European site. The volume of contaminant release is low and would represent an area equivalent to 0.006% and 0.008% of nearby Carlingford Lough SPA and Carlingford SAC, respectively. This, combined with the significant attenuation within Carlingford Lough, would mean that hydrocarbons will dilute to background levels with no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009, S.I. No. 386 of 2015 and S.I. No. 77 of 2019 at nearby Natura 2000 sites.

It can be concluded that the in-combination effects of surface water arising from the proposed development taken together with that of other permitted developments will not be significant based on the in-combination low potential chemical and sediment expected loading. Therefore, based on the loading of any hazardous material considered in the worst-case scenarios mentioned in Section 3.1 above during construction and operation phases, there is subsequently no potential for impact on downgradient Natura 2000 habitats (those in Carlingford Lough, adjacent the site).

The peak wastewater discharge is calculated at 1.25 l/s. The sewage discharge will be collected in the existing tank in Greenore port ultimately treated at Irish Water's WWTP at Dundalk prior to discharge to the Dundalk Bay.

Even without treatment at the Carlingford WWTP, the peak effluent discharge, calculated for the proposed development as 1.25 l/s (which would equate to 0.19% of the licensed discharge at Dundalk WWTP [peak hydraulic capacity]), would not have a measurable impact on the overall water quality within Carlingford Lough and therefore would not have an impact on the current Water Body Status (as defined within the Water Framework Directive).

The assessment has also considered the effect of cumulative events, such as the release of sediment-laden water combined with a hydrocarbon leak on site (1,000 litres as a worst-case scenario during the construction phase). Based on the expected assimilation and dilution within Carlingford Lough and the amount of the hydrocarbon leak volume considered, it is concluded that no perceptible impact on water quality would occur at the Natura 2000 sites as a result of the construction or operation of this Proposed Development. It can also be concluded that the cumulative or in-combination effects of effluent arising from the Proposed Development with that of other permitted proposed developments or with development planned pursuant to statutory plans in the Carlingford/Dundalk area, which will be discharged into Dundalk WWTP will not be significant having regard to the size of the calculated discharge from the Proposed Development and having regard that all new developments are required to comply with SuDS which ensures management of run-off rate within the catchment of Carlingford Lough and Dundalk WWTP.

As the Proposed Development will have no additional stormwater run-off during a stormwater event over and above the current level, surface water run-off from the development in the operational phase will therefore have no impact on the current water quality in any overflow situation at Carlingford Lough and Dundalk Bay.

In addition, there is no long-term discharge planned which could have an impact on the status of the water body. In the scenario of an accidental release (unmitigated leaks mentioned above) there is potential for a temporary impact only which would not be of a sufficient magnitude to effect a change in the current water body status.

Finally, in a worst-case scenario of an unmitigated leak and not considering the operation of the SuDS measures already included in the design, no perceptible risk to nearby Natura 2000 Sites is anticipated given the estimated amount of potential contaminant loading which is expected to be attenuated, diluted and dispersed near source area in the event of occurrence of this worst-case scenario.

Table 3.1 below presents a summary of the risk assessment undertaken.

Source	**Pathways**	**Receptors considered**	**Risk of Impact**
		Construction Impacts (Summary)	
Unmitigated leak from an oil tank to ground/ unmitigated leak from construction vehicle (1,000 litres worst-case scenario).	Bedrock protected by >3-10m high permeability overburden. Low fracture connectivity within the limestone will limit any potential for offsite migration.	Limestone bedrock aquifer (Locally Important Aquifer)	Low risk of migration through poorly connected fracturing within the limestone rock mass. No likely impact on the status of the aquifer/off site migration due to low potential loading, natural attenuation within overburden and discrete nature of fracturing reducing off site migration.
Discharge to ground of runoff water with High pH from cement process/ hydrocarbons from construction vehicles/run-off containing a high concentration of suspended solids	Direct pathway through existing drainage and adjacent Carlingford Lough	Carlingford Lough SPA Carlingford Shore SAC	Potential for local temporary exceedances of statutory water quality standards at outfall. However, no perceptible risk to water requirements for the Natura 2000 site in Carlingford Lough based on loading and high level of dilution in the waterbody. This worst-case scenario would represent 0.084% and 0.095% of the Carlingford Lough SPA and Carlingford Shore SAC, respectively.
		Operational Impacts (Summary)	
Foul effluent discharge to sewer	Indirect pathway through public sewer to Dundalk Bayt	Dundalk Bay SPA Dundalk Bay SAC	No perceptible risk – Even without treatment at Carlingford WWTP, the peak effluent discharge (1.25 l/s which would equate to 0.19% of the licensed discharge at Dundalk WWTP); would not impact on the overall water quality within Dundalk Bay and therefore would not have an impact on the current Water Body Status (as defined within the Water Framework Directive).
Discharge to ground of hydrocarbons from carpark or CTV's berth leak (70 litres worst-case scenario)	Direct pathway through existing drainage and adjacent Carlingford Lough	Carlingford Lough SPA Carlingford Shore SAC	No perceptible risk – Negligible loading of chemical and significant dilution in the Carlingford Lough will ensure any released hydrocarbons are at background levels (i.e., with no likely impact above water quality objectives as outlined in S.I. No. 272 of 2009 and S.I. No. 77 of 2019 amendment). This worst-case scenario would represent 0.006% and 0.007% of the Carlingford Lough SPA and Carlingford Shore SAC, respectively

Table 3.1 *Pollutant Linkage Assessment (without mitigation)*

4.0 CONCLUSIONS

A conceptual site model (CSM) has been prepared following a desk top review of the site and surrounding environs. Based on this CSM, potential Source-Pathway-Receptor linkages have been assessed assuming an absence of any measures intended to avoid or reduce harmful effects of the proposed project (i.e. mitigation measures) in place at the proposed development site.

During the construction and operation phases, there is a direct source-pathway linkage between the proposed development site and Natura 2000 sites within open waters (i.e., Carlingford Lough SPA and Carlingford Shore SAC). There is a direct source pathway linkage from the proposed development through the stormwater drainage which discharges into Carlingford Lough. However, due to the low chemical loading, there is no potential for impact on water quality at these Natura 2000 sites. There is also an indirect linkage through the foul sewer, which eventually discharges to the Dundalk WWTP and ultimately to the Dundalk Bay. The future development has a peak foul discharge that would equate to 0.19% of the licensed discharge at Dundalk WWTP (peak hydraulic capacity). The Proposed Development will not contribute any additional stormwater drainage to the WWTP over the natural greenfield rate.

Even disregarding the operation of design measures including SuDS on site, it is concluded that there will be imperceptible impacts from the proposed development to the water bodies due to emissions from the site stormwater drainage infrastructure to the Carlingford Lough.

It is concluded that there are no pollutant linkages as a result of the construction or operation of the Proposed Development which could result in a water quality impact which could alter the habitat requirements of the Natura 2000 sites within Carlingford Lough and Dundalk Bay.

Finally, and in line with good practice, appropriate and effective mitigation measures will be included in the construction design, management of construction programme and during the operational phase of the proposed development. With regard the construction phase, adequate mitigation measures will be incorporated in the Construction Environmental Management Plan (CEMP). These specific measures will provide further protection to the receiving soil and water environments. However, the protection of downstream European sites is in no way reliant on these measures and they have not been taken into account in this assessment.

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APPENDIX 10.4

WFD ASSESSMENT REPORT

VOLUME III

APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

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WATER FRAMEWORK DIRECTIVE (WFD) SCREENING ASSESSMENT

GREENORE PORT OPERATIONS AND MAINTENANCE (O&M) FACILITY GREENORE, CO. LOUTH

Report Prepared For
Greenore Port Unlimited Company

Report Prepared By

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Our Reference
MA/237501.0452/WR02

Date of Issue
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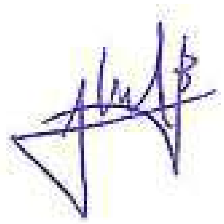
Signature		
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1.0 INTRODUCTION

AWN Consulting Limited (AWN) has prepared this Water Framework Directive (WFD) Screening as part of the Environmental Impact Assessment Report (EIAR) associated with the proposed a development on a approx. 4.88-hectare site at Greenore Port, Greenore, Co. Louth.

This application describes the site in terms of four plots/character areas for ease of reference.

1. 'Terrestrial Port Area', (c.1.9ha) which includes, a port commodity warehouse (former Open Hydro building), hardstanding areas, remnant wall associated with the pre-existing 'engine room', and a communications mast.
2. 'Nearshore Environment' (c.2.3ha) encompassing part of Carlingford Lough and an existing caisson quay wall, known as 'Berth 3'.
3. 'Residential Site' (c. 0.5ha) a greenfield site with a single-storey unoccupied residential dwelling with frontage to the R175, Shore Road.
4. 'Port Office Entrance' (c. 0.18ha) encompassing a portion of the existing office building, known as the 'Seafarers room', hardstanding and parking area to the front of the port office with pockets of green space, that front Euston Street.

The location of each plot is shown in the following Figure.

Figure 1.1 *Proposed Development Plots/Character Areas*

The development describes as follows:

Greenore Port Unlimited Company intend to apply for a 10-year permission for development at Greenore Port and site of dwelling house on Shore Road (A91DD42), Greenore, Co. Louth, (total site area c.4.88 hectare). The development comprising of Operation and Maintenance (O&M) Facilities will serve as the support base for future offshore wind arrays in the Irish Sea.

The proposed development will comprise of:-

(i) Three standalone buildings, each with a gross floor area (GFA) of 1,670 sqm, comprising 681 sqm warehouse floor space, 322 sqm office space and 667 sqm plant, welfare, storage, ancillary and circulation space per unit. The height of each unit ranges from 7.2m for the warehouse (single-storey / double-height space) to 13.5m max for the office 3-storey element. 76 car parking spaces are proposed distributed adjacent to the units including 6 no. disabled parking spaces and 15 no. electric vehicle (EV) charging spaces. Each building includes an internal bike storage room, with 20 spaces per building. Each building includes rooftop solar photovoltaic panels.

(ii) Nearshore works including dredging of harbour sediments to -4m Chart Datum to provide navigable water depths, new quay wall (70m), a 40m anti-slip access ramp, floating pontoon for berthing crew transfer vessels (CTV's). 9 no. berths are proposed, with an additional 2 no. layby berths and a push-on / service berth adjacent to the new quay wall.

(iii) Improvement works to the quay deck including installation of a new reinforced concrete deck with surface water management system incorporating silt traps and hydrocarbon interceptors, and berth infrastructure including bollards, fenders, ladders, lifesaving equipment, power outlets and fire hydrants.

(iv) Surface car park at the Residential site on Shore Road comprising 135 car parking spaces, including ducting for 30 no. EV charging spaces, relocation of existing entrance on Shore Road by c.6m to the east, new boundary wall to Shore Road and a pedestrian access route from the car park through port lands to the O&M Units crossing improved public realm at top of Euston Street.

(v) Re-instatement of former Open Hydro carpark (62 spaces) until the surface car park on Shore Road is operational.

(vi) Upgrade to public/private realm in the foreground of the existing Greenore Port Office building, including upgrade of existing entrance to former open hydro carpark, new pedestrian gate, new feature wall entrance, removal of 6 port car parking spaces, link to new pedestrian route from surface carpark including new opening in port boundary wall, and hard and soft landscaping. Works are partially located within the Greenore Architectural Conservation Area (ACA).

(vii) Replacement of existing 25m mast with new 40m mast to facilitate communications with CTV's while offshore.

(viii) Demolition works to facilitate the above development including:-

a. The former "Open Hydro" warehouse (c. 1,607 sqm GFA);

b. Part of single storey office building (c.38sqm GFA) located adjacent to the entrance to former Open Hydro carpark;

c. ESB substation and associated switch room;

d. Dwelling house (c. 192sqm GFA) and boundary wall on Shore Road.

(ix) And all associated site and development works including single storey ESB substation, above-ground fuel storage tank (c. 200m3), drainage and utilities, landscaping and boundary treatments, security fencing, lighting and signage, etc.

A detailed description of the proposed development is set out in Chapter 2 (Volume II) of this EIAR (Description of the Proposed Development).

2.0 METHODOLOGY

This WFD Screening Assessment has been prepared in response to the requirements of the Water Framework Directive. This WFD Screening Assessment relies on information provided in the Land and Soils (Chapter 9), Water and Hydrology (Chapter 10) of the EIAR and should, therefore, be read in conjunction with these chapters.

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2.1 DETERMINATION OF WATER BODY STATUS

2.1.1 WFD Risk Status

The WFD Risk score is the risk for each waterbody of failing to meet their WFD objectives by 2027. The risk of not meeting WFD objectives has been determined by assessment of monitoring data, data on the pressures and data on the measures that have been implemented. Waterbodies that are At Risk are prioritised for implementation of measures. This assessment was completed in 2020 by the EPA Catchments Unit in conjunction with other public bodies and was primarily based on monitoring data up the end of 2018. The three risk categories are:

- Waterbodies that are ‘At Risk’ of not meeting their Water Framework Directive objectives. For these waterbodies an evidence-based process was undertaken to identify the significant pressures; once a pressure is designated as ‘significant’, measures and accompanying resources are needed to mitigate the impact(s) from this pressure. These ‘At Risk’ waterbodies require not only implementation of the existing measures described in the various regulations, e.g. the Good Agricultural Practices Regulations, but also in many instances more targeted supplementary measures.
- Waterbodies that are categorised as ‘Review’ either because additional information is needed to determine their status before resources and more

targeted measures are initiated or the measures have been undertaken, e.g. a wastewater treatment plant upgrade, but the outcome hasn't yet been measured/monitored.

- Waterbodies that are 'Not at Risk' and therefore are meeting their Water Framework Directive objectives. These require maintenance of existing measures to protect the satisfactory status of the water bodies.

2.1.2 Background to Surface Water Body Status

Under the WFD, surface water body status is classified on the basis of chemical and ecological status or potential. Ecological status is assigned to surface water bodies that are natural and considered by the EPA not to have been significantly modified for anthropogenic purposes (i.e., culverting). Ecological potential is assigned to artificial and man-made water bodies (such as canals), or natural water bodies that have undergone significant modification. The term 'ecological potential' is used as it may be impossible to achieve good ecological status because of modification for a specific use, such as navigation or flood protection. The ecological potential represents the degree to which the quality of the water body approaches the maximum it could achieve. The worst-case classification is assigned as the overall surface water body status, in a 'one-out all-out' system (i.e., by taking the worst case of all the combined risk outcomes). This system is summarised below in Figure 2.1.

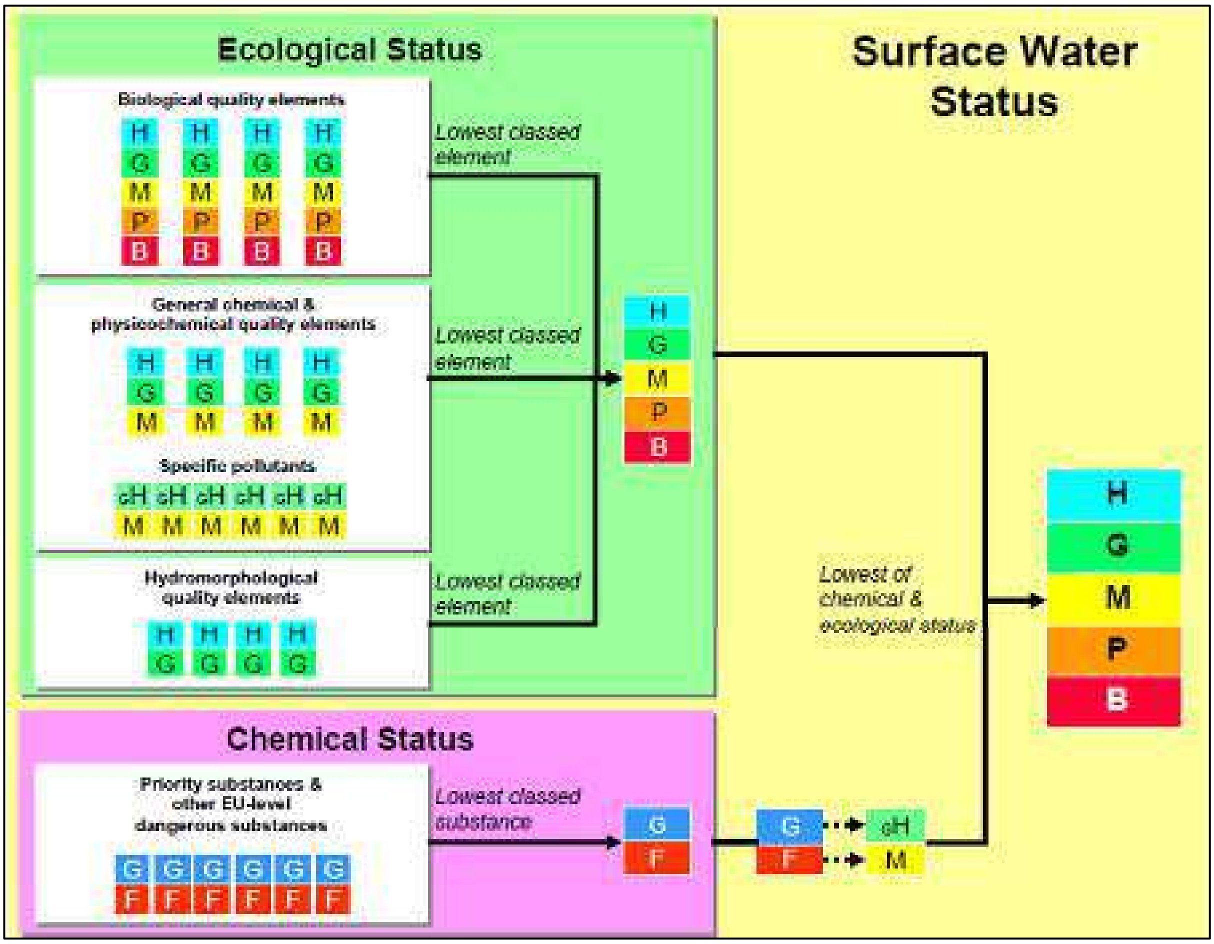


Figure 2.1 *WFD classification elements for surface water body status (NIEA, 2021)*

Chemical Status

Chemical status is defined by compliance with environmental standards for chemicals that are priority substances and/or priority hazardous substances, in accordance with the Environmental Quality Standards Directive (2008/105/EC). This is assigned on a scale of good or fail. Surface water bodies are only monitored for priority substances where there are known discharges of these pollutants; otherwise, surface water bodies are reported as being at good chemical status.

Ecological Status

Ecological status or potential is defined by the overall health or condition of the watercourse. This is assigned on a scale of High, Good, Moderate, Poor or Bad, and on the basis of four classification elements or 'tests', as follows:

- **Biological:** This test is designed to assess the status indicated by a biological quality element such as the abundance of fish, invertebrates or algae and by the presence of invasive species. The biological quality elements can influence an overall water body status from Bad through to High.
- **Physico-chemical:** This test is designed to assess compliance with environmental standards for supporting physicochemical conditions, such as dissolved oxygen, phosphorus and ammonia. The physicochemical elements can only influence an overall water body status from Moderate through to High.
- **Specific pollutants:** This test is designed to assess compliance with environmental standards for concentrations of specific pollutants, such as zinc, cypermethrin or arsenic. As with the physico-chemical test, the specific pollutant assessment can only influence an overall water body status from Moderate through to High.
- **Hydromorphology:** For natural, this test is undertaken when the biological and physicochemical tests indicate that a water body may be of High status. It specifically assesses elements such as water flow, sediment composition and movement, continuity, and structure of the habitat against reference or 'largely undisturbed' conditions. If the hydromorphological elements do not support High status, then the status of the water body is limited to Good overall status. For artificial or highly modified waterbodies, hydromorphological elements are assessed initially to determine which of the biological and physico-chemical elements should be used in the classification of ecological potential. In all cases, assessment of baseline hydromorphological conditions are an important factor in determining possible reasons for classifying biological and physicochemical elements of a water body as less than Good, and hence in determining what mitigation measures may be required to address these failing water bodies.

2.1.3 Background to Groundwater Body Status

Under the WFD, groundwater body status is classified on the basis of quantitative and chemical status. Status is assessed primarily using data collected from the EPA monitoring network; therefore, the scale of assessment means that groundwater status is mainly influenced by larger scale effects such as significant abstraction or widespread/ diffuse pollution. The worst-case classification is assigned as the overall groundwater body status, in a 'one-out all-out' system. This system is summarised in Figure 2.2 below.

Quantitative Status

Quantitative status is defined by the quantity of groundwater available as baseflow to watercourses and water-dependent ecosystems, and as 'resource' available for use as drinking water and other consumptive purposes. This is assigned on a scale of Good or Poor, and on the basis of four classification elements or 'tests' as follows:

- **Saline or other intrusions:** This test is designed to identify groundwater bodies where the intrusion of poor quality water, such as saline water or water of different chemical composition, as a result of groundwater abstraction is leading to sustained upward trends in pollutant concentrations or significant impact on one or more groundwater abstractions.
- **Surface water:** This test is designed to identify groundwater bodies where groundwater abstraction is leading to a significant diminution of the ecological status of associated surface water bodies.
- **Groundwater Dependent Terrestrial Ecosystems (GWDTEs):** This test is designed to identify groundwater bodies where groundwater abstraction is leading to "significant damage" to associated GWDTEs (with respect to water quantity).
- **Water balance:** This test is designed to identify groundwater bodies where groundwater abstraction exceeds the "available groundwater resource", defined as the rate of overall recharge to the groundwater body itself, as well as the rate of flow required to meet the ecological needs of associated surface water bodies and GWDTEs.

Chemical Status

Chemical status is defined by the concentrations of a range of key pollutants, by the quality of groundwater feeding into watercourses and water-dependent ecosystems and by the quality of groundwater available for drinking water purposes. This is assigned on a scale of Good or Poor, and on the basis of five classification elements or 'tests' as follows:

- **Saline or other intrusions:** This test is designed to identify groundwater bodies where the intrusion of poor-quality water, such as saline water or water of different chemical composition, as a result of groundwater abstraction is leading to sustained upward trends in pollutant concentrations or significant impact on one or more groundwater abstractions.
- **Surface water:** This test is designed to identify groundwater bodies where groundwater abstraction is leading to a significant diminution of the chemical status of associated surface water bodies.
- **Groundwater Dependent Terrestrial Ecosystems (GWDTEs):** This test is designed to identify groundwater bodies where groundwater abstraction is leading to "significant damage" to associated GWDTE's (with respect to water quality).
- **Drinking Water Protected Areas (DrWPAs):** This test is designed to identify groundwater bodies failing to meet the DrWPA objectives defined in Article 7 of the WFD or at risk of failing in the future.
- **General quality assessment:** This test is designed to identify groundwater bodies where widespread deterioration in quality has or will compromise the strategic use of groundwater.

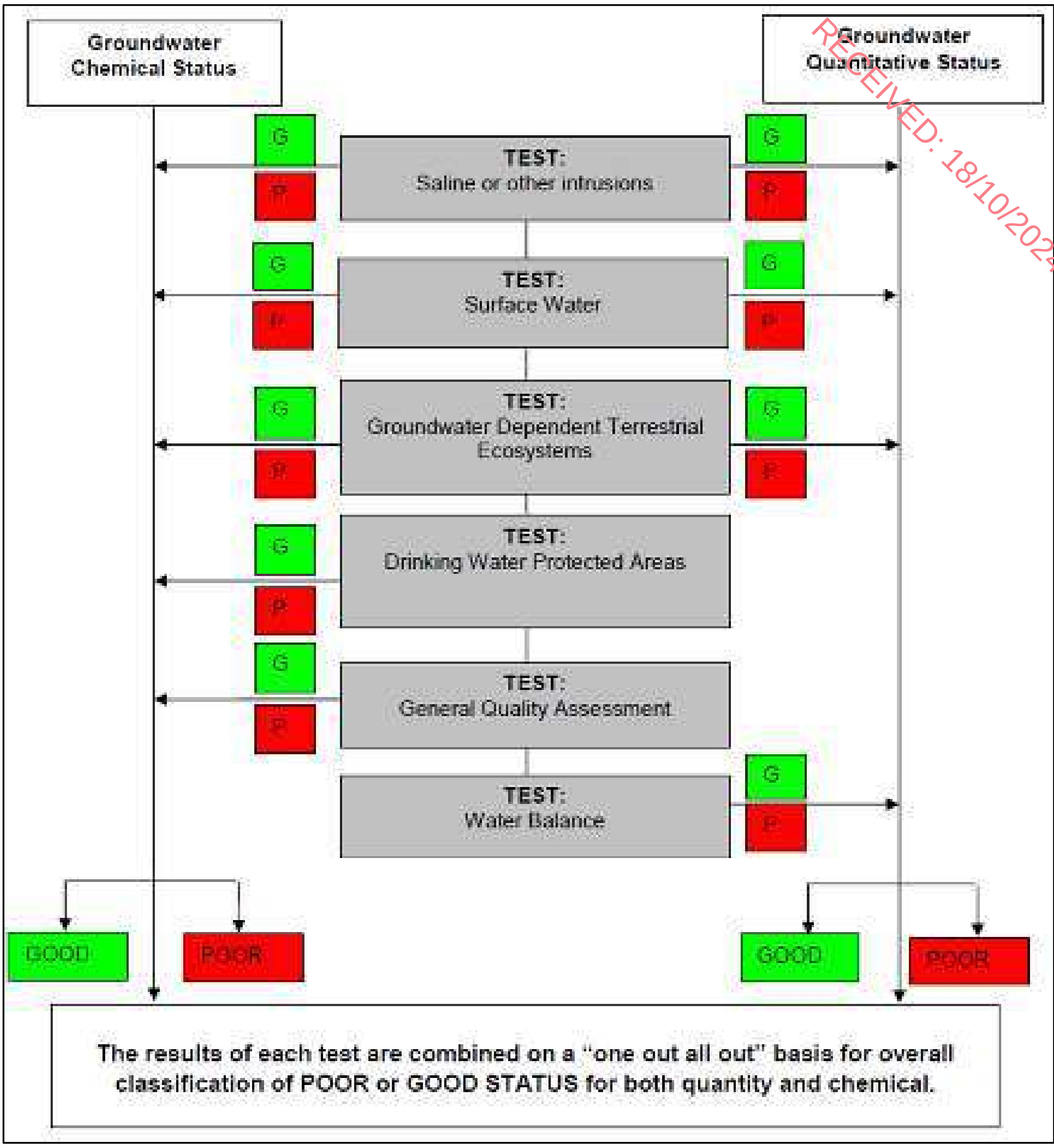


Figure 2.2 *WFD classification elements for groundwater body status (Environmental Agency, 2015)*

2.2 DETERMINATION OF NO DETERIORATION ASSESSMENT

Proposed developments that have the potential to impact on current or predicted WFD status are required to assess their compliance against the objectives defined for potentially affected water bodies.

2.3.1 Surface Water No Deterioration Assessment

Table 2.1 below presents the matrix developed by AWN and used to assess the effect of the proposed development on surface water status or potential class. It ranges from a major beneficial effect (i.e., a positive change in overall WFD status) through no effect to deterioration in overall status class. The colour coding used in Table 2.1 is applied to the spreadsheet assessment in Appendix A of this report.

Table 2.1 *Surface Water Assessment Matrix*

Effect	Description/ Criteria	Outcome
Major Beneficial	Impacts that taken on their own or in combination with others have the potential to lead to the improvement in the ecological status or potential of a WFD quality element for the entire waterbody	Increase in status of one or more WFD element giving rise to a predicted rise in status class for that waterbody.
Minor/ localised beneficial	Impacts when taken on their own or in combination with others have the potential to lead to a minor localised or temporary improvement that does not affect the overall WFD status of the waterbody or any quality elements	Localised improvement, no change in status of WFD element
No Impact	No measurable change to any quality elements.	No change
Localised / temporary adverse effect	Impacts when taken on their own or in combination with others have the potential to lead to a minor localised or temporary deterioration that does not affect the overall WFD status of the waterbody or any quality elements. Consideration will be given to habitat creation measures.	Localised deterioration, no change in status of WFD element when balanced against mitigation measures embedded in the project.
Adverse effect on class of WFD element	Impacts when taken on their own or in combination with others have the potential to lead to the deterioration in the WFD status class of one or more biological quality elements, but not in the overall status of the waterbody. Consideration will be given to habitat creation measures.	Decrease in status of WFD element when balanced against positive measures embedded in the project.
Adverse effect on overall WFD class of waterbody	Impacts when taken on their own or in combination with others have the potential to lead to the deterioration in the ecological status or potential of a WFD quality element, which then lead to a deterioration of status/potential of waterbody.	Decrease in status of overall WFD waterbody status when balanced against positive measures embedded in the project.

2.2.2 Groundwater No Deterioration Assessment

Table 2.2 below presents the matrix used to assess the effect of the proposed development on groundwater status class. It ranges from a beneficial effect but no change in status to deterioration in overall status class. The colour coding used in Table 2.2 is applied to the final 'No Deterioration Assessment' spreadsheet in Appendix A of this report.

Table 2.2 Groundwater Assessment Matrix

Magnitude of Impact of the proposed development on WFD Element	Effect on WFD Element within the assessment boundary	Effect on Status of WFD element at the Groundwater Body Scale
Impacts lead to beneficial effect	Combined impacts have the potential to have a beneficial effect on the WFD element.	Improvement but no change to status of WFD element
No measurable change to groundwater levels or quality.	No measurable change to WFD elements.	No change and no deterioration in status of WFD element
Impacts when taken on their own have the potential to lead to a minor localised or temporary effect	Combined impacts have the potential to lead to a minor localised or temporary adverse effect on the WFD element.	Combined impacts have the potential to lead to a minor localised or temporary effect on the WFD element. No change to status of WFD element and no significant deterioration at groundwater body scale.
Impacts when taken on their own have the potential to lead to a widespread or prolonged effect.	Combined impacts have the potential to have an adverse effect on the WFD element.	Combined impacts have the potential to have an adverse effect on the WFD element, resulting in significant deterioration but no change in status class at groundwater body scale.
Impacts when taken on their own have the potential to lead to a significant effect.	Combined impacts in combination with others have the potential to have a significant adverse effect on the WFD element.	Combined impacts in combination with others have the potential to have an adverse effect on the WFD element AND change its status at the groundwater body scale

2.2.2 Assessment against Future Status Objectives

River Basin Management Plans are used to outline water body pressures and the actions that are required to address them. The future status objective assessment considers the ecological potential of a surface water body and the mitigation measures that defined the ecological potential. Assessments are based on the project (including mitigation measures) risks (construction and operation) with regard to the objectives for achieving good status as set out in the 2nd Cycle RBMP 2018-2021 and *draft* 3rd Cycle RBMP 2022-2027. The assessment considers whether the proposed development has the potential to prevent the implementation or impact the effectiveness of the defined measures in these plans.

2.3 SOURCES OF INFORMATION

The following sources of information were used in the preparation of this report:

- Geological Survey of Ireland- online mapping (GSI, 2023).
- GSI - Geological Heritage Sites & Sites of Special Scientific Interest.
- Ordnance Survey of Ireland (OSI).
- Northern Ireland Environment Agency (NIEA) map viewer.
- Teagasc subsoil database.
- National Parks and Wildlife Services (NPWS, 2023).
- Environmental Protection Agency (EPA) – website mapping and database information. Envision water quality monitoring data for watercourses in the area.
- 3rd Cycle Draft Erne Catchment Report (HA 36) (EPA, 2021).
- River Basin Management Plan for Ireland 2018-2021.
- Draft River Basin Management Plan for Ireland 2022-2027.
- Louth County Council Development Plan 2021-2027.
- The Planning System and Flood Risk Management, Guidelines for Planning Authorities (Department of the Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW)).
- Office of Public Works (OPW) flood mapping data (www.floodmaps.ie)
- South Dublin City Council (2005), Greater Dublin Strategic Drainage Study: Technical Documents of Regional Drainage Policies. Dublin: Dublin City Council.
- 'Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors' (CIRIA 532, 2001).
- National Parks and Wildlife Services (NPWS) – Protected Site Register.

This WFD assessment was based on desktop review of the Environmental Protection agency (EPA) and Local Authority Waters Programme water quality records which were obtained from the portal www.catchments.ie and from the Northern Ireland Environment Agency (NIEA) its mapping portal (https://www.daera-ni.gov.uk/services/natural-environment-map-viewer), both accessed on 16 October 2023. From the aforementioned source of information, the WFD Status classification and Risk score were obtained for the identified water bodies.

The River Waterbody Status have been estimated in accordance with European Communities (Water Policy) Regulations 2003 (SI no. 722/2003). The regulation objectives include the attainment of good status in waterbodies that are of lesser status at present and retaining good status or better where such status exists.

3.0 DESCRIPTION OF EXISTING HYDROLOGICAL AND HYDROGEOLOGICAL ENVIRONMENT

3.1 HYDROLOGY

ERBD) (now the Irish River Basin District), as defined under the Directive 2000/60/EC of the European Parliament, commonly known as the Water Framework Directive (WFD). The WFD, establishes a framework for community action in the field of water policy.

The proposed development site lies within the Newry, Fane, Glyde and Dee Catchment 06 and Big [Louth]_SC_10 WFD sub-catchment 06-9 (Greenore_010 WFD River Sub Basin). According to the EPA river network (EPA maps, https://gis.epa.ie/EPAMaps/ accessed on 12-10-2023), the nearest surface water receptor is the Carlingford Lough coastal waterbody (WFD code: GBNIIE6NB030) which is a transboundary waterbody.

The application site is located at Greenore Port. The port currently has an existing stormwater drainage network in place. This serves as a drainage network for both yard surface water and roof water from buildings. The system drains via gravity and discharges via two different existing outlets, which in turn discharge directly into the Carlingford Lough coastal waterbody; it should be noted that this system includes hydrocarbon interceptors prior to discharge into the waterbody.

Carlingford Lough hosts Natura 2000 Sites (refer to Figure 3.1 and Figure 3.2 below). Currently there is a direct hydrological linkage between the proposed development sites and these sites through the existing stormwater drainage network which outfalls into the Carlingford Lough.

The Carlingford Lough receives water from the Newry catchment, which is a transboundary catchment, and more specifically, from the Newry Estuary transitional waterbody (WFD Code: UKGBNI5NB030010).

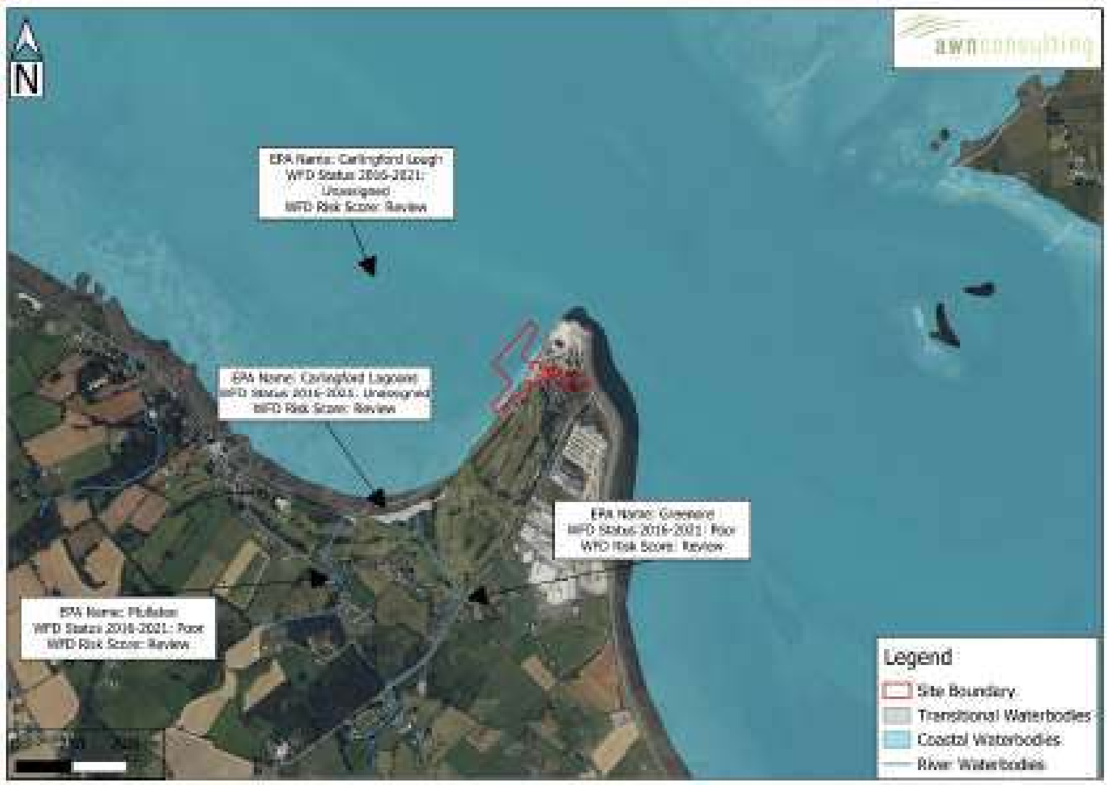


Figure 3.1 *Site Location and Hydrological Environment*

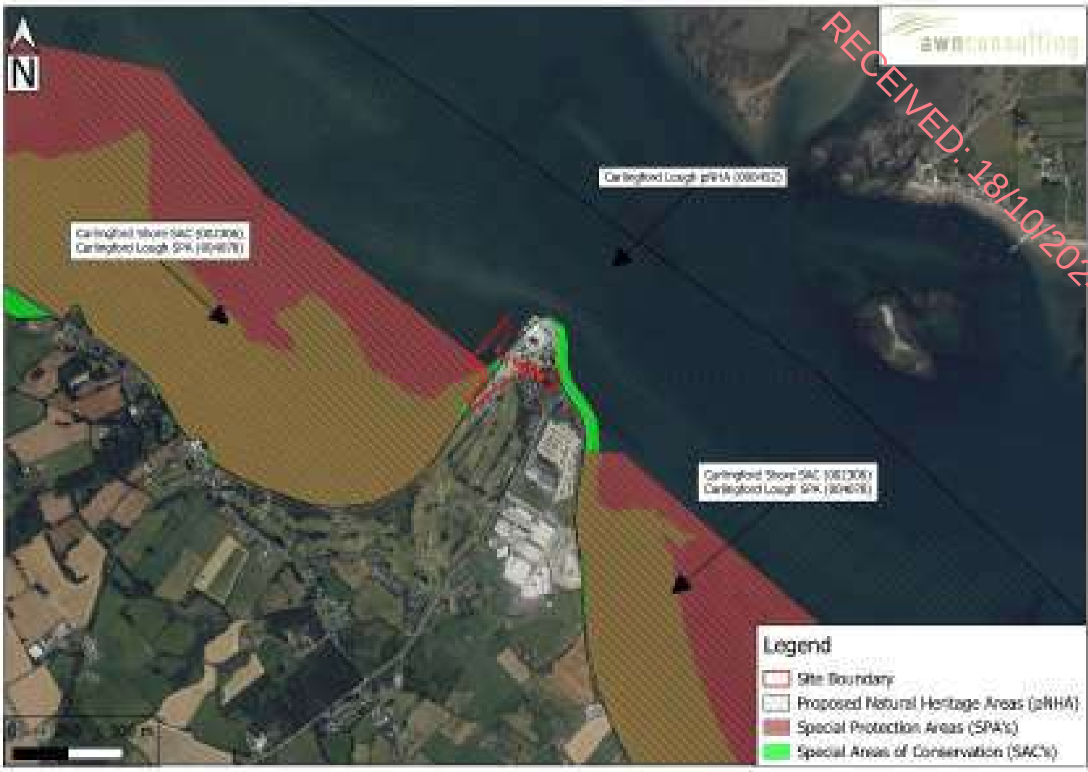


Figure 3.2 *Site Location with Natura 2000 Sites*

The Environmental Protection Agency (EPA, 2023) on-line mapping presents the available water quality status information for water bodies in Ireland. The most recent WFD Status score (2016-2021) states that the Carlingford Lough coastal waterbody has an '*Unassigned*' status while its WFD risk score is '*Under Review*' (refer to www.catchments.ie).

Nevertheless, the Northern Ireland Environment Agency (NIEA) Catchment Data Viewer also presents the water quality status for water bodies in Northern Ireland. As such, the Carlingford Lough coastal waterbody has a '*Moderate*' status for the period 2016-2021.

Surface water quality is monitored periodically by the EPA at various regional locations along with principal and other smaller watercourses. The EPA assess the water quality of rivers and streams across Ireland using a biological assessment method, which is regarded as a representative indicator of the status of such waters and reflects the overall trend in conditions of the watercourse. However, it should be noted that the Carlingford coastal waterbody and its tributary, the Newry Estuary transitional waterbody are not currently monitored by the EPA. The portal www.catchments.ie presented water quality data for the Carlingford waterbody at a single station named '*ambient monitoring TPEFF2100D0268SW001*' but only for the period 2016-2017.

Figure 3.3 below presents a waterbody risk EPA map for the Newry Fane, Glyde and Dee WFD Catchment.

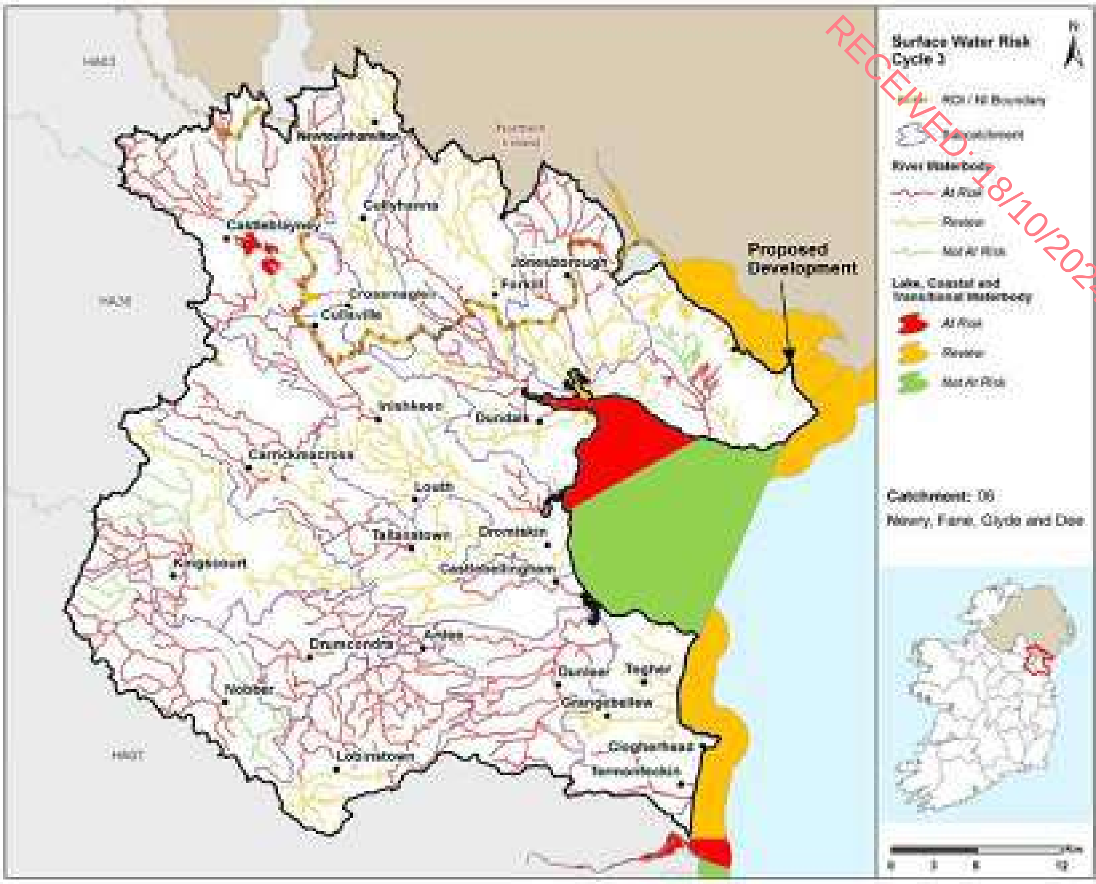


Figure 3.3 *Surface Water 'Risk of not achieving WFD good status' Map*

The Greenore_010 waterbody is considered to have an ecological status of 'Poor' through modelling assessment technique (refer to Figure 3.4 below).

Waterbody: GREENORE_010

Name:	GREENORE_010	Code:	IE_NB_06G180630
Subcatchments:	06_9 Big[Louth]_SC_010	Catchments:	06 Newry, Fane, Glyde and Dee
Latitude:	54.0171212	Longitude:	-6.14579
Cycle 1 RBD:	Neagh Bann	Local Authority:	Louth County Council
Waterbody Category:	River	WFD Risk:	Review
Protected Area:	Yes	High Status Objective:	No
Heavily Modified:	Unknown	Artificial:	Unknown
Area (Km²):	N/A	Length (Km):	7.42
Transboundary:	No	Canal:	No

SW 2016-2021

Status	Assessment Technique	Status Confidence	Value
Ecological Status or Potential	Modelling	low confidence	Poor

Figure 3.4 *Surface Water Quality for the Greenore_010 waterbody, EPA, 2023.*

According to the sub-catchment assessment of the Big[Louth]_SC_010 subcatchment carried out by the EPA in September 2022, there are a number of pressures within this sub-catchments that impact on the hydrological environment (refer to www.catchments.ie). All the water bodies considered within this subcatchment have a WFD risk score of 'At Risk' or under review.

The Greenore_010 and Carlingford Lough are under anthropogenic pressures. The below lists are a list of all significant pressures identified in this sub-catchment (Figure 3.5).

Code	Name	WFD Risk	Pressure Category	Pressure Sub Category
[illegible]	[illegible] Lough	Review	Anthropogenic Pressures	Unknown
GBNIIE6NB020	Mourne Coast	Review	Anthropogenic Pressures	Unknown
IE_NB_040_0050	Castletown Estuary	At risk	Urban Waste Water	Agglomeration PE > 10,000
GBNIIE6NB030	Carlingford Lough	Review	Anthropogenic Pressures	Unknown
IE_NB_040_0000	Outer Dundalk Bay	Review	Anthropogenic Pressures	Unknown
IE_NB_040_0100	Inner Dundalk Bay	At risk	Urban Waste Water	Agglomeration PE > 10,000
IE_NB_06B015400	BIG (LOUTH)_020	At risk	Industry	Section 4
IE_NB_06G180630	GREENORE_010	Review	Anthropogenic Pressures	Unknown
UKGBNI6NB00010	Newry Estuary	Review	Anthropogenic Pressures	Unknown
IE_NB_040_0300	Ballymascanlan Estuary	Review	Anthropogenic Pressures	Unknown
IE_NB_030_0300	Carlingford Lagoons	Review	Anthropogenic Pressures	Unknown

Figure 3.5 *List of main pressures for all waterbodies within the Big[Louth]_SC_010 catchment*

3.2 HYDROGEOLOGY

3.2.1 Aquifer Classification

The GSI has devised a system for classifying the bedrock aquifers in Ireland. The aquifer classification for bedrock depends on a number of parameters including, the area extent of the aquifer (km^2), well yield (m^3/d), specific capacity ($m^3/d/m$) and groundwater throughput (mm^3/d). There are three main classifications: regionally important, locally important and poor aquifers. Where an aquifer has been classified as regionally important, it is further subdivided according to the main groundwater flow regime within it. This sub-division includes regionally important fissured aquifers (Rf) and regionally important karstified aquifers (Rk). Locally important aquifers are sub-divided into those that are generally moderately productive (Lm) and those that are generally moderately productive only in local zones (Ll). Similarly, poor aquifers are classed as either generally unproductive except for local zones (Pl) or generally unproductive (Pu).

The bedrock aquifer underlying the site according to the GSI (www.gsi.ie/mapping) National Draft Bedrock Aquifer Map is classified as a (*Lm*) *Locally Important Aquifer – Generally Moderately Productive*.

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. Due to the nature of the flow of groundwater through bedrock in Ireland, which is almost completely through fissures/ fractures, the main feature that protects groundwater from contamination, and therefore the most important feature in the protection of groundwater, is the subsoil (which can consist solely of/ or of mixtures of peat, sand, gravel, glacial till, clays or silts).

Groundwater Vulnerability is a term used to represent the natural ground characteristics that determine the ease with which groundwater may be contaminated by human activities. According to the GSI mapping information, the majority of the proposed development site experiences a '*High (H)'*, which indicates a general overburden depth potential greater than 3m. This suggests a moderate to good natural protection of the aquifer by high-permeability marine gravel and sands. Refer to Chapters 9 and 10 of Volume II of the EIAR for further details.

3.2.2 Groundwater Quality

The Water Framework Directive (WFD) 2000/60/EC was adopted in 2000 as a single piece of legislation covering rivers, lakes, groundwater, transitional (estuarine) and coastal waters. In addition to protecting said waters, its objectives include the attainment of 'Good Status' in water bodies that are of lesser status at present and retaining 'Good Status' or better where such status exists at present. 'Good Status' was to be achieved in all waters by 2015, as well as maintaining 'high status' where the status already exists. The EPA co-ordinates the activities of the River Basin Districts, local authorities and state agencies in implementing the directive, and operates a groundwater quality monitoring programme undertaking surveys and studies across the Republic of Ireland.

The Groundwater Body (GWB) underlying the site is the Dundalk GWB (EU Groundwater Body Code: IE_NB_G_015). Currently, the EPA (2023) classifies the Dundalk GWB as having '*Good Status*', and a WFD Risk Score of '*Not at risk of not achieving good status*'. The Dundalk GWB has a Good Status for chemical and quantitative categories. Therefore, the overall status is considered Good.

3.3 PROJECT DETAILS

The surface water assessment and the groundwater assessment both examine the potential effects of the proposed development.

3.3.1 Construction Phase

The key activities for the WFD assessment are as follows:

- **Ground Works, Dredging and Piling:** It is known that ground works will comprise excavation, dredging and levelling for foundations, piling and laying of associated services for the buildings and movement of soil for landscaping purposes. Tie rod installation will require the excavation of the area between the anchor and quay walls. Once excavated, tie rods of approximately 100mm diameter will be assembled to connect the two walls. The tie rods will be prestressed to remove any slack in the rod. Backfilling will reuse a large portion of the arisings through soil improvement techniques. Dredging will be carried out by backhoe dredger mounted on pontoons. The dredger will deposit the dredge material into a hopper barge which will be towed to the quayside by tug. It is not anticipated that rock will be encountered during the dredge. Piling will require boring into rock, pitching and setting in place of steel piles from floating and elevated platforms. The works will also require the construction of a piled wall measuring approximately 70m to support a new bankseat, push on berth and facilitate the dredge pocket. The wall will take the form of a combi-pile wall.

- **Marine Works:** It is proposed the construction of 220m long, 5m wide high freeboard pontoon with 9 no. CTV berths and 2 no. lay over berths including 40m access ramp. The pontoons will be secured in place using rock socketed piles.
- **Dewatering:** Given the soil, geological and hydrogeological characteristics of the site, it is not expected that any groundwater will be encountered throughout the site, refer to Chapter 9 and 10 of Volume II. However, during the ground works, excavation and piling, dewatering (removing potential perched groundwater within the subsoil) may be necessary to create a dry working environment and prevent water from seeping into the excavation and flooding the construction site. This dewatering could result in the localised lowering of the local shallow (overburden) groundwater table, which will not be part of the regional bedrock aquifer. There may also be localised pumping of surface run-off from the excavations during and after heavy rainfall events to ensure that the excavation is kept relatively dry. Based on the depth to bedrock there is no potential for impact on the aquifer water table.
- **Surface Water Run-off**: Surface water run-off and dewatering from excavations will be discharged to the local sewer and Carlingford Lough following settlement and treatment (if required).

The potential effects identified are as a result of:

- Suspended solids (muddy water with increased turbidity (measure of the degree to which the water loses its transparency due to the presence of suspended particulates) – arising from dewatering, excavation and ground disturbance.
- Cement/concrete (increase turbidity and pH) – arising from construction materials.
- Hydrocarbons (ecotoxic) – accidental spillages from construction plant or onsite storage.
- Wastewater (nutrient and microbial rich) – arising from poor on-site toilets and washrooms.
- Temporary land-take during the construction phase (excavation works); Excavation of top soil, subsoils and stones will be required for foundations and for levelling of the site. Local removal and reinstatement (including infilling) of the ‘protective’ topsoil and subsoil cover across the development area at the site will not change the overall vulnerability category for the site which is already ‘*High*’. Installation of drainage will minimise the potential for contamination of the aquifer beneath the site.
- Below ground working causing mobilisation of contaminants during the construction and operational phases.

3.3.2 Operational Phase

There is no abstraction of groundwater or discharge to ground proposed. The proposed O&M facilities are located within a previously paved area.

The proposed surface water drainage will not include new outfalls into Carlingford lough as part of the development; the existing outfalls will be used, and their capacity will not be increased.

The collected runoff will be discharged through an existing outfall at Berth 3, and the discharge pipe will remain its size. The surface catchment area will increase in comparison with the existing situation; however, it is intended to attenuate storm volumes and ultimately outfall them at a restricted greenfield runoff rate. A petrol bypass interceptor is proposed before the discharge point at Berth 3.

All other surface water outfalls shall remain the same unaffected. The proposed surface water drainage system designed for this development includes a number of Sustainable Urban Drainage Systems (SuDS) measures which will be incorporated to reduce run-off volumes and improve run-off water quality. The SuDs mechanisms will comprise existing gullies, and the proposed underground attenuation tank together with flow control device and petrol interceptor. These features will be provided to cater for up to a 1-in-100-year rainfall event plus 20% allowance for climate change characteristics.

In addition, the catchment at the satellite carpark will be connected to the public Louth County Council surface water collection on the coast road which has sufficient existing capacity.

The proposed development will require a 200,000 litre above-ground fuel storage tank. This tank shall be double lined and located within a bounded area. As such the only potential for a leak or spill of petroleum hydrocarbons is from vehicles. Unmitigated spills may lead to local contamination of soil. However, it is noted that during the operational phase any accidental discharge will more likely impact stormwater drainage due to the hardstand and drainage infrastructure proposed and any releases to drainage will be mitigated through petrol interceptors.

The hardstand area and the use of SUDs design measures will have a minor effect on local recharge to ground; however, the impact on the overall groundwater regime will be insignificant considering the proportion of the site area in relation to the total aquifer area. The proposed stormwater drainage system for the new building will follow SuDS measures which include swales, underground attenuation tanks and petrol interceptors. This system has been designed in order to discharge following the characteristics of a greenfield run-off into the Carlingford Lough.

The port currently has an existing foul drainage network in place comprising of a foul septic tank and foul lines servicing buildings in the port. The foul collection tank is located under the floor of an existing warehouse, 'Store 0' and collects foul effluent from the port and the village. The collection tank is a Uisce Eireann asset, and they are given access to the site to allow tankers enter and empty the chamber for off-site disposal.

There is an existing 150mm connection to the public Louth County Council/ Irish Water collection foul network from an existing building to be demolished. It is intended to continue this connection and repurpose it for the new development. This foul network in the port and the surround town and hinterland is collected in public network that terminates in the aforementioned Uisce Eireann collection tank in Greenore port (in the warehouse). This tank is then emptied with a tanker periodically and sent to Dundalk WWTP (D0053-01). There will be no direct foul water discharge into Carlingford Lough.

3.4 MITIGATION AND DESIGN MEASURES

The design has taken account of the proposed development's potential impacts on the hydrological environment local to the area where construction is taking place. The only potential impact during construction is accidental releases, and there is limited potential for any contaminant release during operation.

3.4.1 Construction Phase

The following mitigation measures will be implemented during the construction phase.

Suspended solids management.

As there is potential for run-off to directly/indirectly discharge/recharge to a watercourse/groundwater underlying the site (Carlingford Lough/ Dundalk GWB) and in order to manage the potential impact associated with sediment and sediment runoff the following mitigation measures will be implemented during the construction phase.

- During earthworks and excavation works, care will be taken to ensure that exposed soil surfaces are stable to minimise erosion. All exposed soil surfaces will be within the main excavation site which limits the potential for any offsite impacts.
- Run-off water containing silt will be contained on site via settlement tanks and treated to ensure adequate silt removal.
- Silt reduction measures on site will include a combination of silt fencing and settlement measures (silt traps, silt sacks and settlement tanks/ponds).
- Any hard surface site roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads shall be restricted to essential site traffic only.
- A power washing facility or wheel cleaning facility will be installed near to the site compound for use by vehicles exiting the site when appropriate,
- A stabilised entranceway consisting of an aggregate on a filter cloth base that is located at any entry or exit point of the construction site.
- Aggregate will be established at the site entrance points from the construction site boundary extending for at least 10 m.
- The temporary storage of soil will be carefully managed. Stockpiles will be tightly compacted to reduce runoff and graded to aid in runoff collection.
- Aggregate materials such as sands and gravels will be stored in clearly marked receptacles within a secure compound area to prevent contamination.
- Movement of material will be minimised to reduce the degradation of soil structure and generation of dust.
- Excavations will remain open for as little time as possible before the placement of fill. This will help to minimise the potential for water ingress into excavations.
- Weather conditions will be considered when planning construction activities to minimise the risk of run-off from the site.
- Any surface water run-off collecting in excavations will likely contain a high sediment load. This will not be allowed to directly discharge directly to the Carlingford Lough.

In addition to the measures above, all excavated materials will be visually assessed by suitably qualified persons for signs of possible contamination such as staining or strong odours. Should any unusual staining or odour be noticed, samples of this soil will be analysed for the presence of potential contaminants to ensure that historical pollution of the soil has not occurred. Should it be determined that any of the soil excavated is contaminated, this will be segregated and appropriately disposed of by a suitably permitted/licensed waste disposal contractor.

Surface water discharge from the site will be managed and controlled for the duration of the construction works until the permanently attenuated surface water drainage system of the proposed site is complete. A temporary drainage system shall be established prior to the commencement of the initial infrastructure construction works to collect and discharge any treated construction water during construction.

Cement/concrete works

Where feasible all ready-mixed concrete will be brought to site by truck. A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil.

No wash-down or wash-out of ready-mix concrete vehicles during the construction works will be carried out at the site within 10 meters of an existing surface water drainage point. Washouts will only be allowed to take place in designated areas with an impervious surface where all wash water is contained and removed from site by road tanker or discharged to foul sewer submit to agreement with Irish Water / Louth County Council.

The construction contractor will be required to implement emergency response procedures, and these will be in line with industry guidance. All personnel working on the Site will be suitably trained in the implementation of the procedures.

Hydrocarbons and other construction chemicals

The following mitigation measures will be implemented during the construction phase in order to prevent any spillages to ground of fuels and other construction chemicals and prevent any resulting to surface water and groundwater systems:

- Designation of bunded refuelling areas on the Site.
- Provision of spill kit facilities across the Site.
- Where mobile fuel bowsers are used, the following measures will be taken:
    - Any flexible pipe, tap or valve will be fitted with a lock and will be secured when not in use.
    - The pump or valve will be fitted with a lock and will be secured when not in use.
    - All bowsers to carry a spill kit and operatives must have spill response training.
    - Portable generators or similar fuel containing equipment will be placed on suitable drip trays.

In the case of drummed fuel or other potentially polluting substances which may be used during the construction phase, the following measures will be adopted:

- Secure storage of all containers that contain potential polluting substances in a dedicated internally bunded chemical storage cabinet unit or inside a concrete bunded area;
- Oil and fuel storage tanks shall be stored in designated areas, and these areas shall be stored within temporary bunded areas, doubled skinned tanks or bunded containers to a volume of 110% of the capacity of the largest tank/container. Drainage from the bunded area(s) shall be diverted for collection and safe disposal.
- Clear labelling of containers so that appropriate remedial measures can be taken in the event of a spillage.
- All drums to be quality approved and manufactured to a recognised standard.
- If drums are to be moved around the Site, they will be secured and on spill pallets; and

- Drums will be loaded and unloaded by competent and trained personnel using appropriate equipment.

Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in a designated area or within the construction compound which will be away from surface water gulleys or drains or Carlingford Lough (minimum 20 m buffer zone). In the event of a machine requiring refuelling outside of this area, fuel will be transported in a mobile double skinned tank. An adequate supply of spill kits and hydrocarbon adsorbent packs will be stored in this area. All relevant personnel will be fully trained in the use of this equipment. Guidelines such as "Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors" (CIRIA 532, 2001) will be complied with.

The construction contractor will be required to implement emergency response procedures, and these will be in line with industry guidance. All personnel working on the Site will be suitably trained in the implementation of the procedures.

<u>Disposal of collected water (rainfall run-off and perched water)</u>

Rainfall at the construction site will be managed and controlled for the duration of the construction works until the permanently intercepted and attenuated surface water drainage system of the proposed site is complete. Dewatering water from excavation works within overburden deposits will be contained within the site, treated (if required) and discharged to existing site network.

<u>Wastewater Management</u>

Foul wastewater discharge from the site will be managed and controlled for the duration of the construction works.

Site welfare facilities will be established to provide sanitary facilities for construction workers on site. The main contractor will ensure that sufficient facilities are available at all times to accommodate the number of employees on site. Foul water from the offices and welfare facilities on the site will discharge into the existing sewer on site (the cabins may initially need to have the foul water collected by a licensed waste sewerage contractor before connection to the sewer line can be made).

The construction contractor will implement emergency response procedures, and these will be in line with industry guidance. All personnel working on the Site will be suitably trained in the implementation of the procedures.

<u>Management of Surface Water Flow Paths</u>

During construction a site drainage and protection system will be built to reduce the flow of run-off from the site, prevent soil erosion, and protect water quality in the Carlingford Lough. Temporary excavated channels, bunds, or ridges or a combination of the three, may be constructed to divert sediment-laden water to an appropriate sediment retention structure. These will be installed to provide permanent diversion of clean stormwater away from erosion exposed soil areas, or to provide a barrier between exposed areas and unexposed areas of the construction site. Runoff diversion channels/bunds need regular maintenance to keep functioning throughout their life.

Silt fences will be installed around the perimeter of the site where construction is proposed to detain flows from runoff so that deposition of transported sediment can occur through settlement. Inspection and maintenance of the silt fences during construction phase is crucial to ensuring that they work as intended. They will remain in place throughout the entire construction phase.

It is envisaged that a number of geotextile lined settling basins and temporary mounding's and/or silt fences will be installed to ensure silts do not flow off site during the construction stage. This temporary surface water management facility will throttle runoff and allow suspended solids to be settled out and removed. All inlets to the settling basins will be 'riprapped' to prevent scour and erosion in the vicinity of the inlet.

Surface water discharge from the site will be managed and controlled for the duration of the construction works until the permanently attenuated surface water drainage system of the proposed site is complete. A temporary drainage system shall be established prior to the commencement of the initial infrastructure construction works to collect and discharge any treated construction water during construction.

3.4.2 Operational Phase

The design has taken account of the potential impacts of the development on surface water quality; measures have been incorporated in the design to mitigate these potential impacts.

The proposed development will require a 200m3 above ground fuel storage tank that can potentially affect the nearby water quality. This tank shall be double lined and located within a bounded area.

The proposed development stormwater drainage network design includes sustainable drainage systems (SuDS) these measures by design ensure the stormwater leaving the site is to be attenuated and treated within the new development site boundary to ensure suitable quality, before discharging to the Carlingford Lough.

The purpose of the proposed design is to:

- Treat runoff and remove pollutants to improve quality.
- Restrict outflow and to control quantity.
- Increase amenity value.

The layout of the proposed surface water drainage network is shown on the drawing set included with this Application. It is proposed to separate the surface water and foul drainage networks, which will serve the proposed development, and provide independent connections to the local public surface water and goul sewer networks respectively.

In respect of the indirect hydrological link to the European sites associated with Dundalk Bay, via foul water – foul waste arising at the site that will discharge to Dundalk Wastewater Treatment Plant (D0053-01). The peak wastewater discharge is calculated at 1.25 l/s. The sewage discharge will be collected in the existing tank in Greenore port and ultimately treated at Irish Water's WWTP at Dundalk prior to discharge to the Dundalk Bay.

3.5 ASSESSMENT OF SOURCE PATHWAY LINKAGES

This section presents information on the current waterbody status identified in the development area.

The proposed development site lies within the Newry, Fane, Glyde and Dee Catchment 06 and Big [Louth]_SC_10 WFD sub-catchment 06-9 (Greenore_010 WFD River Sub Basin). The Groundwater Body (GWB) underlying the site is the Dundalk GWB (EU Groundwater Body Code: IE_NB_G_015) (EPA, 2023)

This WFD Screening has identified one (1) no. WFD surface water bodies and one (1) no. WFD groundwater bodies of relevance due to the close proximity and connection of these waterbodies during the construction and operation of the proposed development.

The water bodies are listed in Table 3.1 below.

Table 3.1 *WFD water bodies located within the study area*

Type	WFD Classification	WFD Status (2016-2021)	WFD Risk	Waterbody Name / ID	Location
Surface Water	Coastal	Moderate	*Under Review*	Carlingford Lough (GBNIIE6NB030)	Adjacent the site.
Groundwater	Groundwater	Good	Not At Risk	Dundalk GWB (IE_NB_G_015)	Groundwater body immediately underlying the proposed development site.

During the construction phase, there will be a direct connection via surface water to the Carlingford Lough (following settlement and treatment where required). During the operational phase, there is also a direct connection to the Carlingford Lough through the projected stormwater drainage and direct discharge at Berth 3.

There will also be an indirect hydrological connection to the Inner Dundalk Bay transitional waterbody through the foul water discharge, which will be treated off-site at Dundalk Waste Water Treatment Plant (WWTP). However, this waterboy has been excluded from the table above due to its distance from the subject site, the potential loading of contaminants from the site, and significant dilution through its pathway.

It should be noted that the peak effluent discharge, calculated for the proposed development as 1.25 l/s would equate to 0.19% of the licensed discharge at Dundalk WWTP [peak hydraulic capacity]. This flow would not have a measurable impact on the overall water quality within Inner Dundalk Bay and therefore would not have an impact on the current Water Body Status (as defined within the Water Framework Directive).

The table below (Table 3.2) describes the S-P-R model for the site and includes the robust mitigation and design measures which will be incorporated into the proposed development throughout the construction and operational phases.

Table 3.2 *Pollutant Linkage Assessment (with mitigation)*

Source	Pathways	Receptors considered	Risk of Impact	Mitigation Measures
<u>Construction Impacts (Summary)</u>				
Discharge to ground of runoff and dewatering. Unmitigated leak from an oil tank to ground/ unmitigated leak from construction vehicle (1,000 litres worst case scenario).	Bedrock protected by >3-10m high permeability overburden. Low fracture connectivity within the limestone will limit any potential for offsite migration.	Limestone bedrock aquifer (Locally Important Aquifer)	Low risk of migration through poorly connected fracturing within the limestone rock mass. No likely impact on the status of the aquifer/off site migration due to mitigation measures (i.e., CEMP), low potential loading, natural attenuation within overburden and discrete nature of fracturing reducing off site migration.	Only potential for temporary impacts due to accidental releases. A CEMP will be a live document and it will go through a number of iterations before works commence and during the works. It will set out requirements and standards which must be met during the construction stage and will include the relevant mitigation measures outlined in the EIA Report and any subsequent conditions relevant to the proposed development. These include management of soils, re-fuelling of machinery and chemical handling, control of water during the construction phase and treatment of discharge water where required.
Discharge to ground of runoff water with High pH from cement process/ hydrocarbons from construction vehicles/run-off containing a high concentration of suspended solids	Direct pathway to hydrological environment via stormwater drainage	Hydrological environment (Carlingford Lough)	No perceptible risk due to the implementation of the mitigation measures	
<u>Operational Impacts (Summary)</u>				
Discharge of untreated water off-site	Direct pathway to hydrological environment via surface water drainage system	Hydrological environment (Carlingford Lough)	No perceptible risk due to the implementation of the mitigation and design measures which includes SuDS techniques and the use of interceptors along the drainage system.	The proposed development is designed to ensure the protection of the hydrological environment such as delivery and distribution and use of oil interceptors on the stormwater system and the use of SuDS techniques. In order to limit the surface water discharge from the site to pre-development, greenfield rates, and to ensure improvement in the overall surface water quality before ultimate discharge the principles of Sustainable Drainage Systems, (SuDS) are to be implemented.
Discharge of foul water to the Dundalk Waste Water Treatment Plant (WWTP)	Indirect pathway to Inner Dundalk Bay through public foul sewer post treatment at the WWTP.	Hydrological environment (Inner Dundalk Bay)	No perceptible risk to the hydrological environment and the WWTP. Even without treatment at Dundalk WWTP, the peak effluent discharge (1.25 l/s which would equate to 0.19% of the licensed discharge at Dundalk WWTP); would not impact on the overall water quality within Dundalk Bay and therefore would not have an impact on the current Water Body Status (as defined within the Water Framework Directive).	Wastewater discharge to be agreed with Irish Water (IW) in a Wastewater Connection Application.

4.0 NO DETERIORATION ASSESSMENT

4.1 HYDROLOGICAL ENVIRONMENT

The proposed development has a direct hydrological connection to the Carlingford Lough as the proposed stormwater drainage discharges into this water body.

There are mitigation and design measures which will be implemented during the construction phase to protect the hydrological and hydrogeological environment. There is a potential of accidental discharges during the construction phase, however these are temporary short-lived events that will not impact on the water status of waterbodies long-term and as such will not impact on trends in water quality and over all status assessment.

It is expected that localised groundwater dewatering will be required as part of the excavation works; however, it will be associated with perched groundwater within the subsoils and not with the regional aquifer within the bedrock. As such the proposed development will not have an impact on the quantitative aspects in consideration of water body status such as baseflow for the hydrological waterbodies.

The project-specific CEMP which the works Contractor will develop will implement strict mitigation measures to ensure the protection of the hydrological (and hydrogeological) environment during construction which will ensure that there will be no negative impact on the quantitative or qualitative or morphology of the nearby watercourses.

There are limited (greenfield rate) direct discharges of water during the operational phase to open waterbody/ watercourse (Carlingford Lough) and no long-term groundwater dewatering for the proposed development. The discharges will be adequately treated via SuDS measures, hydrobrake (or equivalent) and oil/water interceptor to ensure there is no long-term negative impact to the WFD water quality status of the receiving waterbody. The SuDS and proposed measures have been designed in detail with the ultimate aim of protecting the hydrological (& hydrogeological) environment. The SuDS and project design measures will be maintained correctly as per specifications to ensure long-term/ on-going integrity of same.

There are no changes to the overall hydrological and hydrogeological regime as a result of the proposed development. There are no proposed diversions of any drainage ditches or waterbodies as part of the proposed development.

Overall, the potential effects on the current status of the waterbodies are considered *no impact i.e. no change to the WFD status or elements in terms of the hydrological environment*.

4.2 HYDROGEOLOGICAL ENVIRONMENT

As mentioned above, the proposed development will involve dewatering of the perched groundwater within the subsoils and not with the Dundalk Groundwater Body which is confined within bedrock. As such the proposed development will not have an impact on the quantitative aspects in consideration of water body status such as baseflow for the hydrological waterbodies. During operation there is no current proposal for dewatering.

For the construction phase, there are mitigation and design measures which will be implemented during this phase to protect the hydrogeological environment. There is a potential of accidental discharges during the construction phase, however these are temporary short-lived events that will not impact on the water status of the underlying bedrock aquifer long-term and as such will not impact on trends in water quality and over all status assessment.

The project-specific CEMP which the works Contractor will develop will implement strict mitigation measures to ensure the protection of the hydrogeological environment during construction which will ensure that there will be no negative impact on the quantitative or qualitative of the underlying bedrock limestone aquifer (Dundalk GWB).

In terms of the operational phase, the risk to the aquifer is considered to be low due to the use of oil interceptors on the stormwater system prior to discharge from the site.

Overall, the potential effects on the WFD status to the waterbodies are considered no impact i.e., no change to the current status or elements in terms of the underlying hydrogeological environment.

4.3 ASSESSMENT IN TERMS OF FUTURE GOOD STATUS

The Carlingford Lough and Dundalk GWB are examined in terms of water quality as these sections of waterbodies are indirectly connected to the proposed development site. Currently, the NIEA classifies the WFD Ecological Status for the Carlingford Lough as having '*Moderate*', respectively (2016-2021) based on current monitoring with a current WFD River Waterbody risk score of '*Review*'. Therefore, the objective is currently not being achieved.

According to the sub-catchment assessment of the Big[Louth]_SC_010 carried out by the EPA, there are a number of pressures within this sub-catchment that impact on the hydrological environment. Anthropogenic pressures were identified as the likely significant pressure within these catchments. The EPA classifies the WFD Ecological Status for the Dundalk groundwater body as having '*Good Status'* (2016-2021) and its WFD Waterbody risk score is '*Not at Risk of not achieving good status*' (refer to www.catchments.ie).

As mentioned above, the main pressure for obtaining good status is anthropogenic. The discharges associated with the proposed development will be treated and attenuated prior to discharge off-site. Foul water will be discharged and treated by the Dundalk WWTP which is licensed by the EPA. Therefore, the proposed development will not have any discharges which will hinder catchment improvement measures.

The 2nd cycle of the RBMP 2018-2021 does not include the Greenore Subcatchment as an Area for Action, and therefore has not been highlighted for restoration by the *draft* 3rd cycle of the RBMP 2022-2027. However, the key objective for this waterbody is to have a *Good* status by 2027.

The objective of the Dundalk GWB is Good for 2027. Therefore, the objective is currently being met.

At present there are no local targeted measures within the catchments to maintain or achieve improvements to the status of the water bodies. However, the following are some pressures associated with waterbody catchments:

- Physical Modifications.

- Management of pollution from agricultural activities.
- Management of pollution from sewage and waste water.
- Management of pollution from urban environments.
- Changes to natural flow and levels of water.
- Managing invasive non-native species.

Based on the above information it is not considered that any of the aspects of the proposed development will prevent the WFD objectives from being achieved or to meet the requirements and/or objectives in the second RBMP 2018-2021 (River Basin Management Plan) and draft third RBMP 2022-2027.

5.0 CONCLUSIONS

Appendix A contains the surface water and groundwater assessments where the above potential effects are considered. The colour coded system referred to in Table 2-1 and Table 2-2 above is used to give a visual impression of the assessment.

The WFD assessment indicates that, based on the current understanding of the proposed development, there is no potential for adverse or minor temporary/ long-term or localised effects on the Carlingford Lough surface waterbody. Therefore, it has been assessed that the proposed development will not cause any deterioration or change in water body status or prevent attainment, or potential to achieve, future good status or to meet the requirements and/or objectives in the second RBMP 2018-2021 (River Basin Management Plan) and draft third RBMP 2022-2027.

The WFD assessment indicates that there is no potential for adverse or minor temporary or localised effects on the Dundalk groundwater body. Therefore, it has been assessed that it is unlikely that the proposed development will cause any deterioration or change on its water body status or prevent attainment, or potential to achieve the WFD objectives or to meet the requirements and/or objectives in the second RBMP 2018-2021 (River Basin Management Plan) and draft third RBMP 2022-2027.

No further assessment of WFD is recommended given that no significant deterioration or change in water body status is expected based on the current understanding of the proposed development during construction and operation.

6.0 STUDY LIMITATIONS

The conclusions and recommendations listed above are based on our current understanding of the site. This understanding has been formed from reviewing historical maps and current and previous environmental and engineering reports for the proposed development site. This information is taken as accurate and true.

Public databases held by the EPA, GSI, OPW, NPWS and OSI have been consulted and the most recent available data has been referenced.

No subsurface or destructive testing was carried out as part of this assessment.

7.0 REFERENCES

- EPA, (2023). Environmental Protection Agency, on-line mapping; Available on-line at: http://gis.epa.ie/Envision [Accessed: 23-10-2023].

- GSI, (2023). Geological Survey of Ireland; Available on-line at: www.gsi.ie [Accessed: 23-10-2023].
- NPWS, (2023). National Parks & Wildlife Service; Available on-line at: www.npws.ie [Accessed: 23-10-2023].
- OPW, (2020). The National Preliminary Flood Risk Assessment (PFRA) Overview Report; Flood Relief & Risk Management Division, Engineering Services, Office of Public Works (OPW).
- OPW, (2023). Office of Public Works; Available on-line at: www.opw.ie [Accessed: 23-10-2023].
- Ordnance Survey of Ireland (OSI).
- Teagasc subsoil database.
- 3rd Cycle Draft Erne Catchment Report (HA 36) (EPA, 2021).
- River Basin Management Plan for Ireland 2018-2021.
- Draft River Basin Management Plan for Ireland 2022-2027.
- Louth County Council Development Plan 2021-2027.

APPENDIX A
WATER FRAMEWORK DIRECTIVE ASSESSMENT MATRIX

Risk screening of potential to cause deterioration of current WFD status

	Surface Water	Scheme Elements	Proposed Development						Mitigation Measures	Overall impact with mitigation measures
	Carlingford Lough (GBNIIE6NB030)	Phase (Construction/ Operation)	Construction	Construction	Construction	Construction	Operation	Operation		
		Identified Quantitative impacts	Increased run-off and sediment loading	Temporary land-take during the construction phase	Pollution due to accidental discharges or spillages during the construction phase	Scour during the construction phase	Increase in Hardstanding	Storage of Fuel		
WFD Status	Macrophytes and phytobenthos - combined	Predicted change to status elements (green = none, amber = possibly, red = likely)	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	Construction: The project-specific CEMP will include robust mitigation measures to protect the underlying hydrogeological environment. The CEMP will be a live document and it will go through a number of iterations before works commence and during the works. It will set out requirements and standards which must be met during the construction stage and will include the relevant mitigation measures outlined in the EIA Report and any subsequent conditions relevant to the proposed development. These include management of soils, refuelling machinery and chemical handling and control of water during the construction phase. Operation: The proposed development is designed to ensure the protection of the hydrological environment such as [illegible] and use of oil interceptors on the stormwater system and the use of SuDS techniques, in order to limit the surface water discharge from the site to pre-development, greenfield rates, and to ensure improvement in the overall surface water quality before ultimate discharge the principles of Sustainable Drainage Systems (SuDS) are to be implemented. Details are to be agreed with Louth CC	No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Macroinvertebrates		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
Physio-Chemical Status	Fish	Predicted change to status elements (green = none, amber = possibly, red = likely)	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Total Ammonia		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Total Nitrogen		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Ortho-Phosphate		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
Hydromorphological Elements	Quantity and dynamics of river flow	Predicted change to status elements (green = none, amber = possibly, red = likely)	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Connection to Groundwater		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	River continuity		Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.		Not Applicable.
	River depth and width variation bed		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Structure and substrate of river bed		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Structure of riparian zone		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status

Risk screening of potential to cause deterioration of current WFD status

	Groundwater	Scheme Elements	Proposed Development				Mitigation Measures	Overall Impact
	Dundalk GWB (IE_NB_G_015)	Phase (Construction/ Operation)	Construction	Construction	Operation	Operation		
		Identified Quantitative Impacts	Increased run-off and sediment loading	Pollution due to accidental discharges or spillages during the construction phase	Increase in Hardstanding	Storage of Fuel		
Quantitative Elements	**Saline or other intrusions.** To identify groundwater bodies where the intrusion of poor quality water as a result of groundwater abstraction is leading to sustained upward trends in pollutant concentrations or significant impact on one or more groundwater abstractions.	Predicted change to status elements (green = none, amber = possibly, red = likely)	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	**Construction:** The project-specific CEMP will include robust mitigation measures to protect the underlying hydrogeological environment. The CEMP will be a live document and it will go through a number of iterations before works commence and during the works. It will set out requirements and standards which must be met during the construction stage and will include the relevant mitigation measures outlined in the EIA Report and any subsequent conditions relevant to the proposed development. These include management of soils, re-fuelling machinery and chemical handling and control of water during the construction phase. No significant dewatering is required which would impact on quantitative status. **Operation:** The proposed development is designed to ensure the protection of the underlying hydrogeological environment such as use of oil interceptors on the stormwater system and prior to discharge from the site and the use of SuDS techniques. In order to limit the surface water discharge from the site to pre-development, greenfield rates, and to ensure improvement to the overall surface water quality before ultimate discharge the principles of Sustainable Drainage Systems (SuDS) are to be implemented. No significant abstraction is required which would impact on quantitative status.	No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Surface water. To assess the impact of groundwater abstractions on the ecological status of surface water bodies.		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Groundwater Dependent Terrestrial Ecosystems (GWDTE's) To assess the impact of groundwater abstractions on the condition of GWDTE'S.		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Water balance To identify groundwater bodies where abstractions exceed the available resource		Not Applicable (no dewatering anticipated)	Not Applicable (no dewatering anticipated)	Not Applicable (no water supply from borehole anticipated)	Not Applicable (no water supply from borehole anticipated)		Not Applicable
Chemical Elements	**Saline or other intrusions.** To identify groundwater bodies where the intrusion of poor quality water as a result of groundwater abstraction is leading to sustained upward trends in pollutant concentrations or significant impact on one or more groundwater abstractions.	Predicted change to status elements (green = none, amber = possibly, red = likely)	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Surface water. To assess the impact of groundwater abstractions on the ecological status of surface water bodies.		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Groundwater Dependent Terrestrial Ecosystems (GWDTE's) To assess the impact of nutrient concentrations in groundwater (primarily phosphates) on GWDTEs.		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	Drinking Water Protected Areas (DrWPAs) To identify groundwater bodies failing to meet the DrWPA objectives defined in Article 7 of the WFD or at risk of failing in the future.		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status
	General quality assessment To identify groundwater bodies where widespread deterioration in quality has or will compromise the strategic use of groundwater.		No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.	No measurable change anticipated.		No anticipated impacts to the hydrological environment with no deterioration to the WFD Status

APPENDIX 11.1
TERRESTRIAL HABITAT SURVEY

VOLUME III
APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

Proposed Operations & Maintenance Facility,
Greenore Port, Co. Louth

Terrestrial Habitat Survey

Author: Breffni Martin

Monday 20th May 2024

Issue for Planning Application

Introduction

A terrestrial habitat survey was undertaken to support and inform the preparation of the Biodiversity Chapter of the EIAR and the Supporting Information to Inform an Appropriate Assessment of a planning application for an Operations & Maintenance Facility designed to facilitate off shore wind farm development and maintenance.

The survey was carried out during daylight hours across.

- June, July, August, September 2023
- April and May 2024

Methodology

A literature survey was undertaken, reviewing old OSI maps and other plans, as well as any published information regarding the development of the port. Long term port employees were also consulted.

The terrestrial habitat survey consisted of several walk overs of the development site. During the walkovers all flora species were noted along with their abundance and setting. Identifications were confirmed using Webbs Flora (Webb, 1969) where required. The substrate was also assessed and classified using Fossitt's Guide (Fossitt, 1995).

Invasive species were surveyed in parallel.

Literature Survey

Geology

Carlingford lough is an ice-cut valley bounded by mountain ranges on either side with characteristics of a fjord. As the ice pushed down the lough during the last ice age it came against various obstacles, one of which is the carboniferous limestone bedrock at Greenore, which defined the current topography facilitating a deep-water port. This limestone is hard and deep and underlain by Visean limestone and calcareous shale, and is particularly hard.

Land Reclamation Phase

After the ice melted Greenore point and the current port area became a narrow peninsula cut off from most of the rest of Cooley by intertidal mud and sand flats. There is evidence of human settlement stretching back to the Mesolithic and was doubtless used for farming and the collection of shellfish. In 1830 the lighthouse was built, which, along with a small settlement to the east, is the only structure in the Historic Map 6-inch Colour map (1837-1842) and is still present at the port entrance today.

Figure 1 6-inch Colour map (1837-1842)

In 1863 the Dundalk and Greenore Railway Act authorised the construction of the port and railway, incorporating a hotel based on a model common at the time.

Railway-Hotel-Port Phase

The port was constructed in 1867 to provide links to the UK and Netherlands. The village was constructed to provide homes for the dock and railway workers of the Dundalk, Newry and Greenore

Railway. To construct the railway the shore was enclosed by a pitched boundary sea wall composed of cut cobbles and dredge material was infilled behind the wall. Added to this was clinker from the railway which still forms the substrate on part of Greenore golf course turf, so that over time the intertidal area was infilled and the golf course was established in 1898.

Figure 2 Historic Map 25 inch (1888-1913) – the red arrow shows the location of the photo below

The basic configuration of the port as it stands today was in place by 1870 including the breakwater. At the time the railway was extremely busy with trains running on the hour connecting to Dundalk and Newry, and from there the whole country.

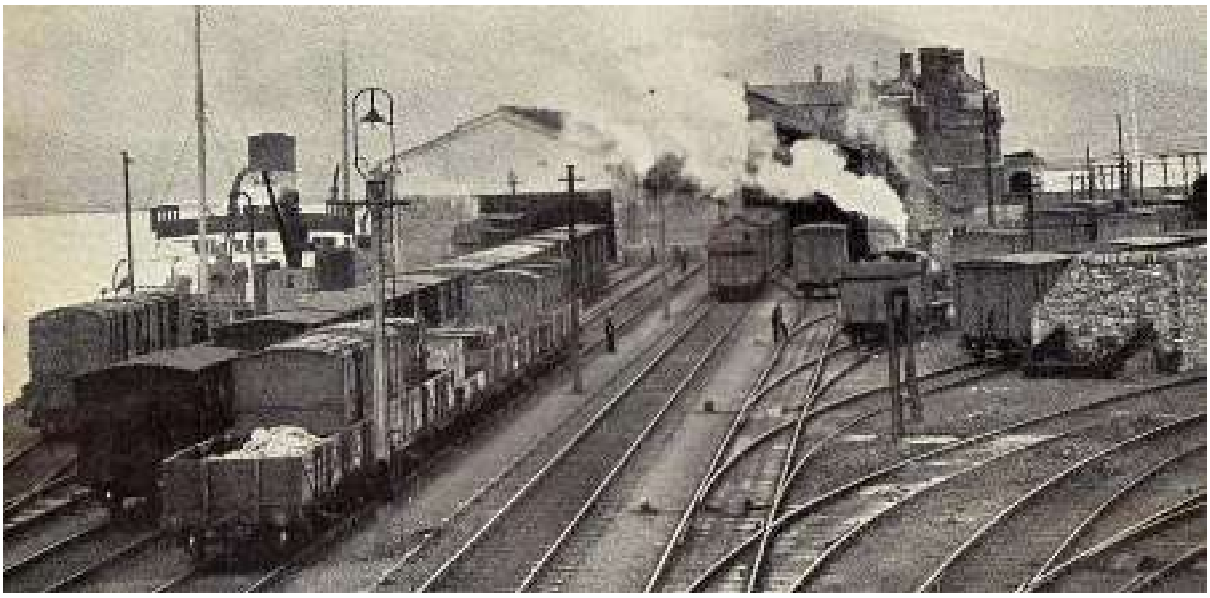


Figure 3 Greenore railway station ca 1930

The two lines terminated at Greenore where several other lines served as shunts and parking, as well as platforms for storing and loading goods for transport from the seaward side, while people boarded from the hotel side. On either side of the railway was a large terminal building, several warehouses, cattle pens and marshalling areas.

Figure 4 Detail of port circa 1888 showing present location of caissons

A large travelling crane was located immediately to the north of the present location of the caissons. A limestone block pitched quay wall was located where the caissons are now.

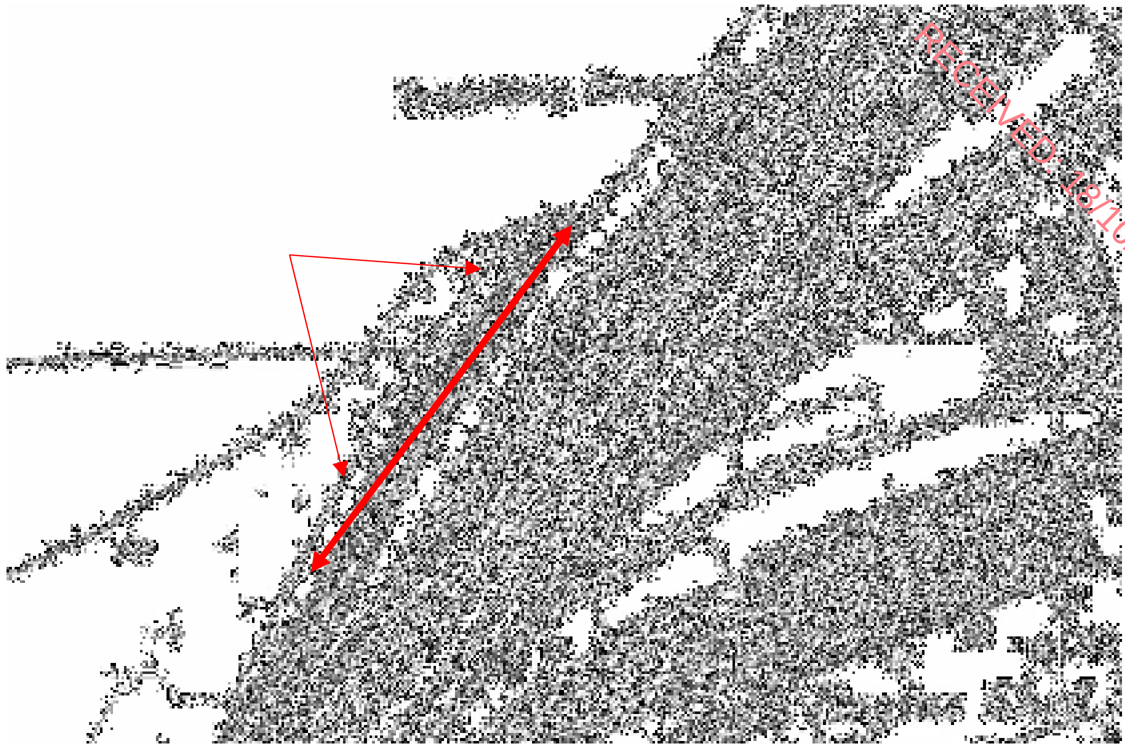


Figure 5 Detail of caisson position circa 1988 – the red arrows indicate the pitched sea wall

Continuing westwards the rest of the pitched retaining wall is composed of cut limestone cobbles which remain today, though somewhat dilapidated in places.

Abandonment of Railway and Extension of Port Facilities

In 1956 the railway was abandoned and the port was taken over by the O'Rahilly family who developed a hydrocarbon storage and transfer area, strengthened the existing quay wall, and emplaced the caissons with a view to developing a third berth for smaller vessels. This work was started in 1989 with the extirpation of the pitched sea wall, the dredging of substrate below it which turned out to be grey sticky clay. This sticky clay was "deposited" on a small sandy spit to the east of the port. Some of the cut blocks were then emplaced in the excavated space and the caissons were then positioned on top of them along the quay wall at their present location; however the project was the abandoned as the focus switched to a major upgrade of the outer berth, berth number 1, which was completed in 2001.

In the interim the area has been extensively used for storage, primarily steel but also other cargos requiring long term storage on the quay wall.

In 2019-2020 the second berth was upgraded and concrete slabs from it were used to stabilise the area behind the caissons.

Field Survey

The terrestrial port area which is part of the working port and includes hardstanding, remnant walls associated with the pre-existing railway, a warehouse, and recently developed quay wall, older concrete caissons (caissons are reinforced concrete cubes open at two ends, approximately 1 cubic metre in volume), a pitched sea wall made of cut limestone cobles, in various states of dilapidation. This has been overlain with concrete slabs stemming from the breaking and refurbishment of the old quay wall.

As such the habitat falls under two categories:

- Coast land
- Built land

Coast Land

The coastal port development area is a narrow strip of land approximately 150 metres by 5 metres consisting of recently developed quay wall, older concrete caissons, a pitched sea wall made of cut limestone cobles. Over time topsoil has arrived windblown and stemming from decayed coastal vegetation. They have also been partially infilled with clean stone. The following species have been observed in small patches or as one or two specimens in and along the edge of the caisson area, particularly where decaying nitrogenous vegetation slips in cracks and crevices along the track and stone bank and give opportunity: Plantago maritima, Beta vulgaris, Aster tripolium, Malva sylvestris, Matricaria discoidea, Cochlearia officinalis, Tripleurospermum maritimum, Senecio squalidus , Erysimum sp and Geranium robertianum along with one example of Reseda luteola. Crambe maritima, Suaeda maritima and Honkenya peploides were absent. This habitat may therefore be classified as Sea Walls Piers & Jetties (CC1).

Figure 6 Coast land showing caissons

Figure 7 Coastal habitat showing steel storage, caissons and concrete slabs

Built Land

Further inland the development area consists of hard standing, a currently used as an animal feed store, some remnant walls and tarmac carpark. These areas consist of concrete hard standing and man-made structures and are as such bereft of vegetation. Much of the area between the warehouse and the quay is currently used for the storage of steel coil and mesh.

Figure 8 Hard standing area with warehouse and steel storage

Figure 9 Hard standing, steel storage and openhydro building

This area may be classified as buildings and artificial surfaces - BL3.

Residential Plot & Front of Port Office.

Amenity Grassland

Amenity grassland (GA2) is a modified grassland habitat that is subject to regular maintenance. The result is a short sward and low biodiversity, which is therefore considered lower local importance. The habitat is present at the residential site within the proposed development site.

BC4 Flower beds and borders

Ornamental flower beds are present at the existing port office entrance/top of Euston Street. The species include,

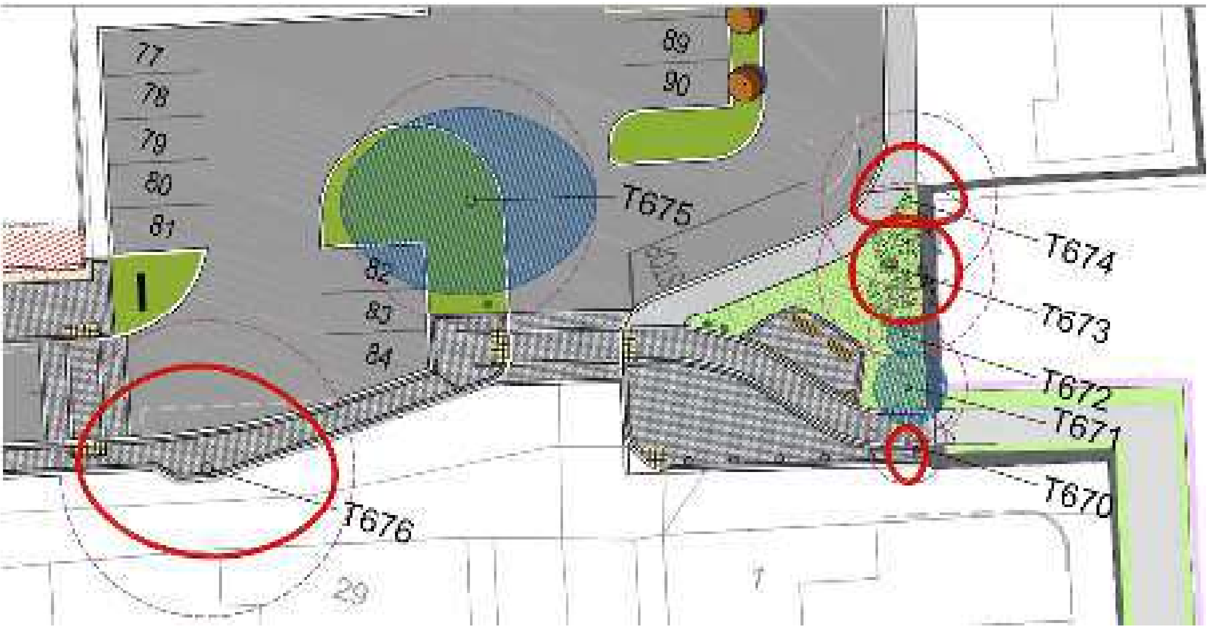
Rowan/Mountain Ash - Sorbus aucuparia (T670 and T671)

Cabbage Tree - Cordyline australis (T672)

Sweet Cherry – Prunus avium (T673 and T674)

Whitebeam – Sorbus aria (T675)

Sycamore – Acer pseudoplatanus (T676)



BL1 Stone walls and other stonework

The subject site contains a section of a wall associated with the former Engine Shed of the Greenore railway station. This now free-standing brick and limestone wall can be categorised as Stone walls and other stonework (BL1) according to Fossitt.

Discussion

The proposed development site is highly human modified and has gone through a number of iterations going back over 150 years.

Conclusions

The literature review and surveys demonstrate that the terrestrial area of the proposed development site does not host habitats of conservation significance and overall is of no particular ecological value.

RECEIVED: 18/10/2024

APPENDIX 11.2
OVERWINTERING BIRD SURVEY 2022-2023

VOLUME III
APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

Proposed Operations & Maintenance Facility, Greenore Port, Co. Louth

Overwintering Bird Survey 2022-2023

Author: Breffni Martin

Monday 20th May 2024

Issue for Planning Application

Introduction

An overwintering bird survey was undertaken to support and inform the report titled *Information to Inform Screening for Appropriate Assessment* submitted as part of a planning application for Operations & Maintenance Facilities designed to facilitate offshore wind farm development. The survey was carried out from October 2022 to March 2023 during daylight hours. It included a survey of the intertidal habitat in the relevant count area, see Figure 1.

Methodology

Desktop Survey

A review of relevant literature was undertaken, covering SPA site supporting documentation, published and unpublished scientific literature, and Irish Wetlands Bird Survey data listed in references. A summary of the conservation status of each species is provided in Appendix 3.

Field Survey

An area of at least 200 metres around the development site was surveyed over four hours on high and low tides, covering both spring and neap, so that all tidal states were covered (see Figure 1). All birds within this area were counted. The area was divided into two zones, zone 1 and zone 2, zone 1 being inside the SPA and zone 2 outside it. Furthermore birds using the breakwater, which is part of zone 2, were separately counted. The 200-metre boundary is based on Cutts methodology for assessing bird disturbance (Cutts, 2013). This survey covered October 2022 to March 2023. Significant bird activity outside the survey area was also noted.

Figure 1 Zones 1 and 2 including the breakwater

Before the start of the bird survey work, the 200-metre area was surveyed by walking over at low tide. The area consists of intertidal mudflats and sandflats in a mosaic with several course patches with, crushed shells, gravels and cobbles and broadly correspond to mixed sediment shores (LS5), though heavily modified by human activity and structures. Mud and vegetation were largely absent, with little evidence of infauna on the surface (casts, siphon holes, etc). Laminaria sp dominated the main channel with Fuscus sp on the edges (quay wall and breakwater base).

The intertidal habitat broadly corresponds to that described in the SPA site supporting documents and its ecological function in relation to birds is primarily to provide a substrate for infauna prey (crustaceans, worms, shellfish etc) and to a lesser extent, vegetation, though this area is likely depauperate in relation to the rest of the intertidal area due to the speed of the current and the substrate. The substrate is quite compacted, probably due to the scouring effect of the tide, which flows at 5 knots per hour at Greenore point, and includes numerous coble sized stones; the current also likely picks up any silt or other fines, preventing them from settling.

The breakwater functions ecologically as a bird roost, mainly at high tide, but also used at low tide by loafing gulls and cormorants. The base of the breakwater consists of large stones of cobble size protecting vertical railway sleepers which serve as an artificial reef breakwater, channelling the water through the berthing area. It supports extensive fucoid and algae species, as well as invertebrates sheltering in the crevices between the rocks. Functionally this also provides an area for some foraging waterbirds such as whimbrel, curlew and grey plover. The area to the north of the breakwater is dominated by oyster trestles, often with green algae growing on it, and as such qualifies as intertidal mud/sand flats, but again, is highly human modified. The coastal pitched wall on the landward side functions as a roost for grey heron on occasion.

The area between the quay wall and the foreshore gradually gives way to sub-tidal habitat going east, so that a portion of zone 2 includes a sub-tidal area which varies depending on tide. At high water the whole area is covered on all tides except some low neap tides.

A benthic survey carried out in August/September 2023 as part of this proposed development found low levels of infauna in the part of the intertidal area sampled, while the rest of the intertidal area was too hard for the grab system to work, making it unlikely that infauna attractive to birds would be present – see benthic section of the *Information to Inform Screening for Appropriate Assessment* for full details.

Results

The total number of species recorded during 2022/23 within a 200-metre bird disturbance “zone of influence” around the proposed development site was 25 consisting of the following maximum counts October 2022 to March 2023. This is compared to the IWeBS most recent max count for this subsite 0Z482.

The rationale for the selection of this sub-site and the exclusion of the other sub-site ref 0Z480 at Greenore is that the substrate and habitat are significantly different. Additionally, the species distribution is also significantly different, as per the ‘Inis Report’, see Appendix 3. This approach is consistent with the precautionary principle so as not to dilute the overall percentage.

Species	**Max**	**IWeBS Sub-site** 0Z482	**%**
Light-bellied Brent Goose	12	489	2.5
Shelduck	2	15	13.3
Wigeon	10	215	4.7
Teal	8	38	21.1
Great Crested Grebe	2	0	na
Great Northern Diver	2	0	na
Red-throated Diver	1	0	na
Cormorant	89	0	na
Shag	4	0	na
Little Egret	3	15	20.0
Grey Heron	5	19	26.3
Oystercatcher	17	168	10.1
Grey Plover	1	2	50.0
Dunlin	15	230	6.5
Black-tailed Godwit	3	156	1.9
Curlew	5	124	4.0
Redshank	12	237	5.1
Turnstone	10	14	71.4
Black-headed Gull	166	200	83.0

Common Gull	27	45	60.0
Lesser Black backed Gull	13	1	1300.0
Herring Gull	1291	142	909.2
Great Black-backed Gull	67	9	744.4
Guillemot	2	0	na
Razorbill	2	0	na

Figure 2 Bird abundance - max counts

Total monthly counts show considerable variance in the numbers of waterbirds present within the ZoI as shown in the following Figure.

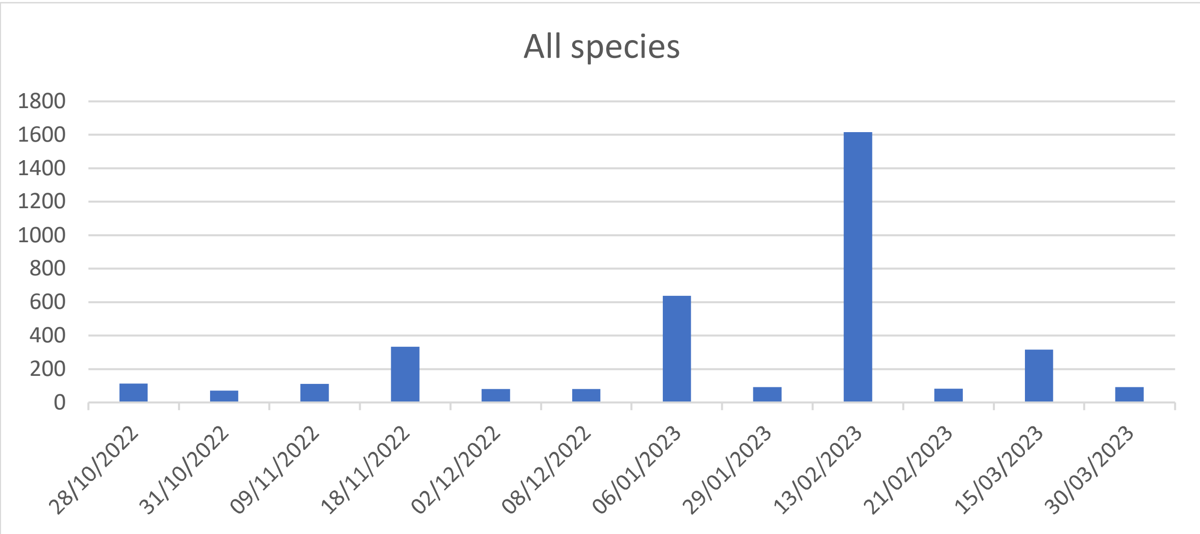


Figure 3 Bird abundance zones 1 + 2

Discussion

The general port area hosts a highly variable number of waterbirds consisting primarily of two cohorts, regularly occurring birds using the breakwater for roosting, and a more variable cohort consisting primarily of gulls who are attracted to the area when animal feed cargos are being discharged. The latter cohort consists almost exclusively of large gulls such as great black backed gulls and herring gulls, with a smaller number of common and black-headed gulls.

Peaks in numbers on the 6th January and 13th February 2023 correspond to discharges of animal feed on the quay wall. When animal feed is discharged from ships holds, it is typically lifted by way of a large grab, and dumped into a hopper which funnels it into a truck. The truck is then covered but inevitably there is spoil, particularly on windy days. Typically gulls will compete for this on the quay wall, along the road out of the port, and in the water fronting the quay wall where they often surface feed. They typically avoid the most active parts of the port, particularly when the Liebherr cranes are operating, but particularly herring gulls will aggressively compete for food items right next to human activity.

At other times, when cargos not attractive to birds are being discharged the numbers drop off considerably, particularly gulls, so that on some occasions there are no birds using the breakwater at all, particularly during eastern or northerly winds when it is very exposed. At other times the breakwater is over washed by spring tides.

Recorded species have variable responses to disturbance, be it visual or from noise, with waders and wildfowl being the most susceptible. Each species is considered below:

Light-bellied Brent Goose

Light-bellied brent geese are highly sensitive to noise and less so to visual disturbance. "When foraging they tolerate disturbance relatively nearby with an average proximity to disturbance threshold of 105m for first reaction. When roosting or loafing the birds are far more sensitive, with the range for first reaction increasing to 205m, nearly doubling in distance the effective range" (Cutts, 2013).

Typically, they respond to disturbance first by scanning; often a parent in a family group will keep watch while others forage. The first sign of disturbance produces scanning behaviour, then walking away, and finally flying. Sudden loud noises may flush an entire flock. During the survey they were only observed on the water, roosting/loafing while awaiting the tide to drop. However, they have been observed and documented feeding on Ulva sp growing on oyster trestles late in the season; they may also feed by upending on higher tides. There is a section of oyster trestles inside the count zone. Over the course of the two years of surveying 2022-2024 to inform this proposed development, this behaviour was not observed within the count zones.

Brent geese usually leave the lough at night to roost in Dundalk Bay unless there is a low tide at night, when at least some birds remain in Carlingford lough overnight, possibly feeding or roosting in channels. This behaviour is quite complex and depends on many factors in including food availability, tide, weather, time of year, and phase of moon. Having said that individuals and family groups are considered to be site-faithful, meaning they will return to the same preferred feeding locations each winter (Wheelan, 2017).

On two occasions family groups of brent geese drifted near or into the periphery of the zone of influence in zone 2 during high tide. These birds likely simply drifted into the area on the tide while waiting for the tide to drop so that could feed on the inner part of the lough.

Sensitivity: High.

Shelduck

Shelduck are generally a wary species and are highly sensitive to visual disturbance, possibly due to sensitivity to wildfowling. "Typically they approach construction works no closer than 300m and are affected by visual disturbance up to 500m away from source. (Cutts, 2013)" During the survey only two birds were seen during one count feeding at the edge of the count area in a patch of mud. Most of the count area is unsuitable for shelducks who filter feed on Hydrobia ulvae (a type of mudsnail). Shelducks also feed at night in Carlingford lough (authors observation), and the small population in the lough appears to roost on the water at night.

Sensitivity: High

Wigeon and Teal

These species are susceptible to disturbance from freshwater recreational activities (Grishanov, 2006) and loud noise, which is typical of a quarry species in Ireland. Typically they respond to disturbance at about 200 metres but may habituate to regular disturbance. In Carlingford lough both species often roost at high tide near the road between Carlingford and Greenore, typically staying about 80 metres from that busy road. Both tend to be site faithful during winter. On one occasion a flock of 10 wigeon drifted into from zone 1 into zone 2 before picking up and flying to Mill Bay, apparently disturbed by oyster workers; wigeon feed on vegetation, including eel grass and green algae. Teal, who filter feed mud, were not seen in the vicinity of the zone of influence.

Sensitivity: High

Great Crested Grebe, Great Northern Diver, Red-throated Diver

These diving species were observed on the water in very small numbers. Typically they follow the tide, occasionally diving for prey (fish), but will also take crustaceans such as crabs and shrimps. Great crested grebes will readily habituate to human activity, particularly when breeding. Great Northern Diver and Red-throated Diver are sea going species and are particularly shy and will generally avoid human activity as well as boats.

Sensitivity: High

Cormorant

A large population of cormorants uses the breakwater area for roosting, peaking at 89 birds, but with a regular presence on all counts. There are several other cormorant roosting sites in Carlingford lough notably Green Island, Block house island and Balagan point and birds may move between these roost sites depending on weather conditions, tides and other factors (e.g. availability of prey). Cormorants at roost are generally unaffected by disturbance unless it is very close; they quickly habituate to human activity. Often, they will depend on other species as sentinels. Cormorants make use of regular roosting sites, with some individuals remarkably faithful to these over time (BTO, 2022).

Sensitivity: Moderate

Shag

Shags are similar to cormorants but tend to be more ocean going; only small numbers were observed. Their main roost in Carlingford lough is on Blackhouse Island.

Sensitivity: High

Little Egret

Little egrets were regular in the count area in small numbers, both foraging and roosting. Little egrets are a recent addition to the Irish avifauna, a harbinger of global warming. Typically they forage by standing in or on the edge of the tide, or tidal channels, small streams, picking out small fish and crustaceans. They roost mainly on the breakwater, though on one occasion on the caissons during a period when the port was quiet. There is a large and growing population of little egrets in Carlingford lough, with a breeding site near Carlingford. Most roost on small islands near Carlingford. They startle relatively easily, typically flying a short distance away.

Sensitivity: Moderate

Grey Heron

Grey herons also breed in the vicinity of Carlingford and Carlingford lough supports a steady population. Generally grey herons may be particularly tolerant of disturbance, often depending on camouflage and stock still posture before flushing. Herons typically roost in trees at night but may also use both the caissons and the breakwater for roosting during the day at high tide, where they will allow approaches to within 20 metres. Grey herons are particularly site faithful and can be strongly territorial in winter, often squabbling with other herons and little egrets.

Sensitivity: Low

Oystercatcher

A relatively small population of oystercatchers occupies the sub-site between Carlingford and Greenore numbering about 130 typically. A max count of 10 was seen roosting on the breakwater. The birds observed in the ZoI were either roosting or feeding on stray mussels (there is no mussel bed as such in the area but mussels ca be carried by the tide). Oystercatchers may feed on a variety of prey, including mussels, clams (notably cockles), worms, and various invertebrates, and may range widely over the winter season depending on availability of food; this would include Dundalk Bay SPA. One individual was seen unsuccessfully foraging in zone 1.

Sensitivity: High

Grey Plover

Grey plovers occur typically as single birds, generally not associating with others. In this instance a single individual was seen foraging for crustaceans at the edge of the ZoI in zone 1.

Sensitivity: High

Dunlin

Dunlins are usually highly social and a few hundred dunlins forage in the sub-site; this number can be quite variable with over 1000 recorded in some seasons. They were observed in small numbers on three occasions, both foraging in the intertidal area in a small busy group, or roosting on the breakwater. Dunlins may range widely over the course of a season depending on food availability; this may include Dundalk Bay SPA.

Sensitivity: High

Black-tailed Godwit

Three black-tailed godwits were observed attempting feeding in the intertidal area briefly; their feeding was notably unsuccessful, not surprising given the hard substrate. Their preferred muddy substrate is absent from the ZoI. They were not observed roosting on the breakwater.

Sensitivity: High

Curlew

A small umber of curlews occasionally foraged around the base of the breakwater, searching for invertebrates amongst the nooks and crannies, and on one occasion roosting on it. Curlews may range widely over the course of a season depending on food availability; this may include Dundalk Bay SPA.

Sensitivity: High

Redshank

Redshanks are waders typical of the upper shore where they often act as sentinels for other birds (i.e. when they spook, they call alerting the other birds). A small number were present on every count both roosting and feeding in the intertidal area (typical redshank habitat) with a peak number of 17 birds roosting in March. Redshanks tend to be site faithful (Burton, 2010) but will range widely at night, when predators are not active. They are unlikely to visit Dundalk Bay SPA.

Sensitivity: High

Turnstone

Like redshanks, the intertidal habitat is attractive to turnstones, who were present on every count also, both foraging and roosting. Turnstones are the most confiding of the Irish waders and may be territorial in winter. Usually between 5 and 7 individuals were present, likely the same flock over the whole winter. The often-garrulous turnstones tend to be site faithful. They generally ignored human activity in the port, approaching to less than 5 metres.

Sensitivity: Low

Black-headed Gull

Black-headed gulls, our smallest common gull, are a "bold and opportunistic feeder" ever present around the port, looking for insects, fish, seeds, worms, scraps, and carrion. They are particularly attracted to animal feed spoil, often feeding on it floating on the water. When not in the port area they often feed on invertebrates in the brackish ponds in the adjacent golf course. At other times they will follow the plough, and are particularly attracted to slurry spread on fields. When the port is busy with animal feed cargos, up to 200 birds have been recorded, but at other times, as little as seven. Black-headed gulls may range very widely over a given season, or even a day, including Dundalk Bay and the North West Irish Sea SPA. They generally ignored human activity in the port, likely due to habituation.

Sensitivity: Low

Common Gull

Common gulls are a bit bigger than black-headed gulls and have similar diet, but tend to be more timid. They occur in smaller numbers, typically no more than 30 when the port is busy. Mainly roosting or loafing on the breakwater.

Sensitivity: Moderate

Lesser Black backed Gull

Lesser black-backed gulls occur in small numbers in Carlingford lough, most birds being immature. A peak of 17 was observed during an animal feed spillage episode, during which they mainly competed for animal feed or loafed on the breakwater.

Sensitivity: Low

Herring Gull

Herring gulls are by far the most common species around the port with numbers on occasion exceeding 1200 in the ZoI, with maybe a further 1000 around other part of the port. They compete aggressively for animal feed spoil when available and are unaffected by operating plant and machinery such as cranes, trucks and people. Mainly seen roosting or loafing on the breakwater or actively competing for food when animal feed cargos were available. Like other gulls may range very widely over a given season, or even a day, and may follow a trawler on one day and a plough on the next, but mainly track the shoreline looking for scavenging opportunities including Dundalk Bay and the North West Irish Sea SPA where there is a large gull roost at Port Oriel.

Sensitivity: Low

Great Black-backed Gull

Great black-backed gulls occur in small numbers around the port, often either in pairs or singly as immatures, the vast majority being immature; great black-backed gulls take five years to mature. As a species they tend to be less aggressive than herring gulls, but similarly tolerant of human activity. Mainly seen roosting or loafing on the breakwater. Because they are the apex gull in Ireland they tend to range less, being capable of dominating any local feeding opportunity.

Sensitivity: Low

Guillemot

Guillemots occur typically singly and at times when the port is quiet, invariably fishing around the area between the pier and the breakwater for small fish, drifting with the tide. They mainly occurred in zone 2 during high tide, and seem very habituated to human activity, approaching the observer to within a few metres.

Sensitivity: Moderate

Razorbill

Like guillemots they typically occur singly and dive for prey items like fish but also crustaceans and sea worms (one observed catching a large ragworm), drifting with the tide. They mainly occupied zone 2 during high tide. Also like guillemots seem very habituated to human activity, approaching the observer to within a few metres.

Sensitivity: Moderate

Other Waterbirds

Several other species of waterbird occur in the SPA subsite including whooper swan, mallard, greenshank, bar-tailed godwit (annex 1, red listed), lapwing, knot, golden plover, ringed-plover, and red-breasted merganser but these were not seen in near proximity to the count area during the survey. The site synopsis report scaup but these have not been seen in Carlingford lough for a number of years. Black guillemots may sometimes return to breeding areas during winter, notably in stormy weather, but were not seen during the survey. Black guillemots are generally of low sensitivity – see Breeding Birds Report included with this application.

Night Roost

Currently the port rarely operates at night (less than 10 times a year). On foot of the proposed development, technicians associated with the proposed development will typically work in 12hr shifts with CTV operation approximately between 06:00 and 21:00. This will be weather and travel time dependent. Scheduling of CTV departures and arrivals will be operator dependent and controlled by Greenore Port. It is unlikely that CTV movement will occur simultaneously.

The breakwater is an important night roost for diurnal species Gulls and Cormorants. Waders typically follow the tides, roosting at high-water and feeding at low water. When feeding at night they disperse very widely and avoid terrestrial areas such as the port area.

Waterfowl roost on the water at night on high water and feed at low water; Brent Geese are known to roost in Dundalk Bay commuting into Carlingford Lough during the day to feed.

Summary

Waterbirds frequenting the zone of influence are clearly habituated to the regular activities of the port and are highly tolerant of it. Birds are undisturbed on the breakwater and clearly tolerate even very heavy port activities when there. Given the 100-metre distance from the active port area to the breakwater it can be inferred that a distance of 100 metres is more generally tolerable. Similarly foraging birds are undisturbed using zone 1 of the ZoI during port operations; zone 2 intertidal is generally not used for foraging, but is used by divers and auks at high tide.

Cormorants, Red Shanks, large Gulls and Turnstones have been shown to tolerate disturbance from port activities at distances down to 10m, see 2023-2024 Overwintering Survey report.

Do Nothing Scenario

The habitats have been significantly modified from their natural state by human activity. In the absence of the development, it is expected that the development site will largely remain the same assuming the same operations. Therefore no significant changes to the habitats within the boundary are likely to occur, in the "do nothing" scenario. Over time the breakwater is likely to degrade and may partially collapse without remediation.

Potential Significant Effects

The proposed development will take place over two phases as set out in the development description and each is assessed separately below without mitigation Appendix 1 details the assessment criteria and Appendix 2 for the conservation status of each relevant species.

Demolition of "openhydro" building

The demolition of the openhydro building will cause visual and noise/vibration disturbance during demolition caused by cutting, breaking, bulldozing etc, It is possible that this may cause some disturbance to birds on the breakwater and in the intertidal area, but given the tolerance of roosting birds 100 metre distance from noisy operations in the port area when discharging vessels, this is considered unlikely. Birds roosting in the caisson area (grey heron) would likely move to the breakwater when disturbed and this is reasonably not considered to be a likely significant effect on the SPA.

The demolition works will generate dust which may be blown over the designated sites, Carlingford Shore SAC and Carlingford Lough SPA, particularly on windy days. The Air Quality assessment prepared for the proposed development and included in the EIAR identifies the risk as follows and proposes mitigation to reduce this to no likely significant effect, post the application of mitigation.

Potential Impact	Dust Emission Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling Risk	Low Risk	Medium Risk	High Risk	Low Risk
Human Health Risk	Negligible	Low Risk	Low Risk	Negligible
Ecological Risk	Low Risk	Medium Risk	Medium Risk	Low Risk

Similarly, water contaminated with demolition dust could also enter the designated sites, for example where it is used for damping dust, or in the case of a significant deluge. This material may enter the SPA where it may be ingested by birds as grit or adventitiously when consuming vegetation (eg Zostera sp) producing a potential knock-on effect. The Water Chapter of the EIAR proposes mitigation in this regard.

Construction of New Buildings

Construction activities will similarly involve visual and noise/vibration disturbance during the works. As with the demolition works, this disturbance is considered unlikely to affect birds on the breakwater or foraging in the intertidal area given their tolerance for other similar port activities. However, construction may also generate dust and contaminate water with the potential to enter the designated sites, for example, on windy days, during damping operations, or during rainfall.

Dredging Intertidal Area

There are two potential impacts, the first from the dredging activity itself, and the second from the extirpation of an area of intertidal mixed sediment flats. The dredging activity and the permanent extirpation of a section of intertidal foraging area, 3000 sq.m/0.05% oof the whole intertidal area at the sub-site, will make it unavailable to waders, and to a lesser extent, gulls for foraging, given that gulls mainly use it for surface feeding of spoil from the port. In relation to waders the main affected species are redshank, turnstone, curlew, grey heron and little egret. Given that the sub-site is likely well below carrying capacity for these species, and that the breakwater will remain available at the eastern end, the impact is likely to be small displacement and slight deprivation of a small foraging area, which is unlikely to have any long-term effect.

The dredging activity will also lead to significant disturbance close to the breakwater and will create a plume of silt in the water which may increase turbidity, affecting the ability of divers and auks to fish. The plume may produce a knock-on effect on birds by settling on intertidal vegetation such as Zostera sp beds on an incoming tide. However, given the character of the substrate, generally coarse with fines being absent this is unlikely to be significant, see Benthic Section of the Biodiversity Chapter for full details. The level of turbidity is likely to be low given the coarseness of the substrate and the lack of silt in the substrate.

Piling for New Pontoons

Piling driving element of the piling works involves the production of noise which has a startle effect, though some bird species may become quickly habituated if it is regular (e.g. gulls). To reduce any startle effect, this can be mitigated by monitoring by a suitably qualified observer and a slow start-up to habituate the birds.

Construction of New Quay Platform and Floating Pontoons

Construction of the quay platform and pontoons may result in temporary displacement of waders, and this is unlikely to have any significant effect on waterbird condition or productivity.

Summary of Potential Significant Effects Stemming from Proposed Development

Activity	Quality	Significance	Duration	AA Screening Test
Demolition of former open-hydro building	Negative	Slight	Temporary	Likely Significant Effect
Construction of O&M Buildings	Negative	Slight	Medium term	Likely Significant Effect
Dredging and piling intertidal area	Negative	Moderate	Temporary	Likely Significant Effect
Quay wall and pontoon construction	Negative	Not significant	Long-term	No Likely Significant Effect
Operation	Negative/Neutral	Slight	Long-term	No Likely Significant Effect

Summary of Potential Significant Effects of Various Receptors

Receptor	Value/abundance	Potential Impact Construction	Potential Impact Operation
Carlingford Lough SPA intertidal area	International	Complete conversion of 3000m sq / 0.05% of sub-site intertidal to subtidal	Nil
Light-bellied Brent Goose	12	Small displacement* if present	Nil
Shelduck	2	Nil	Nil
Wigeon	10	Nil	Nil
Teal	8	Nil	Nil
Great Crested Grebe	2	Nil	Nil
Great Northern Diver	2	Nil	Nil
Red-throated Diver	1	Nil	Nil
Cormorant	89	Small displacement	Nil
Shag	4	Nil	Nil
Little Egret	3	Neutral	Nil
Grey Heron	5	Neutral	Nil
Oystercatcher	17	Small displacement	Small displacement
Grey Plover	1	Nil	Nil
Dunlin	15	Small displacement	Nil
Black-tailed Godwit	3	Nil	Nil
Curlew	5	Small displacement	Small displacement
Redshank	12	Small displacement	Small displacement
Turnstone	10	Small displacement	Small displacement
Black-headed Gull	166	Small displacement	Nil
Common Gull	27	Small displacement	Nil
Lesser Black backed Gull	13	Small displacement	Nil
Herring Gull	1291	Nil	Nil
Great Black-backed Gull	67	Nil	Nil
Guillemot	2	Neutral	Nil
Razorbill	2	Neutral	Nil

*Small displacement means displacement between 10-100m

Conclusions

The proposed development is likely to result in the short-term displacement of a small number of waders from both the breakwater for roosting and the intertidal area for foraging. This displacement will be most pronounced during construction; during operations birds are likely to habituate just as they do during routine port operations. The displacement will likely be of the order of 10 to 100 metres from the pontoon area in relation to roosting waders; displacement from the intertidal area for foraging is likely to be inconsequential given the depauperate nature of the substrate. This displacement is unlikely to have any significant effect on the long-term viability of the waders affected, for example in terms of food availability or coming into breeding condition. Any impact on gulls is considered insignificant due to their ready tolerance and habituation to port activities. Impact on auks and divers is likely to be neutral in terms of foraging. A small area of intertidal mixed sediment flats listed as a QI for the site will be converted to intertidal through dredging.

To confirm these findings, it is proposed to complete the following additional studies:

- Repeat of 2022/23 Overwintering Bird Survey
- Focal Observations on individual birds in order to determine behaviour inside the ZoI.
- Targeted visits to determine the effect of extreme tidal and weather effects on bird behaviour.

Several wader species may also use Dundalk Bay SPA, notably dunlins, oystercatchers and curlews, where they form Qualifying Interests for that site. The slight displacement caused by the development is unlikely to impact their conservation objectives in Dundalk Bay.

Gulls may also visit Dundalk Bay SPA and the North-west Irish Sea pSPA, also QIs but the development is unlikely to have any impact on their conservation objectives (Cos) for those sites; indeed, birds are generally attracted to the port area by the availability of animal feed. Divers and auks may also range into both sites but given no likely impact from the development, no impact on their COs is considered likely.

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Appendix 1 EPA Impact Classification

Impact Characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment.
	Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative	A change which reduces the quality of the environment.
Significance	Imperceptible	An effect capable of measurement but without significant consequences.
	Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging trends.
	Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound	An effect which obliterates sensitive characteristics.
Duration and Frequency	Momentary Effects	Effects lasting from seconds to minutes.
	Brief Effects	Effects lasting less than a day.
	Temporary Effects	Effects lasting less than a year.
	Short-term	Effects lasting one to seven years.
	Medium-term	Effects lasting seven to fifteen years.
	Long-term	Effects lasting fifteen to sixty years.
	Permanent	Effects lasting over sixty years.
	Reversible Effects	Effects that can be undone.
	Frequency	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost.
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Synergistic	Where the resultant effect is of greater significance than the sum of its constituents.
	'Worst Case'	The effects arising from a development in the case where mitigation measures substantially fail.

Appendix 2 Abundance and Conservation Status of Bords Recorded in the Zone of Influence.

Species	Max	Sub-site	%	BD annex	BoCCI	QI Carlingford Lough	QI Dundalk Bay	North-west Irish Sea SPA
Light-bellied Brent Goose	12	489	2.5		amber	yes	yes	
Shelduck	2	15	13.3		amber		yes	
Wigeon	10	215	4.7		~~red~~			
Teal	8	38	21.1		amber		yes	
Great Crested Grebe	2	0	na		amber		yes	
Great Northern Diver	2	0	na	1	amber			yes
Red-throated Diver	1	0	na	1	amber			yes
Cormorant	89	0	na		amber			yes
Shag	4	0	na		amber			yes
Little Egret	3	15	20.0		green			
Grey Heron	5	19	26.3		green			
Oystercatcher	17	168	10.1		amber		yes	
Grey Plover	1	2	50.0		amber		yes	
Dunlin	15	230	6.5	1*	~~amber~~green		yes	
Black-tailed Godwit	3	156	1.9		amber		yes	
Curlew	5	124	4.0		red		yes	
Redshank	12	237	5.1		red	nationally important	yes	
Turnstone	10	14	71.4		green			
Black-headed Gull	166	200	83.0		red		yes	yes
Common Gull	27	45	60.0		amber		yes	yes
Lesser Black backed Gull	13	1	1300.0		amber			yes
Herring Gull	1291	142	909.2		amber		yes	yes
Great Black-backed Gull	67	9	744.4		amber			yes
Guillemot	2	0	na		amber			yes
Razorbill	2	0	na		amber			yes

Appendix 3 Marine Institute – Carlingford Lough Waterbird & Disturbance Surveys, Winter 2019-2020

Marine Institute

Carlingford Lough Waterbird and Disturbance Surveys

Winter 2019-20

Bird Survey Report

July 2020

INIS Environmental Consultants Ltd.

Suite 11,
Shannon Commercial Properties,
Information Age Park,
Ennis,
County Clare
Ireland.

Quality Assurance

The findings outlined within this report and the data we have provided are to our knowledge true and express our bona fide professional opinions. This report has been prepared and provided in accordance with the Chartered Institute of Ecology and Environmental Management (CIEEM) Code of Professional Conduct. Where pertinent, CIEEM Guidelines used in the preparation of this report include the *Guidelines for Ecological Report Writing* (CIEEM, 2017), *Guidelines for Preliminary Ecological Appraisals* (CIEEM, 2015) and *Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine*, (CIEEM, 2018). CIEEM Guidelines include model formats for Preliminary Ecological Appraisal and Ecological Impact Assessment. Also, where pertinent, evaluations presented herein take cognisance of recommended Guidance from the EPA such as *Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EPA, 2017), and in respect of European Sites, *Managing Natura 2000 sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC* (European Commission, 2018).

Due cognisance has been given at all times to the provisions of the *Wildlife Act (1976),* the *Wildlife (Amendment) Act (2000)*, the *European Union (Natural Habitats) Regulations (SI 378/2005)*, the *European Communities (Birds and Natural Habitats) Regulations (2011),* EU Regulation on Invasive Alien Species under *EU Regulation 1143/2014*, the *EU Birds Directive 2009/147/EC* and the *EU Habitats Directive 92/43/EEC*.

No method of assessment can completely remove the possibility of obtaining partially imprecise or incomplete information. In line with Best Practice, any limitation to the methods applied or constraints however are clearly identified within the main body of this document.

Version	Date		Author(s)	Signature
1	02/07/20	**Report prepared by:**	Breffni Martin BSc	
1	06/07/20	**Report checked by:**	Dr. Alex Copeland BSc PhD	
1	07/07/20	**Report signed off by:**	Howard Williams BSc CEnv MCIEEM CBiol MRSB MIFM	
Title		Carlingford Lough Waterbird and Disturbance Survey – Winter 2019-20 Bird Survey Report		

Notice

This report was produced by INIS Environmental Consultants Ltd. (INIS) on behalf of Marine Institute for the specific purpose of assessing wintering bird populations in Carlingford Lough SPA, Co. Louth, with all reasonable skill, care and due diligence within the terms of the contract with the client, incorporating our terms and conditions and taking account of the resources devoted to it by agreement with the client.

This report may not be used by any person other than Marine Institute, the client, without the client's express permission. In any event, INIS accepts no liability for any costs, liabilities or losses arising as a result of the use of or reliance upon the contents of this report by any person other than the client.

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Table of Contents

1. INTRODUCTION

INIS Environmental Consultants Ltd. (INIS) were contracted to co-ordinate a series of waterbird population surveys and disturbance surveys at Carlingford Lough, Co. Louth during the 2019/20 winter season. The waterbird surveys followed the standard methodology used for surveying wintering waterbirds at low tide (Lewis & Tierney, 2014); the surveys included four low tide surveys and a single high tide survey.

The waterbird disturbance surveys were carried out to monitor areas where Oyster Aquaculture takes place within Carlingford Lough SPA and focused on Light-bellied Brent Geese *(Branta bernicla hrota)* within the SPA. Monthly surveys were carried out from the autumn migration period (October 2019) through to spring migration (April 2020) whereby maximum numbers and disturbance responses and movement of Light-bellied Brent Goose flocks and individuals were monitored on an hourly basis during survey periods.

This report details the results of the 2019/20 waterbird survey programme at Carlingford Lough. The results are examined and discussed in light of similar surveys undertaken by Martin (2011) and described in NPWS (2013). Due to the cross-border nature of the site, it was not surveyed previously as part of the National Parks & Wildlife Service (NPWS) Waterbird Survey Programme (NPWS, 2012) Survey Programme.

1.1. Constraints and limitations

There are a number of limitations inherent to field-based surveying. These particularly relate to availability of suitable weather conditions for completing surveys, with good visibility and little wind or rain of paramount importance. As such, when undertaking and completing fieldwork, careful consideration and planning is made to ensure optimal weather conditions during survey periods. The data presented here were all collected in optimal weather conditions.

When counting shorebirds, disturbance can substantially impact on the birds present within small areas if they are able to disperse away from the source of disturbance to adjacent areas of similar habitat but out with the areas where surveying is taking place. Such disturbance may happen in advance of the count taking place or during the survey period. To gauge levels of disturbance Best Practice methods include an assessment of disturbance levels encountered during the recording period. Such an assessment of disturbance allows the likely impact on shorebird numbers and distribution to be determined, particularly when looking at likely response to different disturbance events. Details of recorded disturbance are therefore provided.

Constraints and any limitations to available datasets used for comparative analysis are presented in where known.

1.2. Statement of Authority

Mr Howard Williams MCIEEM CEnv CBiol MRSB MIFM is Lead Ecologist with Inis and has more than 20 years' experience as a professional ecologist, specialising in birds. Following his degree, he worked as a biologist for the ESB for three years (1997-2000). Mr Williams has completed in excess of 500 separate ecology assessments in Ireland and the UK since 2000. Mr Williams is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). He is a Chartered Environmentalist (CEnv) with the Society for the Environment (Soc Env) and a Chartered Biologist (CBiol) with the Society of Biology. He is also a full member of the Institute of Fisheries Management. Mr Williams is principal ecologist with INIS Environmental Consultants Ltd and currently project manager on all INIS projects in the Republic of Ireland and the UK.

Breffni Martin BSc is an ecological consultant specialising in birds and habitats. He has studied Carlingford Lough and Dundalk Bay for the last 15 years completing over 400 hours of focal observations on oystercatchers as part of an appropriate assessment of a cockle fishery in Dundalk bay (2014-17), as well as over 700 hours observations on birds in Carlingford Lough (2010-11) in a study which informed the designation of the outer part of the Lough. He also completed over 60 boat-based surveys, and hundreds of hours of MMO work in the Lough. Breffni a board member of Birdwatch Ireland and director and acting manager of the Louth Nature Trust, an environmental NGO which runs the little tern protection scheme at Baltray (Boyne valley), amongst other things.

2. EXISTING ENVIRONMENT

2.1. Site Description

Carlingford Lough is a 15km long and narrow sea inlet that is also the estuary of the Newry River (Crowe, 2005). A glacial fjord, the Lough is flanked by glacial moraines and mountains - the Mourne Mountains to the north and Cooley Mountains to the south-west. The Lough straddles the border between Northern Ireland (County Down) and Ireland (County Louth). The Lough is generally shallow with the average depth between 2 and 10 m, although the narrow channels that run along the centre of the Lough may be as deep as 25 m (Taylor *et al.,* 1999). The site is underlain mainly by a bedrock of carboniferous limestone and this appears at times in the form of bedrock shore or outcrops of dipping limestone. Biogenic reefs are present in an area of tidal rapids at the south west mouth of the Lough. Granite boulders are also found as are banks comprising of sand and gravel and intertidal mudflats (NPWS, 2002). There are a number of small rock and shingle islands at the mouth of the Lough which are of importance for Harbour and Grey Seals, as well as breeding terns.

The site designated as Carlingford Lough SPA (Site Code 4078) covers a total area of 595ha on the southern side of Carlingford Lough between Carlingford Harbour and Ballagan Point (see Figure 2.1). The SPA is split into two sections either side of Greenore Point. Of the total area of the SPA, 304ha are considered to be sub-tidal habitats (i.e. habitats below mean low water mark), 282ha of intertidal habitats and 9ha of supratidal habitats (i.e. habitats occurring above mean high tide mark). The predominant habitats within the SPA are intertidal sand and mud flats, but also areas of mixed substrate, rocky foreshore, *Zostera* beds, *Salicornia* beds, anoxic mud and saltmarsh.

This SPA is of special conservation interest for non-breeding (over-wintering) Light-bellied Brent Goose (*Branta bernicla hrota*). There are extensive mudflats along the northern shore of the Lough and together with saltmarsh these are included in the 827ha area designated as a SPA in the United Kingdom (site code UK9020161). The qualifying species for this SPA are wintering Light-bellied Brent Goose as well as Common Tern (*Sterna hirundo*) and Sandwich Tern (*Sterna sandvicensis*) as breeding species.

Carlingford Shore SAC (Site code 002306) is designated for Perennial Vegetation of Stony Banks and Annual Driftline Vegetation. The areas of *Zostera* and *Salicornia* are not included in the qualifying interests. The SPA and SAC site synopses are given in Appendix 1.

Figure 2.1: Location of Carlingford Lough SPA, Co. Lough (source: NPWS, 2012); the SPA is outlined in blue.

2.2. Carlingford Lough Waterbirds

2.2.1. Waterbird Special Conservation Interests (SCIs)

Carlingford Lough SPA is of special conservation interest for non-breeding (wintering) Light-bellied Brent Goose which occurs in numbers of international importance.

2.2.2 Published status and trends of Carlingford waterbirds

Systematic counting of birds in Carlingford Lough started through the Wetland Birds Survey (WeBS) in 1994-95 in the part in Northern Ireland and the Irish Wetland Birds Survey (I-WeBS) in 1998-99 on the Irish side (NPWS, 2013). Because of the political situation Carlingford Lough was counted from the north and the south as separate non coordinated counts. Some more detailed work was undertaken as part of an EIS for a port development (Martin, 2011). From 2014, WeBS/I-WeBS counts were coordinated between north and south which has considerable increased the quality of data. The present report describes the first survey undertaken using low tide methodology in Carlingford Lough.

3. METHODOLOGIES

3.1. Background to the low tide survey programme

The Irish Wetland Bird Survey (I-WeBS) is the primary method by which data are collected for wintering waterbird populations at Irish wetland sites. These data, largely collected by volunteer field surveyors since the winter season of 1994/95, have underpinned the designation of Special Protection Areas (SPAs), and have enabled the production of waterbird population estimates and trends at national and at site level (e.g. Crowe & Holt, 2013; Burke *et al*., 2019; Lewis *et al*., 2019). I-WeBS surveys are undertaken primarily on a rising or high tide, when birds are pushed closer to shore or are gathering at roost sites and are therefore easier to count than when widely distributed across exposed tidal flats.

However, while I-WeBS surveys are designed to obtain the most accurate peak counts of waterbirds at a site, they cannot provide information about waterbird abundance or distribution during the low tide period, when many waterbirds are feeding. This gap in knowledge was addressed somewhat in 2009/10, when the National Parks and Wildlife Service (NPWS) initiated a programme of low tide surveys which took place over the three winter seasons of 2009/10, 2010/11 and 2011/12 at 32 coastal SPAs (The NPWS Waterbird Survey Programme). Due to the cross-border nature of Carlingford Lough SPA, it was not surveyed as part of the NPWS Waterbird Survey Programme. However, comparable counts were undertaken in 2010-11 (by Martin (2011); described in NPWS (2013)).

3.2. Survey design and count area

3.2.1. Waterbird distribution surveys

During the 2019/20 season, a standard survey programme of four low tide counts and one high tide count was undertaken. Low tide surveys were carried out on 23rd October 21st November 2019 and 4th December 2019 and 19th February 2020. The high tide survey was undertaken on 14th January 2020. Optimum dates were chosen in each month when the survey period spanned midday to facilitate travel to/from the site, but also to ensure surveys were carried out in the best weather and light conditions.

The surveys covered the two subdivisions (sub-sites) of Carlingford Lough SPA (see Table 3.1; Figure 3.1**)**. The two count sub-sites, 0Z482 and 0Z480, were counted by one fieldworker on each survey day. All of the 2019/20 season surveys were carried out by a single surveyor.

Table 3.1: *Count Sub-sites of Carlingford Lough*

Sub-site Code	Sub-site Name	Sub-site area
0Z480	Ballagan to Greenore	303ha
0Z482	Greenore to Carlingford	292ha

Figure 3.1: *Count sub-sites used for the Carlingford Lough waterbird surveys.*

3.2.2. Light-bellied Brent Goose disturbance surveys

INIS have extensive experience of undertaking through-the-tide disturbance surveys of shorebirds at a number of coastal sites, including coastal SPAs, throughout Ireland. The methodology developed was adapted to assess Carlingford Lough was deployed to assess the level of disturbance to Brent Geese within Carlingford Lough SPA.

For the purposes of this study, two zones on the southern shore are identified (See Figure 3.2):

- Zone 1: part of the outer Lough; and
- Zone 2: the inner Lough.

The zones have significantly different habitats with Zone 1 comprising sandy mudflats backing onto a moderately high energy shingle beach. Zone 2 is more sandy mud than muddy sand whilst the reverse is the situation in Zone 1. Zone 2 supports a significant *Zostera* bed (see Figure 3.3) but in recent years the invasive seaweed, *Sargassum muticum*, commonly known as Japanese wireweed, has spread over the mudflats and in deeper water. Patches of *Spartina anglicans* are also spreading in the mudflat areas. There is extensive aquaculture activity, primarily pacific oysters, with up to half of the available mudflat/sandflat areas being occupied.

Figure 3.2: Survey zones used for the Carlingford Lough disturbance surveys.

Figure 3.3: Survey Zone 2, showing Zostera beds in blue, Spartina anglica in red, and mussel bed in black

3.3. Field survey methods

3.3.1. Waterbird surveys

The survey period on each day extended from two hours either side of low or high tide (depending on the survey being undertaken). Waterbirds were counted within each count sub-site, and the data for each sub-site were recorded separately. Waterbird counts were conducted on the 'look-see' basis (Bibby *et al*., 2000) which involves scanning across the survey area and counting all birds seen. Birds were recorded according to their species code following the 2-letter coding system used by I-WeBS and developed by the British Trust for Ornithology.

In addition to counts of each species, the behaviour of waterbirds during counts was attributed to one of two categories (foraging or roosting/other) while the position of the birds was recorded as per one of four broad habitat types (intertidal, subtidal, supratidal and terrestrial). Field maps of count sub-sites were used to map significant flocks of foraging/roosting birds ('flock maps').

Information on the presence of activities that could cause disturbance to waterbirds was also recorded. Following Lewis & Tierney (2014), activity types were categorised as follows:

(1) human, on-foot - shoreline (2) human, on foot – intertidal aquaculture, (3) bait-diggers (4) non-powered watercraft (5) powered watercraft, (6) water-based recreation (e.g. wind-surfers) (7) horse-riding (8) dogs (9) aircraft (10) shooting (11) other (12) winkle pickers (13) aquaculture machinery (14) other vehicles.

When an activity was observed to cause a disturbance, the waterbird species affected were recorded and a letter code system used to indicate the bird's response to the activity as follows:-

W - Weak response, waterbirds move slightly away from the source of the disturbance.

M - Moderate response, waterbirds move away from the source of the disturbance to another part of your sub-site; they may return to their original position once the activity ceases.

H - High response, waterbirds fly away to areas outside of your sub-site and do not return during the current count session.

The length of the activity was also recorded by adding by the codes **A – D** (see below) and a record was made as to whether the activity was already occurring within the sub-site when the count started.

A – short/discrete event.

B – activity occurs for up to 50% of the count period.

C – activity length estimated at >50% but < 100% of the count period.

D – activity continues after the count period has ended.

3.3.2. Light-bellied Brent Goose disturbance surveys

Within each of the two Survey Zones where Oyster Aquaculture takes place, monthly surveys of the location, movements and behavior of Light-bellied Brent Goose took place from the autumn migration period (October 2019) through to spring migration (April 2020). For each Survey Zone, one VP was selected that offered good views of the trestles in that area. These VPs were identified during an initial site reconnaissance visit and for the northern zone the VP included the large area of Eelgrass present towards the shore within its field of view.

The survey methodology followed a complete tidal cycle, typically centred on a low tide, and covering the period from three hours before to three hours after. Light-bellied Brent Geese were counted within the survey area on an hourly basis i.e. a single visit resulted in six hourly counts. During the hour, repeat counts were made to obtain the maximum number of birds within each survey area during the allocated hour of survey time.

The observer was required to arrive at least 30 minutes prior to starting to survey to ensure that their approach did not cause a disturbance in itself. Counts were undertaken using the 'look see' method (Bibby *et al.,* 2000) whereby each area was scanned using a telescope and all Light-bellied Brent Geese observed were identified and counted. The number of birds was recorded within the following categories:

- **Position re. tideline** – either 'on tideline' or 'not on tideline'. Note that 'on tideline' includes birds +/- 10m away from it, and birds within the channel that remains at low water.
- **Activity** – foraging or roosting/other.
- **Trestles** – recorded as either 'on trestles' or 'not on trestles.'

Other information was recorded such as weather conditions, start time and end time, sector code, count quality, etc. Each count was also accompanied by a field map upon which an estimate of the tideline position was drawn by the fieldworker. These maps also included flight-lines of Light-bellied Brent Geese moving into, out of and through the survey area.

The effects of any activities upon the geese within survey areas was also recorded as per the standard low tide methodology (Lewis & Tierney, 2014) as follows:

(1) human, on-foot - shoreline (2) human, on foot – intertidal aquaculture, (3) bait-diggers (4) non-powered watercraft (5) powered watercraft, (6) water-based recreation (e.g. wind-surfers) (7) horse-riding (8) dogs (9) aircraft (10) shooting (11) other (12) winkle pickers (13) aquaculture machinery (14) other vehicles.

When an activity was observed to cause a disturbance, a letter code system used to indicate the bird's response to the activity as follows:

W - Weak response, birds move slightly away from the source of the disturbance.
M - Moderate response, birds move away from the source of the disturbance to another part of your sub-site; they may return to their original position once the activity ceases.
H - High response, birds fly away to areas outside of your sub-site and do not return during the current count session.

The length of the activity was also recorded by adding by the codes **A – D** (see below) and a record was made as to whether the activity was already occurring when the count started.

A – short/discrete event.
B – activity occurs for up to 50% of the count period.
C – activity length estimated at >50% but < 100% of the count period.
D – activity continues after the count period has ended.

Where possible all Light-bellied Brent Geese observed were checked for colour rings.

3.4. Data analysis

3.4.1. General

Field data were collected in notebooks and later transferred by the field surveyor into Excel datasheets. At the end of the survey season the Excel datasheets were compiled and validated before being formatted and entered into an Access database. From Access, data summaries were produced such as site totals, sub-site totals, etc.

Waterbird numbers were assessed with reference to national and international threshold levels as follows:

- A waterbird species that occurs in numbers that correspond to 1% or more of the individuals in the all-Ireland population of the species is said to occur in numbers of all-Ireland importance. Current population threshold values are published in Burke *et al*. (2019).

- A waterbird species that occurs in numbers that correspond to 1% or more of the individuals in the biogeographic population of the species or subspecies is said to occur in 'internationally important numbers.' Current international population threshold values are published by the African-Eurasian Migratory Waterbird Agreement (AEWA) Conservation Status Review 7 (CSR7) (AEWA 2018) (published online at wpe.wetlands.org).

3.4.2. Waterbird distribution

Following the methods used in NPWS (2012), data analyses were undertaken to determine the proportional use of two sub-sites by Light-bellied Brent Goose, relative to the whole area surveyed on each survey occasion. This gives an indication of the preferred distribution of Light-bellied Brent Goose within the SPA. Analyses were undertaken on datasets as follows:

- Total numbers (low tide surveys);
- Total numbers (high tide survey);
- Total numbers of foraging birds (low tide surveys);
- Intertidal foraging densities (low tide surveys).

3.4.3. Trends

This is the first survey undertaken at Carlingford Lough using low tide methodology. Methodology used in the 2010-11 survey (Martin, 2011) and I-WeBS are only partially comparable. I-WeBS data are presented, along with a comparison of the 2010-11 (Martin, 2011) data and 2019-20 data from the work reported here.

3.4.4. Light-bellied Brent Goose disturbance surveys

The results of the disturbance survey were analysed to assess possible impacts on the Light-bellied Brent Goose population in Carlingford Lough, including disturbance related to aquaculture, recreation and other activities with the potential to impact upon this species within the SPA.

4. RESULTS

4.1. Survey schedule and conditions

The 2019/20 winter waterbird survey season proceeded relatively unhampered by weather conditions. Very few weekend days were chosen for counting, largely for weather reasons. All surveys were carried out in good weather conditions (Table 4.1).

Table 4.1: *Weather conditions for the 2019/20 survey programme.*

Date	Tide Focus	Sub-site	Cloud	Rain	Wind	Notes
23.10.19	LT1	0Z482	3	1	3	No survey constraints
23.10.19	LT1	0Z480	3	1	3	No survey constraints
21.11.19	LT2	0Z482	3	1	3	No survey constraints
21.11.19	LT2	0Z480	3	1	3	No survey constraints
04.12.19	LT3	0Z482	1	1	2	No survey constraints
04.12.19	LT3	0Z480	1	1	2	No survey constraints
19.02.20	LT4	0Z482	3	2	2	No survey constraints
19.02.20	LT4	0Z480	3	1	2	No survey constraints
14.01.20	HT1	0Z482	1	1	2	No survey constraints
14.01.20	HT1	0Z480	1	1	2	No survey constraints

4.2. Species assemblage and diversity

A total of 29 waterbird species were recorded in the two sub-sites surveyed including seven species of wildfowl, 14 species of waders and four species of gull (Table 4.2). Five species that are Red-listed in as species of high conservation concern in Ireland (Colhoun & Cummins, 2013) were recorded (Knot, Curlew, Redshank, Black-headed Gull and Herring Gull), along with 16 species that are Amber-listed.

The diversity of species recorded in the two sub-sites is shown in Table 4.3. A total of 20 species were recorded in sub-site OZ480 with 26 species recorded in OZ482. Light-bellied Brent Goose was recorded in both sub-sites.

4.3. Total numbers of waterbirds

The total numbers of waterbirds recorded during each survey visit during winter 2019-20 to the two sub-sites are shown in Table 4.4. Total numbers recorded during low tide surveys ranged from 1,895 individuals (October 2019) to a peak count of 2,777 individuals (February 2020). A total of 2,120 waterbirds were counted during the January 2020 high tide survey (Table 4.4).

Table 4.2: Species recorded during the winter surveys at Carlingford; the status of each species on Annex I (EU Birds Directive) and on the Red and Amber lists Birds of Conservation Concern in Ireland (Colhoun & Cummins, 2013) are also shown, along with scientific nomenclature and BTO 2-letter recording code used during fieldwork.

Species name	Scientific name	Code	BoCCI	Annex I
Light-bellied Brent Goose	*Branta bernicla hrota*	PB	Amber	
Shelduck	*Tadorna tadorna*	SU	Amber	
Wigeon	*Anas penelope*	WN	Amber	
Teal	*Anas crecca*	T.	Amber	
Mallard	*Anas platyrhynchos*	MA		
Red-breasted Merganser	*Mergus serrator*	RM		
Eider	Somateria mollissima	EI	Amber	
Cormorant	*Phalacrocorax carbo*	CA	Amber	
Shag	*Phalacrocorax aristotelis*	SA		
Little Egret	*Egretta garzetta*	ET		Yes
Grey Heron	*Ardea cinerea*	H.		
Oystercatcher	*Haematopus ostralegus*	OC	Amber	
Ringed Plover	*Charadrius hiaticula*	RP	Amber	
Grey Plover	*Pluvialis squatarola*	GV	Amber	
Lapwing	*Vanellus vanellus*	L.		
Knot	*Calidris canutus*	KN	Red	
Purple Sandpiper	Calidris maritima	PS		
Dunlin	*Calidris alpina*	DN	Amber	
Snipe	Gallinago gallinago	SN	Amber	
Black-tailed Godwit	*Limosa limosa*	BW	Amber	
Bar-tailed Godwit	*Limosa lapponica*	BA	Amber	Yes
Curlew	*Numenius arquata*	CU	Red	
Greenshank	*Tringa nebularia*	GK	Amber	
Redshank	*Tringa totanus*	RK	Red	
Turnstone	*Arenaria interpres*	TT		
Black-headed Gull	*Chroicocephalus ridibundus*	BH	Red	
Common Gull	*Larus canus*	CM	Amber	
Herring Gull	*Larus argentatus*	HG	Red	
Great Black-backed Gull	*Larus marinus*	GB	Amber	

Table 4.3: Sub-site diversity (tick marks indicate that a species was recorded in that sub-site)

Species name	Sub-site 0Z480	Sub-site 0Z482
Light-bellied Brent Goose	✓	✓
Shelduck		✓
Wigeon		✓
Teal		✓
Mallard		✓
Eider	✓	
Red-breasted Merganser	✓	✓
Cormorant	✓	✓
Shag	✓	
Little Egret		✓
Grey Heron	✓	✓
Oystercatcher	✓	✓
Ringed Plover	✓	✓
Grey Plover		✓
Lapwing	✓	✓
Knot		✓
Purple Sandpiper	✓	
Dunlin	✓	✓
Snipe		✓
Black-tailed Godwit	✓	✓
Bar-tailed Godwit	✓	✓
Curlew	✓	✓
Greenshank		✓
Redshank	✓	✓
Turnstone	✓	✓
Black-headed Gull	✓	✓
Common Gull	✓	✓
Herring Gull	✓	✓
Great Black-backed Gull	✓	✓
Total Species	**20**	**26**

4.4. Species totals

Totals for individual species from each survey visit during the 2019-20 recording period at Carlingford Lough are shown in Table 4.4. During the low tide survey peak counts of Light-bellied Brent Goose, the qualifying interest, was 261 birds, though it should be noted that during the disturbance counts larger numbers were recorded, the peak being 350 in Zone 2 on the 20th December.

Table 4.4: Total numbers of waterbirds counted at Carlingford Lough during each survey visit over winter 2019/20; thresholds to determine national and international importance of populations for each species (where applicable) are also shown (after Burke et al., 2019).

Species Name	1% Int	1% Nat	LT1	LT2	LT3	LT4	HT1
Light-bellied Brent Goose	400	350	174	243	261	122	48
Shelduck	2,500	100	4			11	
Wigeon	14,000	560	205	192	326	218	156
Teal	5,000	360	4		32	22	22
Mallard	53,000	280	31	6	18	28	20
Eider	9,800	55			4		
Red-breasted Merganser	860	25			47	16	4
Cormorant	1,200	110	38	31	125	104	96
Shag	2,000	-		4		12	
Little Egret	1,100	20	11	12	28	7	12
Grey Heron	5,000	25	9	14	27	17	25
Oystercatcher	8,200	610	130	301	168	330	528
Ringed Plover	540	120	24	18	74	36	61
Grey Plover	2,000	30	5	1	4		
Lapwing	72,300	850	188	170	168	170	216
Knot	5,300	160			135	57	104
Purple Sandpiper	110	20				2	
Dunlin	13,300	460	132	200	271	236	275
Snipe	100,000	-			2		
Black-tailed Godwit	1,100	200	26	31	48	56	42
Bar-tailed Godwit	1,500	170	13	6	20	16	31
Curlew	7,600	350	51	57	93	43	41
Greenshank	3,300	20	11	5	6	4	9
Redshank	2,400	240	202	281	222	175	167
Turnstone	1,400	95	54	56	85	115	107
Black-headed Gull	31,000	-	311	35	280	135	24
Common Gull	16,400	-	90	112	109	114	78
Herring Gull	14,400	-	118	247	187	44	46
Great Black-backed Gull	3,600	-	64	10	37	30	37
All Species			**1,895**	**2,032**	**2,777**	**2,120**	**2,149**

Maximum counts of Red-breasted Merganser, Grey Heron, Redshank and Turnstone all exceeded numbers in excess of the 1% national population threshold on one of the low tide survey visits, with Grey Heron and Turnstone also exceeding the national population threshold on the high tide roost survey visit in January. No species had number recorded in excess of the 1% international threshold.

4.5. Trends in waterbird numbers

Because this is the first occasion that the low tide methodology used in this survey was used there is no available comparative data for low tide counts other than a survey completed in 2010/11 (Martin, 2011). However, that study assessed Light-bellied Brent Goose numbers through the full tidal cycle and was undertaken on four days per month as opposed to one day, so the 2019/20 data is not directly comparable. Nevertheless, the data from the 2010-11 and 2019-20 survey are compared in Table 4.5.

Table 4.5: *Light-bellied Brent Goose numbers in the two sub-sites from this survey (2019-20) compared to data from Martin (2011).*

	Sub-site 0Z480			Sub-site 0Z482			Carlingford Lough (all)		
	2010-11	2019-20	Change	2010-11	2019-20	Change	2010-11	2019-20	Change
October	126	9	-92.8%	218	165	-24.3%	344	174	-49.4%
November	109	37	-66.1%	294	206	-29.9%	403	243	-39.7%
December	275	89	-67.6%	412	172	-58.3%	687	261	-62.0%
January	177	0	-100%	132	48	-63.6%	309	48	-84.5%
February	346	12	-96.5%	176	110	-37.5%	522	122	-76.6%

I-WeBS has been undertaken only irregularly at Carlingford Lough, with counts available for 2009-10; 2011-12 and 2015-16[1]. These data are shown in Table 4.6 along with the high-tide roost count from January 2020.

Table 4.6: *Light-bellied Brent Goose numbers from the January 2020 high tide roost survey and historical data from I-WeBS.*

	2009-10	2011-12	2015-16	2019-20
Light-bellied Brent Goose	13	156	19	48

[1] Data sourced from BirdWatch Ireland website shoing I-WeBS data for Carlingford Lough [https://f1.caspio.com/dp/f4db3000060acbd80db9403f857c; accessed July 2020].

4.6. Sub-site totals

The total numbers of waterbirds recorded during each survey visit within each sub-site are shown in Table 4.7 (sub-site 0Z480) and Table 4.8 (sub-site 0Z482).

Table 4.7: Total numbers of waterbirds counted at sub-site 0Z480 at Carlingford Lough during each survey visit over winter 2019/20.

Species	LT1	LT2	LT3	LT4	HT1
Light-bellied Brent Goose	9	37	89	12	
Eider			4		
Red-breasted Merganser			47	16	
Cormorant	20	22	36	93	96
Shag		4		12	
Grey Heron	2	5	4	1	
Oystercatcher	42	132	52	157	210
Ringed Plover	3	12	35	1	6
Lapwing	71	74	20	61	
Purple Sandpiper				2	
Dunlin	37	45	68	30	9
Black-tailed Godwit		16			
Bar-tailed Godwit	4		6		
Curlew	8	50	36	24	
Redshank	63	208	129	78	49
Turnstone	16	36	26	58	66
Black-headed Gull	146	35	30	20	22
Common Gull	45	92	38	20	62
Herring Gull	102	143	85	20	40
Great Black-backed Gull	57	8	18	18	37
Total	**625**	**919**	**723**	**623**	**597**

Roosting locations of birds recorded in the high tide roost survey in January are shown in Figure 4.1 (for sub-site 0Z480) and Figure 4.2 (for sub-site 0Z482).

Table 4.8: Total numbers of waterbirds counted at sub-site 0Z482 at Carlingford Lough during each survey visit over winter 2019/20.

Species	LT1	LT2	LT3	LT4	HT1
Light-bellied Brent Goose	165	206	172	110	48
Shelduck	4			11	
Wigeon	205	192	326	218	156
Teal	4		32	22	22
Mallard	31	6	18	28	20
Red-breasted Merganser					4
Cormorant	18	9	89	11	
Little Egret	11	12	28	7	12
Grey Heron	7	9	23	16	25
Oystercatcher	88	169	116	173	318
Ringed Plover	21	6	39	35	55
Grey Plover	5	1	4		
Lapwing	117	96	148	109	216
Knot			135	57	104
Dunlin	95	155	203	206	266
Snipe			2		
Black-tailed Godwit	26	15	48	56	42
Bar-tailed Godwit	9	6	14	16	31
Curlew	43	7	57	19	41
Greenshank	11	5	6	4	9
Redshank	139	73	93	97	118
Turnstone	38	20	59	57	41
Black-headed Gull	165		250	115	2
Common Gull	45	20	71	94	16
Herring Gull	16	104	102	24	6
Great Black-backed Gull	7	2	19	12	
Total	**1,270**	**1,113**	**2,054**	**1,497**	**1,552**

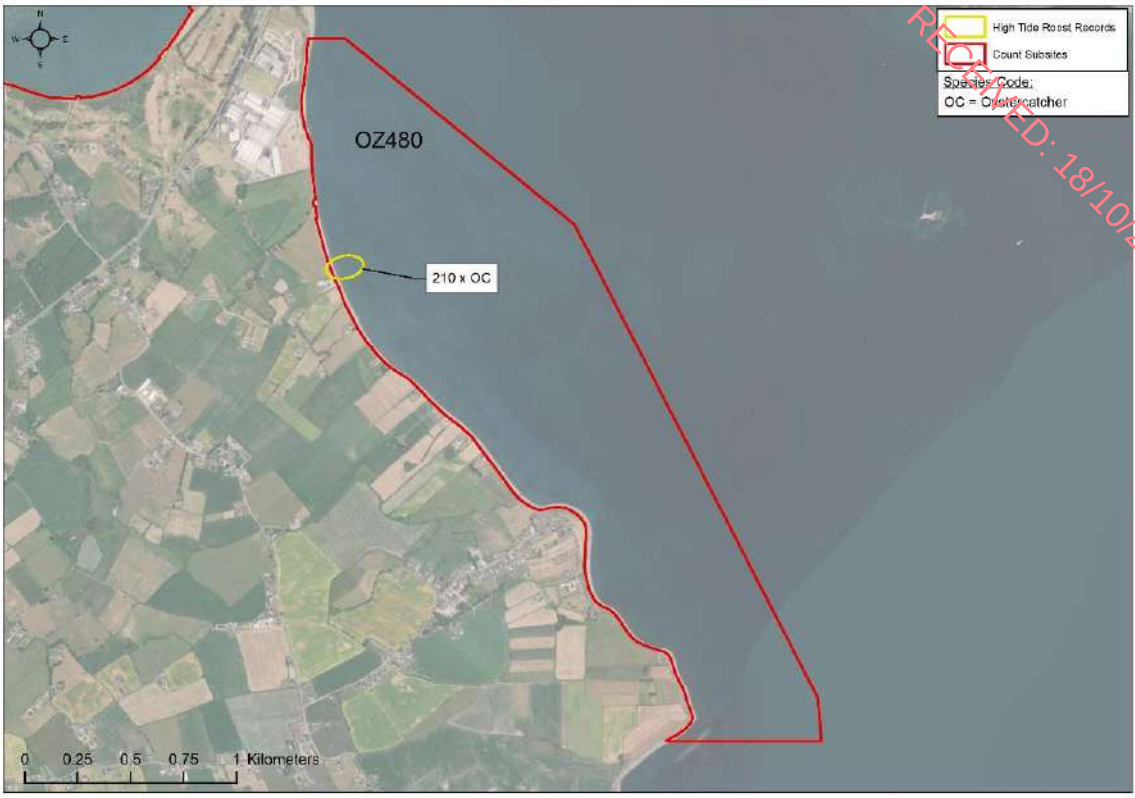

Figure 4.1: *High tide roost records (from January 2020) for sub-site 0Z480 (see Table 4.2 for species codes used during bird recording fieldwork)*

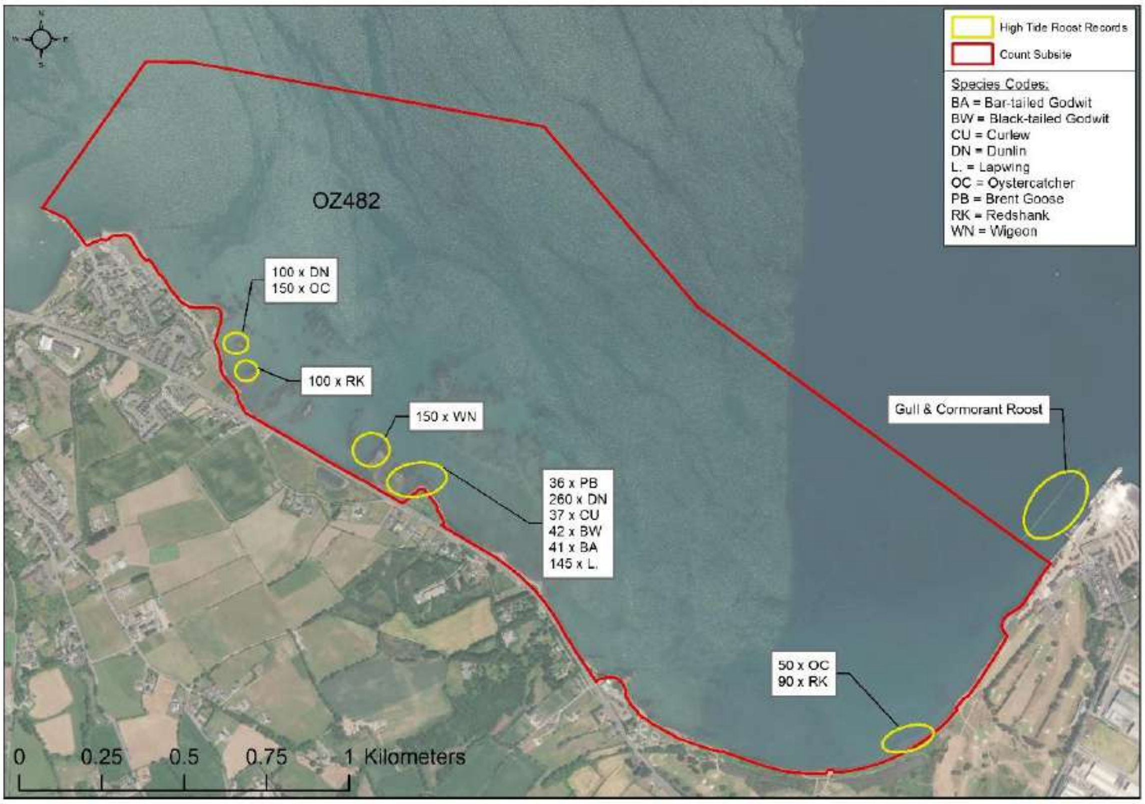

Figure 4.2: *High tide roost records (from January 2020) for sub-site 0Z482 (see Table 4.2 for species codes used during bird recording fieldwork)*

4.7. Waterbird densities

Waterbird densities for the two sub-sites are shown in Table 4.9. Waterbird density is higher in sub-site 0Z482, due to a more complex range of habitats, and the presence of many small freshwater streams carrying a food source on to the site. Subsite 0Z482 also supports greater cover of eelgrass *(Zostera sp.)* which is an important component in the diet of Brent Geese. In contrast, sub-site 0Z480 is limited to mud and sand flats, with only two significant freshwater streams.

Table 4.9: Average density (birds/100ha) and range (min-max; birds/100ha) of total waterbirds within count sub-sites 2019/20

Species name	Sub-site 0Z480			Sub-site 0Z482		
	Mean	Min	Max	**Mean**	Min	Max
Light-bellied Brent Goose	**9.70**	0.00	29.37	**48.01**	16.44	70.55
Shelduck				**1.03**	0.00	3.77
Wigeon				**75.14**	53.42	111.64
Teal				**5.48**	0.00	10.96
Mallard				**7.05**	2.05	10.62
Eider	**0.26**	0.00	1.32			
Red-breasted Merganser	**4.16**	0.00	15.51	**0.27**	0.00	1.37
Cormorant	**17.62**	6.60	31.68	**8.70**	0.00	30.48
Shag	**1.06**	0.00	3.96			
Little Egret				**4.79**	2.40	9.59
Grey Heron	**0.79**	0.00	1.65	**5.48**	2.40	8.56
Oystercatcher	**39.14**	13.86	69.31	**59.18**	30.14	108.90
Ringed Plover	**3.76**	0.33	11.55	**10.68**	2.05	18.84
Grey Plover				**0.68**	0.00	1.71
Lapwing	**14.92**	0.00	24.42	**46.99**	32.88	73.97
Knot				**20.27**	0.00	46.23
Purple Sandpiper	**0.13**	0.00	0.66			
Dunlin	**12.48**	2.97	22.44	**63.36**	32.53	91.10
Snipe				**0.14**	0.00	0.68
Black-tailed Godwit	**1.06**	0.00	5.28	**12.81**	5.14	19.18
Bar-tailed Godwit	**0.66**	0.00	1.98	**5.21**	2.05	10.62
Curlew	**7.79**	0.00	16.50	**11.44**	2.40	19.52
Greenshank				**2.40**	1.37	3.77
Redshank	**34.79**	16.17	68.65	**35.62**	25.00	47.60
Turnstone	**13.33**	5.28	21.78	**14.73**	6.85	20.21
Black-headed Gull	**16.70**	6.60	48.18	**36.44**	0.00	85.62
Common Gull	**16.96**	6.60	30.36	**16.85**	5.48	32.19
Herring Gull	**25.74**	6.60	47.19	**17.26**	2.05	35.62
Great Black-backed Gull	**9.11**	2.64	18.81	**2.74**	0.00	6.51
All Species	**230.17**	**197.03**	**303.30**	**512.74**	**528.30**	**557.73**

The densities for birds foraging in intertidal habitats during the four low tide surveys conducted over the winter of 2019-20 at Carlingford Lough are shown in Table 4.10 (note that the data for high tide surveys is excluded from this table). One species (Red-breasted Merganser) was not recorded using intertidal habitats during the fieldwork period.

Table 4.10: Average density (birds/100ha) and range (min-max; birds/100ha) of waterbirds recorded foraging in intertidal habitats within both sub-sites during 2019-20 fieldwork for low tide surveys.

Species name	Mean	Min	Max
Light-bellied Brent Goose	**61.44**	39.01	86.17
Shelduck	**1.33**	0.00	3.90
Wigeon	**83.42**	68.09	115.60
Teal	**5.14**	0.00	11.35
Mallard	**7.36**	2.13	10.99
Eider	**0.35**	0.00	1.42
Cormorant	**4.34**	0.00	13.48
Shag	**1.06**	0.00	4.26
Little Egret	**3.46**	2.48	4.26
Grey Heron	**4.61**	3.19	6.03
Oystercatcher	**81.12**	46.10	117.02
Ringed Plover	**13.48**	6.38	26.24
Grey Plover	**0.89**	0.00	1.77
Lapwing	**48.23**	41.13	57.45
Knot	**17.02**	0.00	47.87
Purple Sandpiper	**0.18**	0.00	0.71
Dunlin	**74.38**	46.81	96.10
Snipe	**0.18**	0.00	0.71
Black-tailed Godwit	**14.27**	9.22	19.86
Bar-tailed Godwit	**4.88**	2.13	7.09
Curlew	**20.83**	15.25	32.98
Greenshank	**2.30**	1.42	3.90
Redshank	**78.01**	62.06	99.65
Turnstone	**27.48**	19.15	40.78
Black-headed Gull	**54.17**	12.41	110.28
Common Gull	**34.04**	24.11	40.43
Herring Gull	**52.84**	15.60	87.59
Great Black-backed Gull	**9.57**	3.55	21.99
All Species	**706.38**	**653.55**	**785.11**

4.8. Light-bellied Brent Goose distribution

The monthly disturbance surveys targeted at Light-bellied Brent Goose indicated some broad patterns in habitats use, with certain areas favoured within the two survey Zones (see Figure 4.3). Of the eight "favoured" areas, six largely correlate with the location of four watercourses which are likely to be important for drinking and washing (see Figure 4.3). The two other favoured areas are likely linked to the availability of feeding opportunities (refer to Figure 3.3).

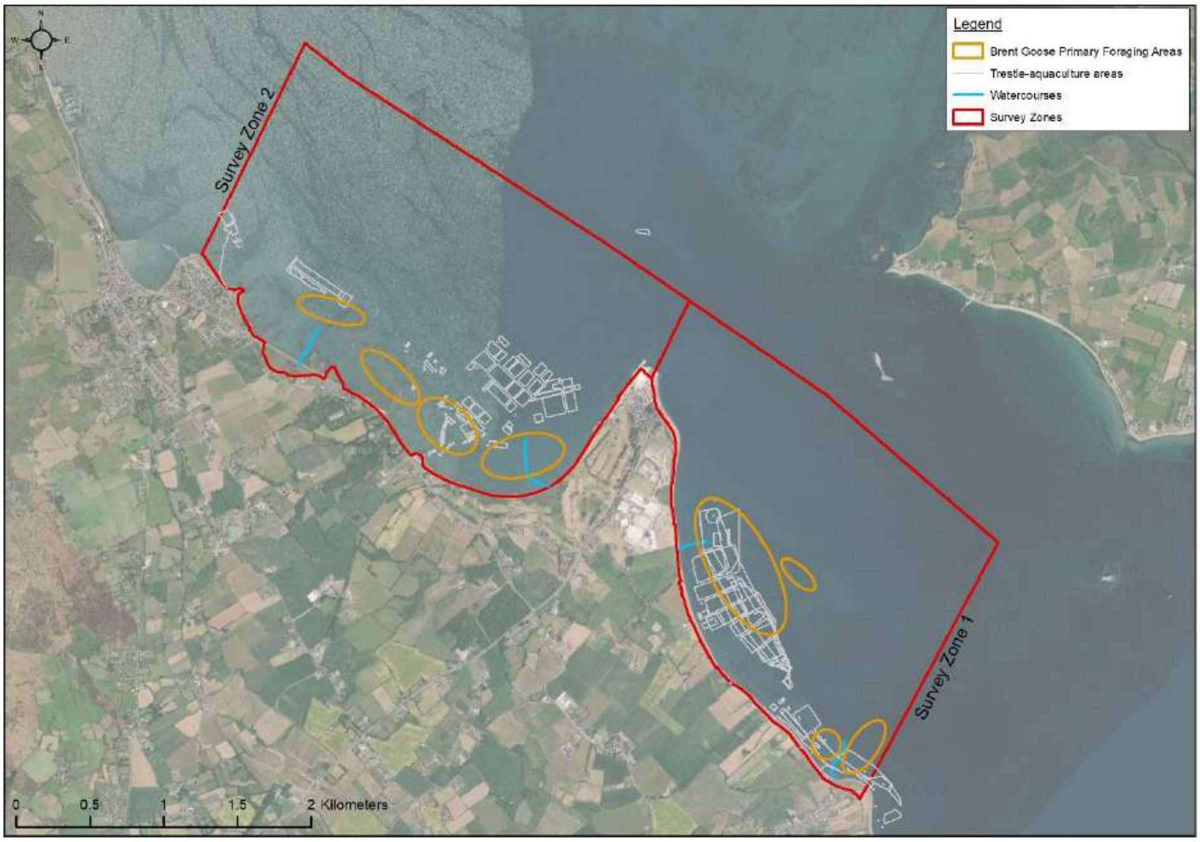

Figure 4.3: *Favoured sites (marked in orange) used by Light-bellied Brent Goose during hourly observations within the survey zones; watercourses running into the survey areas marked in blue; survey zones are outlined in red. Aquaculture areas (trestles) are also outlined.*

Although not recorded during the January high tide roost survey (see Figures 4.1 and 4.2) , during the targeted surveying for Light-bellied Brent Goose, small numbers were recorded at roost during high tide in Zone 2 (36 birds) on the water amongst the saltmarsh grasses, which they may consume during roosting. Light-bellied Brent Goose does not typically roost during high tide in Zone 1, probably because there is no saltmarsh habitat and the current is too fast.

4.9. Activities and disturbance

Disturbance events recorded during fieldwork are shown in Table 4.10. Out of 46 disturbance events, two were considered to have a high impact on Light-bellied Brent Goose, with birds flying away from the study area; these were caused by a dog walking and a walker on the mudflats. One event, involving motorised watercraft, caused moderate disturbance, with birds moving within the study area. Six disturbance events caused a slight movement of birds within the survey area

Table 4.10: Disturbance Activities recorded at Carlingford Lough 2019/20.

Month	Survey Zone	Disturbance Activity	Duration	Observed Impact on Light-bellied Brent Goose
October	1	Aquaculture machinery	Up to 50% of count period	None
	2	Aquaculture machinery	Up to 50% of count period	Slight movement of birds away from disturbance
		Aircraft	Short/discrete	Slight movement of birds away from disturbance
		Construction work	Continued after count	None
November	1	Aquaculture machinery	Up to 50% of count period	None
	2	Aquaculture machinery	Up to 50% of count period	Slight movement of birds away from disturbance
		Aircraft	Short/discrete	Slight movement of birds away from disturbance
		Construction work	Continued after count	None
		Winkle picking	Up to 50% of count period	None
		Aquaculture (on foot; checking oyster bags)	Short/discrete	None
December	1	Aquaculture machinery	Up to 50% of count period	None
		Winkle picking	Up to 50% of count period	None
		Bait diggers	Up to 50% of count period	None
	2	Aquaculture machinery	Continued after count	Slight movement of birds away from disturbance
		Non-aquaculture vehicle	Up to 50% of count period	Slight movement of birds away from disturbance
		Aquaculture machinery	Short/discrete	None
		Winkle picking	Up to 50% of count period	None
		Aquaculture (on foot; checking oyster bags)	Short/discrete	None
		Dogs (off lead with walker)	Short/discrete	High impact - all birds flew away
		Walker on mudflat	Short/discrete	High impact - all birds flew away
January	1	Aquaculture machinery	Continued after count	None
		Aquaculture (on foot)	Continued after count	None
		Winkle picking	Up to 50% of count period	None
	2	Construction work	Continued after count	None
		Winkle picking	Short/discrete	None
		Walker on mudflat	Short/discrete	None

Month	Survey Zone	Disturbance Activity	Duration	Observed Impact on Light-bellied Brent Goose
February	1	Aquaculture machinery	Continued after count	None
		Aquaculture (on foot)	Continued after count	None
		Winkle picking	Up to 50% of count period	None
	2	Construction work	Continued after count	None
		Winkle picking	Short/discrete	None
		Walker on mudflat	Short/discrete	None
March	1	Aquaculture machinery	Continued after count	None
		Aquaculture (on foot)	Continued after count	None
		Winkle picking	Up to 50% of count period	None
		Winkle picking	Short/discrete	None
	2	Construction work	Continued after count	None
		Winkle picking	Short/discrete	None
		Walker on mudflat	Short/discrete	None
		Powered watercraft	Short/discrete	Moderate impact – birds moved to another part of the site
April	1	Aquaculture machinery	Continued after count	None
		Aquaculture (on foot)	Continued after count	None
		Winkle picking	Up to 50% of count period	None
	2	Construction work	Continued after count	None
		Winkle picking	Short/discrete	None
		Walker on mudflat	Short/discrete	None

5. DISCUSSION

5.1. Overview of the 2019/20 season

The first counts were undertaken from the 24th October by which time the typical assemblage of wintering water birds was already present and all summer birds (notably terns) had departed. Twenty-nine species of waterbirds were recorded including four gull species, with Lesser Black-backed Gull absent. Nine wildfowl and 16 wader species were observed. Notably absent were Scaup and Great Crested Grebe, both of which have been in decline in Carlingford Lough form over a decade.

It is also notable that very few birds of prey were recorded.

The 2019/20 species list includes two species (Little Egret and Bar-tailed Godwit) listed on Annex I of the EU Bird's Directive, and five species that are on the Birds of Conservation Concern in Ireland (BoCCI) lists (Colhoun & Cummins, 2013).

5.2. Waterbird numbers and trends

Numbers of Light-bellied Brent Goose were in line with expectations over previous years and seem to be largely determined by events on migration and on wintering grounds, at least in the context of Carlingford Lough. The site summary (NPWS, 2013) indicates 175 birds; IWeBs counts range from 186 to zero birds on some counts. As previously noted, this is the first low tide count so numbers are not directly comparable, however the 2010/11 study (Martin, 2011) noted 543 on the 16th December 2010 while the max count recorded during 2019/20. However the low tide survey methodology is not directly comparable with the method used in 2010-11, which included several monthly counts, increasing the likelihood of higher numbers being encountered on any given month, particularly due to the complex way in which Light-bellied Brent Goose move around Carlingford Lough and Dundalk Bay (NPWS, 2013).

5.3. Waterbird distribution

As the tide recedes most waders and wildfowl species follow the tide out, with the exception of Turnstone and Redshank which tend to spread out over the upper shore, sometimes gathering where a feeding opportunity emerges. From low tide other waders tend to do the same thing, so that species tend to be widely spread out and not clustered in flocks.

Dunlin tend to move around the lower shore in several fast-moving flocks. Golden plover (when present) prefer the southern area of Zone 2, along with Knots when they are not foraging for clams in the patches of muddy sand and sandy mud. Of the wildfowl, Light-bellied Brent Goose tend to congregate at the *Zostera* during October, then moving to the green algae areas which are fed by freshwater streams. It should be noted that there is a discharge of sewage at Greenore port which may backwash over the southern end of Zone 2 and add to the eutrophication, and hence algal blooms. This is supported by the data observed here, with the distribution of Light-bellied Brent Goose matching the availability of these resources.

Wigeon prefer the middle part of Carlingford Lough, although both compete for *Zostera* when it is present, and both compete for green algae as the tide rises and feeding opportunities becomes scarcer. Light-bellied Brent Goose also tend to dominate the aquaculture areas whereas the smaller Wigeon have a tendency to avoid them.

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Wigeon are generally absent from Zone 1, or only occur in small numbers whereas Light-bellied Brent Goose use both and in the latter part of the year may favour Zone 1 over Zone 2.

5.4. Waterbird disturbance

Generally speaking there was very little disturbance observed and where it was observed bird responses were weak, typically by walking away from the source of the disturbance, occasionally flying a short distance. All species seem highly habituated to the principal course of disturbance, aquaculture, with one exception. Construction activity was ongoing at the Carlingford Oyster company facility and all species simply avoided the area keeping a distance of about 50 metres (the chief disturbance was from excavators working and flashing warning lights). Walkers and dog walkers were a regular phenomenon and traffic along the road bordering both sites a constant feature, but again produced very little response from any bird species. Equally, occasional bait diggers produced very little observable response.

Responses to the main sources of disturbance were minimal suggesting that birds are highly habituated to disturbances including aquaculture activities, walkers/dog walkers, bait diggers, traffic and construction activity. Given that most counts took place on weekdays disturbance from recreational activities may have been underestimated.

Outside of the count dates a significant disturbance triggering a strong bird response was observed at the north end of Zone 2. At this location there is a mussel bed used by up to 200 oystercatchers. Immediately adjacent to it is an oyster cultivation concession. Disturbance included walking or driving straight across the sand/mud flats rather than sticking to the designated pathways, parking on the oyster bed through low tide and various running about and strewing oyster cultivation equipment (trestles and bags) in a disorganised way. The result is significant deprivation of foraging opportunities for the oystercatchers.

6. CONCLUSION

This first survey of the southern shore of Carlingford Lough using low tide methodology was successfully completed. The chief conclusions are as follows:

- The bird species using the areas are well habituated to aquaculture activity and generally undisturbed by it;
- They forage and roost amongst and on top of the oyster cultivation structures (trestles and bags) on almost all tides (particularly Light-bellied Brent Goose geese who exploit the fact that green algae grown on the oysters);
- Distribution follows patterns previously observed in 2010/11;
- Bird numbers show a slight decline in relation to previous studies, however the methodology is not directly comparable.

In future, low tide studies in this area need to take account of the fact that there is a large sub-site on the other side of the Lough and birds regularly commute back and forth to exploit foraging and roosting opportunities exposed by the movement of the tide. Future studies should also take account of the fact that the qualifying interest, Light-bellied Brent Goose, primarily roost in Dundalk Bay and commute into Carlingford Lough as the tide starts to expose feeding areas, or in the early morning, returning to roosting areas typically at dusk. When birds arrive they spread out over the Lough searching for feeding areas and filling them, with a portion of the flock carrying on to Mill Bay on the north side of the Lough, typically after stopping to drink and wash at a stream at the south end of Zone 1.

Such subsite/habitat preference highlights the importance of sensitive site management and sustainable use of coastal wetland sites. While sites may seem large in size and to have 'plenty of room' for birds, foraging habitat selection can often lead to birds having a very restricted distribution. Moreover, as site-specific conservation objectives are now published for most coastal SPA sites in the Republic of Ireland, and one objective is based around the maintenance of the distribution of waterbirds, knowledge and assessment of waterbird distribution over time, is of paramount importance in assessing the favourable conservation status of a designated SPA and marrying that with human activity. The continuation of studies such as the one reported here are therefore an important part of the overall delivery of conservation management for these internationally important sites.

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APPENDIX I: CARLINGFORD LOUGH SPA/SAC SITE SYNOPSES

SITE SYNOPSIS

SITE NAME: CARLINGFORD LOUGH SPA

SITE CODE: 004078

Carlingford Lough SPA comprises parts of the south side of Carlingford Lough, Co. Louth, between Carlingford Harbour and Ballagan Point. The predominant habitats present are intertidal sand and mud flats

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for Light-bellied Brent Goose. The E.U. Birds Directive pays particular attention to wetlands, and as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

In winter the site supports an internationally important population of Light-bellied Brent Goose (253 – all figures are five year mean peaks for the period 1995/96 to1999/2000). A range of other waterfowl species occurs within the site, including Wigeon (107), Oystercatcher (289), Dunlin (392), Bar-tailed Godwit (33), Redshank (108) and Turnstone (29). The intertidal flats provide feeding areas for the wintering birds. The sub-tidal areas outside the SPA support a range of species including Great Crested Grebe, Cormorant and Red-throated Diver.

Carlingford Lough SPA is of international importance for its Light-bellied Brent Goose population. Of note is the occurrence of Bar-tailed Godwit, a species that is listed on Annex I of the E.U. Birds Directive.

14.11.2011

SITE SYNOPSIS

Site Name: Carlingford Shore SAC

Site Code: 002306

The Carlingford Shore SAC site comprises the entire southern shoreline of Carlingford Lough and continues round the tip of the Cooley Peninsula to just west of Cooley Point. While the principal conservation interests lie in the perennial vegetation of shingle banks and the annual vegetation of drift lines, the site also has intertidal sand and mudflats, patches of saltmarsh, some areas of dry grassland, and an area of mixed deciduous woodland. The site is flanked by Carlingford Mountain to the south-west. The underlying rock within the SAC is mainly carboniferous limestone. This outcrops in places in the form of bedrock shore or reefs. Granite boulders are occasionally found. Intertidal mudflats and sand/gravel banks also occur.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

[1210] Annual Vegetation of Drift Lines
[1220] Perennial Vegetation of Stony Banks

In Carlingford Shore SAC the shingle and drift line habitats extend more or less continuously from Greenore to west of Cooley Point. They occur as a strip of varying width, from only a few metres in places, to up to about 50 m. One of the best developed areas is south of Ballagan Point. The substrate varies from stones and cobbles to gravels and coarse sands. The exposure level of this shoreline is high.

The perennial vegetation of the upper beach of these shingle banks is widely ranging, well developed and often stable. In places lichens encrust the stones farther back from the sea. Typical species present throughout the site include oraches (*Atriplex* spp., including *A. prostrata, A. glabriuscula* and *A. littoralis*), Sea Beet (*Beta vulgaris* subsp. *maritima*), Wild Carrot (*Daucus carota*), Red Fescue (*Festuca rubra*), Sea-milkwort (*Glaux maritima*), Lyme-grass (*Leymus arenarius*) and Sea Radish (*Raphanus raphanistrum* subsp. *maritimum*). This grades landward mainly into lowland dry grassland, though there are patches of wet grassland.

The vegetation of the stony banks is often interspersed with the vegetation occupying accumulations of drift material and gravels rich in nitrogenous organic matter. The vegetation is sparse. Species seen include Prickly Saltwort (*Salsola kali*), Sea Rocket (*Cakile maritima*), Sea Sandwort (*Honkenya peploides*), Sea Spurge (*Euphorbia paralias*), Sea Mayweed (*Matricaria maritima*) and oraches. The Red Data

Book species Oysterplant (*Mertensia maritima*) is also found. This plant is protected under the Flora (Protection) Order, 1999.

There are small patches of saltmarsh on the drier sections of outcropping reefs and at the landward edge of the site. Species present include Sea Aster (*Aster tripolium*), Sea Purslane (*Halimione portulacoides*), Lax-flowered Sea-lavender (*Limonium humile*), Common Saltmarsh-grass (*Puccinellia maritima*), Sea Arrowgrass (*Triglochin maritima*) and Sea Plantain (*Plantago maritima*). In areas which are more regularly flooded Annual Sea-blite (*Suaeda maritima*) is found. A small brackish lake is present on the landward side of the railway line.

A relatively extensive expanse of intertidal flats (more sand than mud) occur, particularly between Greenore Point and Carlingford Harbour. The flats in this area are broken by outcropping reefs and some shingle deposits and saltmarsh on the drier higher rocks. These flats are very important feeding grounds for wildfowl and waders. Patches of green algae (filamentous, *Ulva* sp. and *Enteromorpha* sp.) and lugworm casts occur in places, while fucoid seaweeds are common on the more stony flats. Abundant barnacle shells and lichens are also present on many of the rocks. Eelgrass (*Zostera* sp.) beds are found on the flats - the main food source for the internationally important population of Pale-bellied Brent Goose at the site. Small tufts of cord-grass (*Spartina* sp.) are also found.

Above the low-lying shoreline dry grassland often occurs, with species such as Red Fescue, Common Bent (*Agrostis stolonifera*), Ribwort Plantain (*Plantago lanceolata*), Common Bird's-foot-trefoil (*Lotus corniculatus*), Yarrow (*Achillea millefolium*) and Common Ragwort (*Senecio jacobaea*). West of Carlingford town the shoreline is backed in places by low cliffs. An area of mixed woodland occurs at Ferry Hill, overlooking the mouth of the Newry River. This has a low canopy dominated by Elder (*Sambucus nigra*) and with some Pedunculate Oak (*Quercus robur*), Beech (*Fagus sylvatica*) and Sycamore (*Acer pseudoplatanus*). The non-native and invasive Rhododendron (*Rhododendron ponticum*) is common.

The threshold for internationally important numbers of birds within the site has been exceeded in single years, by some species such as Pale-bellied Brent Goose in the 1980s and 1994/95. The site is nationally important for a number of species such as Great Crested Grebe, Cormorant, Ringed Plover and Red-Breasted Merganser. This classification is based on species which attained interim all-Ireland importance on the basis of the three year mean maximum counts for the winters 1994/95-96/97. There are a number of bird species recorded, including Golden Plover and Bar-tailed Godwit, which are listed under Annex I of the E.U. Birds Directive. The intertidal flats between Greenore and Carlingford have been designated a Special Protection Area (SPA) under the E.U. Birds Directive. Black Guillemots (6) were recorded in pairs nesting in wooden breakwater in Greenore and 8 birds were seen at the breakwater. A colony of Terns in Northern Ireland feed in the SPA, particularly Sandwich Tern with some Common Tern.

Approximately 25-30 Grey Seals haul out on reefs between Greenore and Carlingford. This species is listed in Annex II under the E.U. Habitats Directive.

The principal activities in the site are recreational usage and shellfish production. Much of the area around the mean low water mark (MLWM) between Carlingford Harbour and Greenore is under production of oyster, and to a lesser extent, clams. The principal threat to the shoreline habitats is further commercial development, either for shellfish or tourism. Coastal defence works is also a threat to the shoreline. Aquaculture occurs in Carlingford Lough and may have negative impacts on the wintering bird populations.

Carlingford Shore has a wide diversity of habitats including very good examples of perennial vegetation of stony banks and drift lines. The presence of Red Data Book species adds to the ecological interest. The wide area of intertidal flats within the site is internationally important for birds and is designated as a Special Protection Area. The presence of Grey Seal, an Annex II species under the E.U. Habitats Directive, adds to the conservation value of the site.

APPENDIX 11.3

OVERWINTERING BIRD SURVEY 2023-2024

VOLUME III

APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

Proposed Operations & Maintenance Facility, Greenore Port, Co. Louth

Overwintering Bird Survey 2023-2024

Author: Breffni Martin

Monday 20th May 2024

Issue for Planning Application

Introduction

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An overwintering bird survey was undertaken to support and inform the Biodiversity chapter of the EIAR and the report titled *Information to Inform Screening for Appropriate Assessment* submitted as part of a planning application for Operations & Maintenance Facilities designed to facilitate off shore wind farm development. The survey was carried out from October 2023 to March 2024 during daylight hours. It included a survey of the intertidal habitat at Greenore Port. This survey represented the second year of surveying, it repeated the 2022-23 season with the following additional surveys:

- Focal Observations on individual birds in order to determine behaviour inside the Zone of Influence (ZoI).
- Targeted visits to determine the effect of extreme tidal and weather effects on bird behaviour.

Methodology

Desktop Survey

See detail presented in the Overwintering Bird Survey 2022-2023.

Field Survey

See detail presented in the Overwintering Bird Survey 2022-2023.

Behavioural Study

The behavioural study consisted of approximately 96 focal observations on bird behaviour within the ZoI. Each observation lasted five minutes with the main behaviour during that time classified as:

- Roosting
- Loafing
- Foraging
- Preening
- Agnostic (e.g. aggression)
- Other

Where foraging was observed the number of successful outcomes was recorded, and an attempt was made to identify prey items.

Targeted Surveys

Targeted surveys consisted of several surveys targeting unusual weather and tidal events, such as extreme high and low tides, and winter storms and high winds.

Results

Bird Abundance and Distribution Survey

The total number of species recorded during the 2023/24 survey periods within the ZoI around the proposed development site was 27 consisting of the following maximum counts October 2023 to March 2024. This is compared to the IWeBS most recent max count for this subsite 0Z482.

Species	Max	IWeBS Sub-site 0Z482	%
Light-bellied Brent Goose	0	489	0
Shelduck	2	15	13.3
Wigeon	5	215	2.3
Teal	0	38	0
Mallard	6	22	27
Great Crested Grebe	0	0	na
Great Northern Diver	0	0	na
Red-throated Diver	0	0	na
Cormorant	32	0	na
Shag	3	0	na
Little Egret	2	15	13
Grey Heron	5	19	26
Oystercatcher	9	168	5.3
Knot	5	200	2.5
Ringed plover	1	15	6.6
Grey Plover	0	2	0
Dunlin	2	230	0.8
Bar-tailed godwit	2	15	13
Black-tailed Godwit	0	156	0
Curlew	6	124	4.8
Redshank	32	237	23
Turnstone	18	14	128

Black-headed Gull	96	200	48
Common Gull	32	45	71
Lesser Black backed Gull	0	1	0
Herring Gull	470	142	379
Great Black-backed Gull	8	9	88.8
Guillemot	1	0	na
Razorbill	1	0	na

Figure 1 Bird abundance - max counts

Brent geese were not seen in the vicinity of the ZoI during the entire count season. The main cohort was concentrated in the Zosteria area about 2km distant. During bad weather they sometimes used the golf course for feeding and for shelter. In the latter part of the year they focussed on the two outflows along the Carlingford shore road, which had significant algal blooms, likely due to agricultural runoff triggered by heavy rain; the season was notably wet.

Total monthly counts show considerable variance in the numbers of waterbirds present within the ZoI:

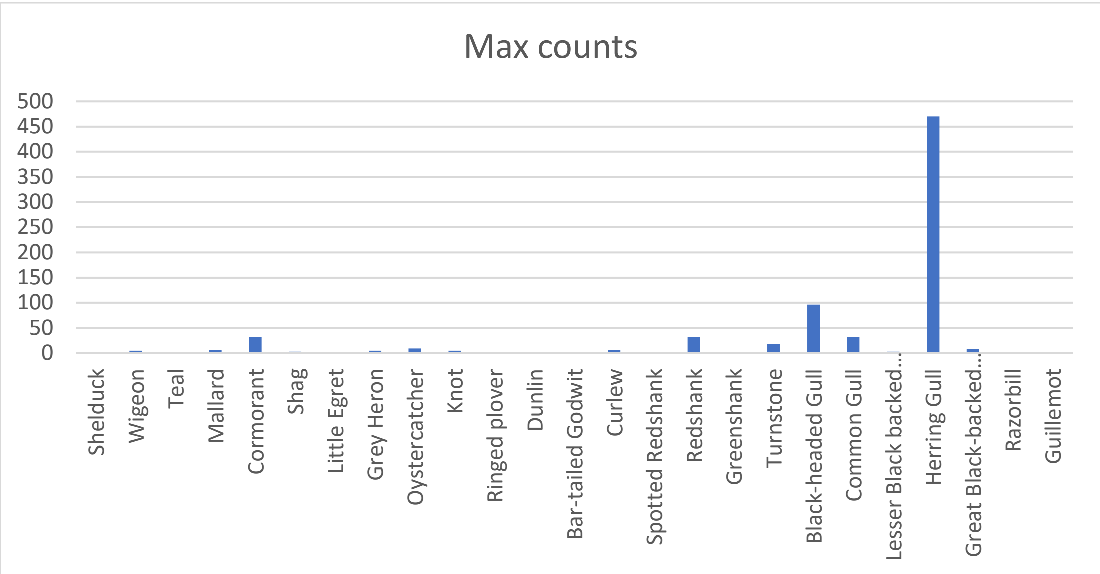

Figure 2 Bird abundance zones 1 + 2

For the purposes of this study, two zones on the southern shore are identified and are shown on the following Figure.

Figure 3 Survey Zone Boundaries

Behavioural Study

A total of 96 focal observations were made during the abundance surveys. Four observations were interrupted for various reasons, most typically the bird flew off. The study covered a total of 19 species (the most common: cormorant, herring gull, guillemot, grey heron, great black-backed gull, great northern diver, turnstone, shag, black-headed gull, common gull, razorbill, redshank, curlew, wigeon, mallard, shelduck, , oystercatcher, bar-tailed godwit, and little egret). As detailed in the following Table, the main activity observed was roosting and loafing where loafing includes waterflow drifting on the water.

Roosting	Foraging	Loafing	Preening	Agnostic	Total
19	35	38	3	1	96
19.8	36.5	39.6	3.1	1.0	100.0

Table 1 Focal Observation Results

In terms of foraging the activity was divided into two categories, waders hunting for prey items in the ZoI and gulls surface feeding spoil from the port. Of the former only three successful hunts were completed, on all three occasions involving redshanks picking prey items from the intertidal area.

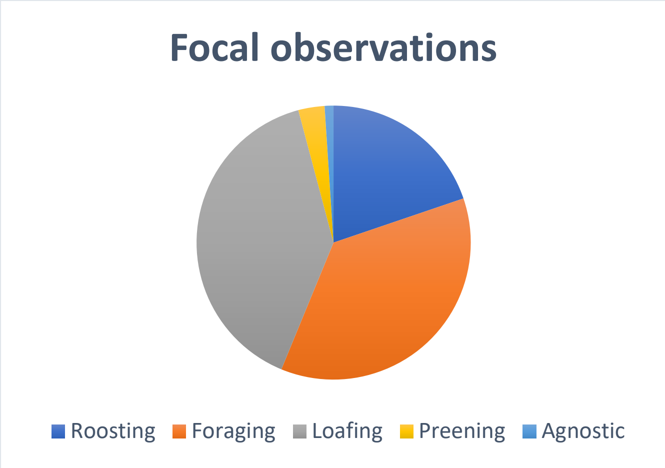

Figure 4 Bird activity in the ZoI

Targeted Surveys

Wednesday 18/19th Oct 2023 – Storm Babet

Storm Babet was an intense extratropical cyclone which affected large parts of northern and western Europe including Ireland. it brought intense winds and rain.

No birds were on the breakwater on either the evening of the 18th or the afternoon of the 19th – large numbers were observed in the Greenore golf course including waders, waterfowl and gulls.

Thursday 25th January 2024 – Full Moon - Night Survey

No instance of night feeding was observed. Approximately 200 gulls and 25 cormorants were observed roosting on the breakwater.

Sunday 21 Jan 2024 – Storm Isha

Storm Isha brought extremely high swirling winds mainly from the west and north. Similar to storm Babet, no birds occupied the breakwater with large numbers gathered in the golf course and surrounding fields.

Wednesday 28th February 2024

A large vessel was being manoeuvred by two pilot boats in fair weather. The purpose of the targeted survey was to closely observe the effect of the disturbance occasioned by manoeuvring the ship by birds. In the event no disturbance was noted by any species. The following images were captured during that survey.

Thursday 29th February 2024 – High Tide

The conditions were that of a very high astronomical tide. No birds were observed on the breakwater – they moved mainly to Green Island. The following images were taken during that survey.

Figure 5 Astronomical high tide

Figure 6 Green Island Roost

10th and 11th March 2024 Astronomical low tide.

These days were chosen to undertake a night survey and to determine the extent to which the intertidal area was used at low water when most of it is exposed. The following species were recorded foraging in the seaweed: oystercatcher, bar-tailed godwit, curlew, little egret, grey heron and redshank. As the light dropped, they left the area heading towards the tideline along the Greenore to Carlingford shore.

Discussion

Bird Abundance and Distribution

The conclusions of the initial survey in 2022/2023 are largely borne out by the repeat survey in 2023/2024.

Night Roost

It was confirmed that the breakwater is used as a night roost primarily by gulls and cormorants, in suitable weather conditions, but foraging at night was not observed. This may be due to the possibility that birds prefer more open areas at night, where they are less exposed to terrestrial predators coming onto the intertidal area.

Bird Behaviour

The main behaviour observed is loafing and roosting on the breakwater. Foraging is mainly a function of the cargo/spoil stemming from port operations. This area is only available on some spring tides (0.5 metres or less) and these only occur on about 18 days in a given year, and that the area is only available for a few hours either side of low water, making it available for about 36 hours over a given overwintering period. Taking this as running from September to March, it covers a period of 212 days or 5,088 hours. This means the area is available for less than 1% of the over wintering period.

Furthermore, it was noted that foraging in this area on spring tides does not meet with great success, and birds were observed to prefer other softer areas for foraging., specifically the more muddy sections exposed at low tide further upstream; because these areas are rarely exposed they may provide exceptional feeding opportunities.

Targeted Visits

The targeted visits demonstrated that the breakwater, though an important roosting and loafing area, is not critical, and in times of bad weather or extreme tides, other areas are preferred (the golf course, Green Island).

They also demonstrated the very high level of tolerance birds using the breakwater have to the existing port operations. This high degree of habituation means that birds will readily habituate to the activities stemming from the proposed development.

Summary

Waterbirds frequenting the zone of influence are habituated to the regular activities of the port and are highly tolerant of it. Birds are undisturbed on the breakwater and tolerate even very heavy port activities when there, down to distances of 10 metres, for example the manoeuvring large ships by the pilot boats.

The zone 2 intertidal area within which the proposed Berth 3 and pontoon is planned is not a productive foraging area relative to the rest of the sub-site.

The breakwater is an important but not critical for roosting and loafing. During extreme weather and tides, birds go to other better protected areas.

A degree of displacement may be expected during construction of the facility, but waterbirds are likely to quickly habituate during operation.

Bibliography

BTO. (2022). *Species Account.*

Burton. (2010). *Winter site-fidelity and survival of Redshank Tringa totanus at Cardiff, south Wales.* Bird Study.

Cutts. (2013). *Waterbird Disturbance Mitigation Toolkit.* University of Hull.

Grishanov. (2006). *Conservation problems of migratory waterfowl and shorebirds and their habitats in the.*

Wheelan. (2017). *Species Focus - Wings.* BWI.

APPENDIX 11.4
BREEDING BIRD SURVEY 2023

VOLUME III
APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

Proposed Operations & Maintenance Facility,
Greenore Port, Co. Louth

Summer 2023 Breeding Bird Survey

Author: Breffni Martin

Introduction

A breeding bird survey was carried out in June and July 2023 with the objective of surveying the proposed development site in terms of breeding birds, documenting them and their locations and assessing any possible impact on them stemming from the development. Both terrestrial birds and waterbirds were included in the survey.

Conservation status of breeding birds

All birds and their breeding place are protected under the Irish Wildlife Act.

Methodology

A literature search was undertaken to review any past records of breeding birds in the area.

A field survey was also undertaken following the methodology of the Country Side Bird Survey. This involves following transects over the development site early in the morning and recording all species and their behaviour, specifically:

- Singing
- Display
- Gathering nesting material
- Provisioning nest
- Presence of juveniles.

The survey covered the proposed development area as well as suitable habitats immediately adjacent.

Birds in the wider area were also checked (Greenore golf course, Green Island, an island in Carlingford lough, and the breakwater).

Results

Literature Review

A review of relevant literature from the Irish National Biodiversity Centre, The Irish Birding Database, and Birdwatch Ireland produced no relevant results with the exception of common swifts, which are know to breed in Greenore village. At least 22 pairs attempted nesting in the eaves of the terrace along Eustace street in 2022, along with four pairs of house martins (authors observation). A range of other passerines were recorded in the autumn on the Irish Birding database including blackcap, chiffchaff and turtle dove.

Field Surveys

Port Hardstanding Area

A pair of wagtails and a pair of rock pipits are regular along the quay wall and nesting was confirmed in both cases (provisioning of nests). A single pair of jackdaws bred in a cavity in an old wall. No evidence of gulls breeding in the port area was found, though in previous years herring gulls occasionally nested on the roof of a warehouse (author's observation); a significant reduction in gull numbers was seen during the summer of 2023, with mainly sub-adult birds frequenting the port. No evidence of shelduck nesting was seen in the vicinity of the port, though a single pair did produce at least six ducklings at Shilties Lough (about 2km distant) in 2022, while possible breeding was also recorded in Oysterman, a rocky outcrop 1200 metres away the same year.

Residential Plot

A pair of blackbirds, two pairs of collared doves and a pair of woodpigeons were recorded as breeding in the garden area. A pair of robins are nesting in a garden immediately adjacent to the garden.

Euston Street

Swifts and house martins were noted flying up and down the main street in Greenore village.

Lane to rear of Euston Street

No birds recorded along the access lane.

Port Office Building

No sign of breeding birds was found in the office structures, such as house sparrows and starlings, who may nest in the eaves of such structures.

Breakwater

Black guillemots were confirmed breeding during the summer of 2023 with two pairs using the nesting boxes on the breakwater and a further pair in cavities on the quay wall; the latter are unlikely to be successful due to the presence of rats who may predate eggs and young.

Green Island

Several pairs of herring gull successfully bred on Green island, approximately 1.5 km to the east of the proposed development site. In the past Green Island has hosted colonise of nesting terns (mainly common and sandwich, in the distant past roseate) but this colony has failed in recent years for various reason, possibly due to over-washing of the shingle substrate and predation by large gulls. They may also have been impacted by avian influenza, which had an overall devastating impact on other tern colonies in 2023.

Lighthouse

Several pairs of cormorants regularly nest on Haulbowline lighthouse, 3.7 km from the development site.

Greenore Golf Course

Approximately 1250 pairs of rooks and 30 pairs of jackdaws nest in tall pines in the golf course; these birds regularly visit the port area in search of food spoil. A range of passerines also nest in the golf course.

Discussion

The terrestrial breeding bird population is typical for this kind of habitat. No rare or especially protected passerines were found.

Possible Breeding Bird Impacts Stemming from the Development

The two pairs of breeding passerines were observed nesting in the 'engine room wall' that is being incorporated into the proposed development as a heritage feature. No works are proposed to the wall. The other passerine was observed at a location where a wildflower meadow is proposed, to the southwest of the proposed Berth 3. The landscaping at this location will avoid the bird nesting season and thereafter this location will represent an enhanced nesting location offering protection from predators. .

Black guillemots have proven to be well habituated to activity in the port, but it is possible that the pile driving element of the marine piling works may disturb nesting, through startling causing eggs to break, and the nest to be abandoned. Black guillemots generally lay about 20th May and fledge young around the end of June.

The development is unlikely to affect nesting corvids in the golf course given their habituation to the activities in the port.

Similarly the development is unlikely to impact nesting gulls on green island. It is possible that dredging, specifically rock breaking element, could impact breeding terns, should they perform, but given the course nature of the dredge, this impact is considered to be minimal and unlikely to have a significant effect.

Conclusion

The proposed development is unlikely to impact on breeding birds. Applying the precautionary approach mitigation to be developed for black guillemots and included in the biodiversity chapter.

References

Birdwatch Ireland web site

National Biodiversity Centre website

Irish birding database.

Countryside Bird Survey Counter Manual – Birdwatch Ireland

BTO/JNCC/RSPB Breeding Bird Survey Instructions – 2015 BTO

APPENDIX 11.5

Terrestrial Mammal Survey

VOLUME III

APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

Proposed Operations & Maintenance Facility,
Greenore Port, Co. Louth

Terrestrial Mammal Survey

25 May 2024– FNAL

For Planning Submission

Introduction

To inform the biodiversity chapter of the EIAR, terrestrial mammal surveys were undertaken.

Several otter (*Lutra lutra*) surveys were undertaken. Otters are well known to use the wetlands and sand/mud flats around Greenore and many images can be found on social media.

Signs of other mammals were also checked during the otter surveys.

Surveys were completed across the following timeframes:

- June, July, August, September 2023
- April and May 2024

Conservation Status

Otters are a highly protected Annex II species in Ireland and considered *near threatened* by the IUCN. Despite an apparent decline reported in the most recent national survey in 2010/11 its status is generally considered favourable per the most recent national survey (Reid, 2013). According to the Vincent Trust: "The Irish otter population appears to have remained largely stable and is regarded as a European stronghold. In Ireland otters are found in a diverse array of aquatic habitats, from small streams to major rivers, upland lakes to coastal lagoons and sandy beaches. The Irish otter population appears to have remained largely stable and is regarded as a European stronghold. In Ireland otters are found in a diverse array of aquatic habitats, from small streams to major rivers, upland lakes to coastal lagoons and sandy beaches." The White-Water River ASSI, which flows into Mill Bay in Carlingford Lough records otters as being "widespread" (DAERA, 2013).

Methodology

The otter surveys were undertaken at the same time as the breeding bird survey, i.e. in June and July 2023, and again in October, following the methodology outlined in the national otter survey of Ireland (Reid, 2013) and Otters and Development (NIEA, 2008). The survey checked all possible otter sites within 1 km of the development site. Methodology involved covering all of the coastline within 1km from the development site, and following all the riparian corridors into the hinterland to the same distance. All evidence of otter presence was recorded including prey remains, spraints, footprints, slides, paths, couches, and footprints. Any evidence of holts was also noted. The overall favourability of the sites was also assessed in terms of disturbance, threats (e.g. from crossing roads, loose dogs) and habitat features.

During survey, a careful examination of all habitat features was made for signs of badger activity. Searches for signs of activity were undertaken in accordance with relevant guidance documents including Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (NRA, 2009), Badger Survey – Specific Requirements (NIEA, 2009). Habitat features of potential interest to badger recorded during the habitat survey were revisited and searched for setts and field signs indicating badger activity in the locale of the proposal. Field signs are characteristic and sometimes quite obvious and include tufts of hair caught on barbed wire fences, conspicuous badger paths, footprints, small, excavated pits or latrines in which droppings are deposited, scratch marks on trees, and snuffle holes, which are small scrapes where badgers have searched for insects and plant tubers (NIEA, 2009).

Signs of other mammals were also recorded.

A detailed literature survey was also undertaken.

Results

Literature Survey

Otters are not recorded in Carlingford lough per the National Biodiversity Centre database; however this is likely the result of poor reporting, and the fact that Carlingford lough was not specifically surveyed. A review of previous EIARs to support various developments in Carlingford Lough (, Greenore-Greencastle Ferry), otter spraints were extensively recorded along the Greenore to Carlingford shoreline during the faunal study work undertaken in 2007 for Greenore Port, and again during a survey to support the Greenore-Greencastle Ferry development in 2015, (RPS, 2015). The White Water river ASSI records otters as being numerous; this is immediately across the bay from Greenore. A cursory review of social media such as Facebook and twitter produced many photos from the area. in addition to which the author has observed otters in the vicinity of the lough on many occasions. Consultations with Louth County Council produced several records: Two dead otters along the road between Greenore and Carlingford, likely killed by passing cars, and an otter along the same road under a car (2022). Otters have also been noted using the Ghan House wetland adjacent to Carlingford village.

From the literature survey it may be concluded that otters are not uncommon along the Carlingford lough shore.

As part of the EIS for the Greenore Ferry development a badger survey was undertaken with the following results "No signs of badger activity were recorded within 100m of the proposed Greenore and Greencastle development footprints during Extended Phase 1 Habitat Surveys in 2012…Badgers are likely to forage throughout the semi-improved grasslands to the south of Greenore Port and to the south of the Greenore Coastguard Slipway which will be unaffected by the proposed development."

Field Survey

Otter spraints were frequently recorded along the sea wall at the adjacent golf course, with several clustered around the sluice between the bay and the ponds in Greenore golf course. Similarly several were found at Hammils Quay (a slip adjacent to the old railway track) and other points along the bank. Spraints were also found inside the golf course where the watercourse runs into the golf course under a culvert. Spraints were also recorded along the channel that runs from the Greenore pNHA wetlands into the golf course. Several otter paths and a possible slide were found in Greenore Golf course on an island in one of the ponds, suggesting a possible couche. Spraints were not seen along the east side of the port, though they have been recorded there in the past.

Figure 1 Spraint records in red

There are several wetlands that feed small watercourses entering Carlingford lough in the hinterland, notably Millgrange, Nootka, Greenore pNHA and Mulatee wetlands, which are all more than one km from the development site. Several signs of otter were seen in the Greenore pNHA in particular possibly indicate presence of a holt.

Figure 2 Wetlands around Greenore port

No signs of badger or fox were noted during the otter survey. It was observed that the water table in the vicinity of the port is very high (most of Greenore Golf course is below the high water mark).

Discussion

The intertidal bay between Carlingford and Greenore provides quality otter foraging habitats with an abundance of crabs, crayfish, and fish available. The widespread otter spraints suggest extensive use of the golf course streams and ponds, the shore and the intertidal area by otters. Wetlands in the hinterland may serve as holt habitats.

Local otters likely lie up during the day in holts or couches, and at night access the bay through a watercourse that feeds the ponds in the golf course, from where the water flows into the lough via a tidal sluice, given the level of sprainting at this point. Alternative points of access are via two culverts under the Greenore Road R176. The total distance of the three small watercourses running into the bay is approximately15km. Given typical otter densities which may range from 0.16 to 0.28 otters per stream kilometre (Sittenthaler, 2020) suggesting a maximum of 4.2 otters. Taken together the survey would suggest that there may be a single boar and two or three sows in the wider area, with this population increasing during breeding.

Figure 3 Otter spraints at Hammils Quay

Potential impact of the proposed development on otters

Otter habitats are hydrologically connected to the development site and likely forage within 1km of the port, though primarily at night or in the early morning. Behaviour will typically involve swimming or walking over the littoral and sub littoral areas at dusk in search of prey, and returning at dawn. In summer because of extended daylight they may be out well after dawn. Ranges may be very extensive, up to 25km, though the local animals are likely to stay within the bay and hinterland area unless searching for a mate. Otters are active all year round.

The development has the potential to impact otters through noise, lighting and visual disturbance to otters during construction and operation. In addition to this possible pollution impacts during construction and operation may directly impact otters, or have secondary effects resulting in the degradation of otter foraging habitats, and knock on effects on fish or other otter prey species.

Construction Phase

There is a possibility that noise and visual disturbance from construction, in particular piling, may cause otters to avoid the port area for foraging, which may reduce their ability to find sufficient food during this period. Equally dredging may trigger the release of silt increasing the turbidity of water and reducing ability to catch fish. However since otters are primarily nocturnal, and that this work will be of relatively short duration, and the nature of the dredge is likely to include minimal silt, the impact is considered unlikely. Because the nearest hold is unlikely to be within 1km from the development site (the islands in the golf course are considered unlikely holt locations). A mineral oil spillage or release of contaminated water may also impact otters or their prey, however mitigation measures as set out in the EIAR should attenuate this risk to the extent that any long-term impact is unlikely.

Operational Phase

The operational phase will result in a small increase in marine traffic which may disturb otters when foraging or transiting through the port area. however there is already considerable e port traffic and other traffic in the lough and this is unlikely to make a significant different, given a presumably high level of habituation. Notably otters are occasionally observed by aquaculture workers, to whom they seem also habituated, to a degree. Oyster workers often work at night to follow the tide. In addition to this the intertidal area is often visited by walkers, bait collectors and other leisure users. A mineral oil spillage may also impact otters or their prey, however mitigation measures as proposed in the EIAR should attenuate this risk to the extent that any long-term impact is unlikely. Lighting at night may displace otters.

Impact	**Phase**	**Impact type**	**Significance**	**Mitigation**
Oil spill	Operation	Oiling of fur/injection of oil Knock-on effect on prey	Intermediate Minor	Limit on oil storage (CEMP) Containment (CEMP)
Pollution (contaminated water from construction)	Construction	Knock-on effect on prey	Minor	Short duration,
Lighting	Operation and construction	Displacement	Minor	Wildlife sensitive lighting
Visual disturbance	Operation when at night	Displacement	Minor	Habituation
Noise and vibration	Construction	Displacement	Minor	Habituation
Dredging	Construction	Turbidity in the water column	Minor	Dredge is course and unlikely to produce significant turbidity

Conclusions

Otters regularly frequent the bay between Greenore and Carlingford and may hunt on the foreshore at low water or in the sea when the tide is high.

Otters are likely habituated to a degree of disturbance, particularly at night.

Wildlife sensitive lighting measures will also be outlined in the CEMP.

Any impact from construction activities is likely to be short duration and only occur during daylight when otters are absent. Otters are likely to quickly habituate to any impact from operations, as they have done with aquaculture and port operations.

Dredge is unlikely to produce significant turbidity in the water column.

The proposed project is unlikely to impact otters since they are unlikely to use the port area, and appropriate mitigations are in place in relation to any possible pollution event.

No evidence of badgers or badger setts was observed.

References

Otter Survey of Ireland 2004/2005, Bailey et al, NPWS

National Otter Survey of Ireland 2010/12 NPWS

A comparison of three methods to evaluate otter latrine activity, Rivera et al 2019

Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (NRA, 2009), Badger Survey – Specific Requirements (NIEA, 2009)

APPENDIX 11.6

BAT FAUNA

IMPACT ASSESSMENT

VOLUME III

APPENDICES TO

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

ALTEMAR
Marine & Environmental Consultancy

Bat Fauna Impact Assessment for the Proposed Development of Operations & Maintenance Facilities

at Greenore Port, Greenore, Co. Louth.

23rd May 2024

Prepared by: Bryan Deegan (MCIEEM) of Altemar Ltd.
On behalf of: Greenore Port Unlimited Company.

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Document Control Sheet			
Client	Greenore Port Unlimited Company.		
Project	Proposed O&M Development at Greenore Port, Greenore, Co. Louth		
Report	Bat Fauna Impact Assessment		
Date	23rd May 2024		
Version	Author	Reviewed	Date
Final	Bryan Deegan	Frank Spellman	23rd May 2024

SUMMARY

Exiting Structures:	Structures within the proposed site that are proposed for demolition include a derelict house in the residential plot, and a large grain storage building (former open hydro) and part of the port office building.
Location:	Greenore, Co. Louth
Bat species present:	None Roosting.
Proposed Development:	Operation and Maintenance Facilities
Survey date:	3rd August 2023 & 23rd May 2024

Competency of Assessor

This report has been prepared by Bryan Deegan MSc, BSc (MCIEEM). Bryan has over 30 years of experience providing ecological consultancy services in Ireland. He has extensive experience in carrying out a wide range of bat surveys including dusk emergence, dawn re-entry and static detector surveys. He also has extensive experience reducing the potential impact of projects that involve external lighting on Bats. Bryan trained with Conor Kelleher author of the Bat Mitigation Guidelines for Ireland (Kelleher and Marnell (2022)) and Bryan is currently providing bat ecology (impact assessment and enhancement) services to Dun Laoghaire Rathdown County Council primarily on the Shanganagh Park Masterplan. The desk and field surveys were carried out having regard to the guidance: Bat Surveys for Professional Ecologists – Good Practice Guidelines 3rd Edition (Collins, J. (Ed.) 2016) and Marnell, Kelleher and Mullen (2022), Bat Mitigation Guidelines for Ireland V2 (which update and replace the Bat Mitigation Guidelines for Ireland published in 2006).

The 2024 survey was carried out by Frank Spellman (MSc Zoology, BSc Zoology). Frank has extensive experience in carrying out a wide range of fauna surveys as both a sub-contractor and employee for environmental consultancies and organisations in Ireland and the US. These include both roving and static acoustic bat surveys, terrestrial non-avian mammal surveys, breeding/wintering bird surveys, and freshwater ecology surveys. Frank has been lead surveyor on numerous development projects within Ireland carrying out full avian/non-avian mammal, wintering bird and breeding bird assessments.

Legislative Context

Wildlife Act 1976 (as amended by, inter alia, the Wildlife (Amendment) Act 2000).

Bats in Ireland are protected by the Wildlife (Amendment) Act 2000. Based on this legislation it is an offence to wilfully interfere with or destroy the breeding or resting place of any species of bat. Under this legislation it is an offence to "*Intentionally kill, injure or take a bat, possess or control any live or dead specimen or anything derived from a bat, wilfully interfere with any structure or place used for breeding or resting by a bat, wilfully interfere with a bat while it is occupying a structure or place which it uses for that purpose.* "

Habitats Directive- Council Directive 92/43/EEC 1992 on the conservation of natural habitats and of wild fauna and flora has been transposed into Irish Law, including, via, *inter alia*, the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended). See Art.73 of the 2011 Regulations which revokes the 1997 Regulations.

Annex II of the Council Directive 92/43/EEC 1992 on the conservation of natural habitats and of wild fauna and flora (EC Habitats Directive) lists animal and plant species of Community interest, the conservation of which requires the designation of Special Areas of Conservation (SACs); Annex IV lists animal and plant species of Community interest in need of strict protection. All bat species in Ireland are listed on Annex IV of the Directive, while the Lesser Horseshoe Bat (*Rhinolophus hipposideros*) is protected under Annex II which related to the designation of Special Areas of Conservation for a species.

Under the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended), all bat species are listed under the First Schedule and, pursuant to, *inter alia*, Part 6 and Regulation 51, it is an offence to:

- Deliberately capture or kill a bat;
- Deliberately disturb a bat particularly during the period of breeding, hibernating or migrating;
- Damage or destroy a breeding site or resting place of a bat;
- Keep, sell, transport, exchange, offer for sale or offer for exchange any bat taken in the wild.

Project Description

Greenore Port Unlimited Company intend to apply for a 10-year permission for development at Greenore Port and site of dwelling house on Shore Road (A91DD42), Greenore, Co. Louth, (total site area c.4.88 hectare). The development comprising of Operation and Maintenance (O&M) Facilities will serve as the support base for future offshore wind arrays in the Irish Sea.

The proposed development will comprise of:-

i. Three standalone buildings, each with a gross floor area (GFA) of 1,670 sqm, comprising 681 sqm warehouse floor space, 322 sqm office space and 667 sqm plant, welfare, storage, ancillary and circulation space per unit. The height of each unit ranges from 7.2m for the warehouse (single-storey / double-height space) to 13.5m max for the office 3-storey element. 76 car parking spaces are proposed distributed adjacent to the units including 6 no. disabled parking spaces and 15 no. electric vehicle (EV) charging spaces. Each building includes an internal bike storage room, with 20 spaces per building. Each building includes rooftop solar photovoltaic panels.

ii. Nearshore works including dredging of harbour sediments to -4m Chart Datum to provide navigable water depths, new quay wall (70m), a 40m anti-slip access ramp, floating pontoon for berthing crew transfer vessels (CTV's). 9 no. berths are proposed, with an additional 2 no. layby berths and a push-on / service berth adjacent to the new quay wall.

iii. Improvement works to the quay deck including installation of a new reinforced concrete deck with surface water management system incorporating silt traps and hydrocarbon interceptors, and berth infrastructure including bollards, fenders, ladders, lifesaving equipment, power outlets and fire hydrants.

iv. Surface car park at the Residential site on Shore Road, known locally as Barbara's Field, comprising 135 car parking spaces, including ducting for 30 no. EV charging spaces, relocation of existing entrance on Shore Road by c.6m to the east, new boundary wall to Shore Road and a pedestrian access route from the car park through port lands to the O&M Units crossing improved public realm at top of Euston Street.

v. Re-instatement of former Open Hydro carpark (62 spaces) until the surface car park on Shore Road is operational.

vi. Upgrade to public/private realm in the foreground of the existing Greenore Port Office building, including upgrade of existing entrance to former open hydro carpark, new pedestrian gate, new feature wall entrance, removal of 6 port car parking spaces, link to new pedestrian route from surface carpark including new opening in port boundary wall, and hard and soft landscaping. Works are partially located within the Greenore Architectural Conservation Area (ACA).

vii. Replacement of existing 25m mast with new 40m mast to facilitate communications with CTV's while offshore.

viii. Demolition works to facilitate the above development including:-
   a. The former "Open Hydro" warehouse (c. 1,607 sqm GFA);
   b. Part of single storey office building (c.38sqm GFA) located adjacent to the entrance to former Open Hydro carpark;
   c. ESB substation and associated switch room;
   d. Dwelling house (c. 192sqm GFA) and boundary wall on Shore Road.

ix. And all associated site and development works including single storey ESB substation, above-ground fuel storage tank (c. 200m3), drainage and utilities, landscaping and boundary treatments, security fencing, lighting and signage, etc. A comprehensive description of the proposed development is set out in Chapter 2 of this EIAR, see Volume II.

The proposed development area, site location and site layout plan are shown in Figures 1-3.

Landscape

The landscape strategy for the proposed development has been prepared by Cunnane Stratton Reynolds. The landscape masterplan is shown in Figure 4.

Arboricultural Assessment

An Arboricultural assessment has been undertaken by Cunanne Stratton Reynolds to accompany this planning application. The tree survey report outlines the following tree impacts:

'Direct Loss of Trees

3.3 The proposed scheme is currently in conflict with the following trees and or a significant portion of their calculated root protection area, making their retention unviable in the context of the proposed development and therefore requiring their removal to facilitate the proposed development.

Tag No	Tree Species	Tree Class	Number of trees
T174	Pinus radiata (Monterey Pine)	B2	1
T178	Pinus radiata (Monterey Pine)	B1	1
T670	Sorbus aucuparia (Rowan)	B1	1
T673	Prunus avium (Cherry)	C1	1
T674	Prunus avium (Cherry)	B1	1
T676	Acer pseudoplatanus	B1	1

Indirect Impacts

3.4 Cognisance must also be given to indirect impacts - in particular care must be taken to ensure the proposed development and ancillary works do not represent an unacceptable conflict with the calculated 'Root Protection Area' of the existing trees proposed for retention.

Disturbance of 'Root Protection Area' may just as readily kill or destabilise a tree over time, by means of root damage/severance and or earth compaction/covering preventing essential transfer of water, air and nutrients to roots.

Good planning and site management therefore will be required during construction works to ensure these areas are not adversely impacted by construction activities. It is important that the site manager carefully review the tree protection drawing Dwg 22369A_T_103, prior to commencement of works on site and raise any queries prior to commencement of works.

The use of tree protection fencing to exclude construction access to root protection areas of trees and hedgerows identified for retention, as illustrated in tree protection drawing Dwg 22369A_T_103, will be critical to avoiding detrimental impacts and the long-term viability of the retained tree.

Proposed tree protection measures should be in place from the outset prior to the commencement of works. Any queries should be raised with the project Arborist prior to commencement of works on site.

Provided proper tree protection measures are adhered to it is not anticipated that any further trees will require removal due to indirect impacts.'

The tree classification & complaints plan, tree impacts plan and tree protection plans are shown in Figures 5-7.

Lighting

The lighting strategy for the proposed development has been prepared by Belton Consulting Engineers. The site lighting lux levels are shown in Figure 8.

Figure 1. Site outline

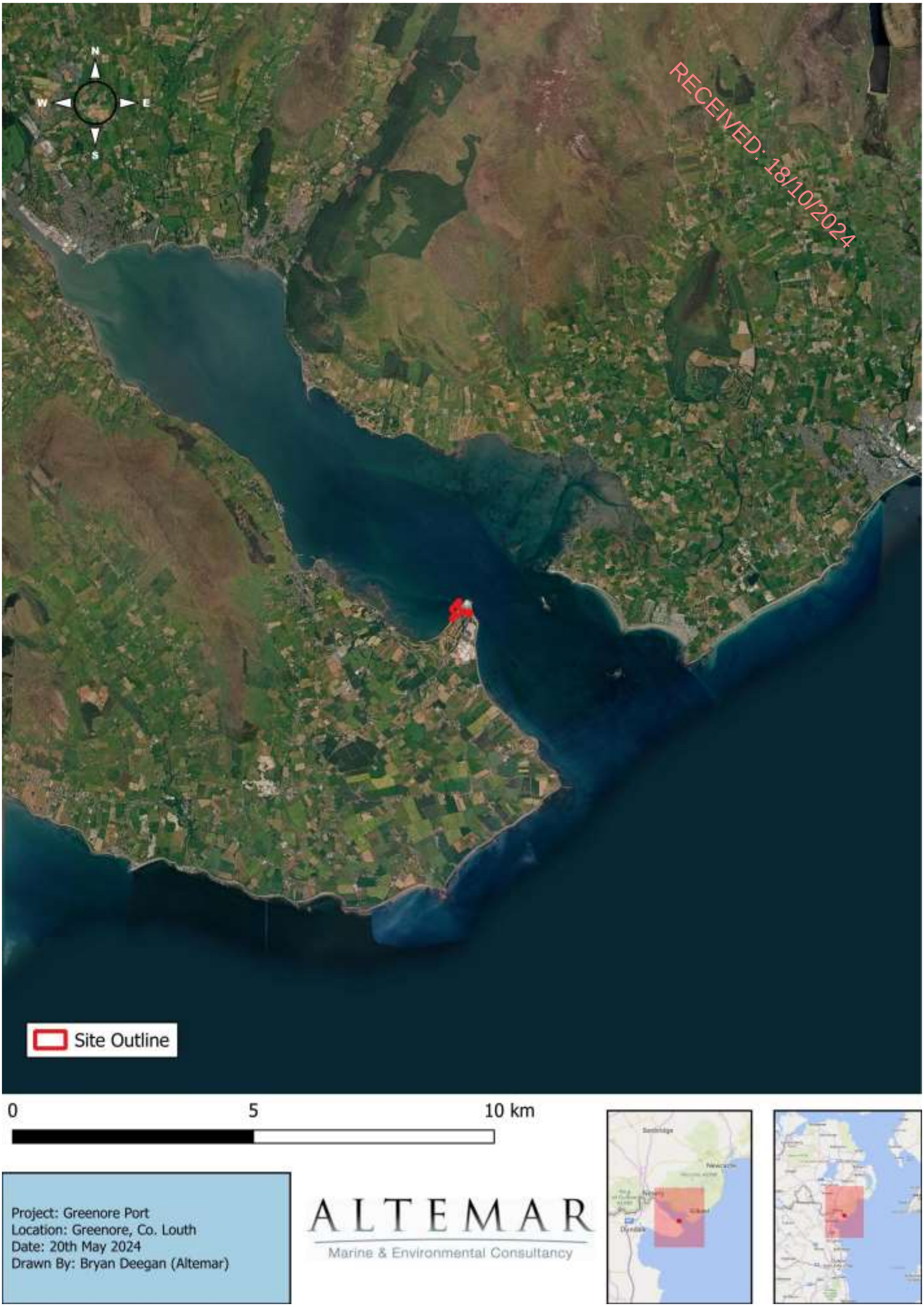

Figure 2. Site location

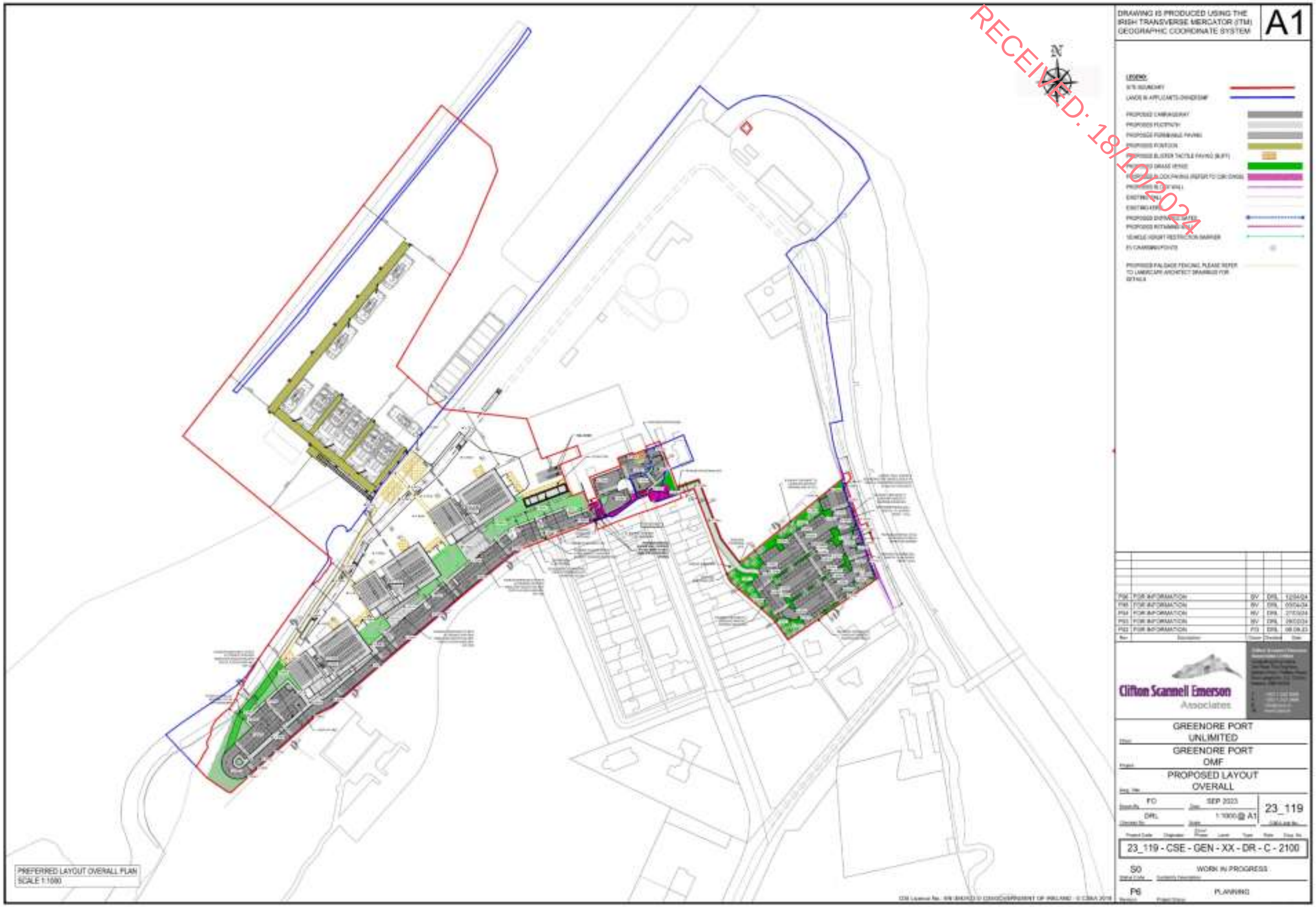

Figure 3. Site layout

Figure 4. Proposed landscape masterplan

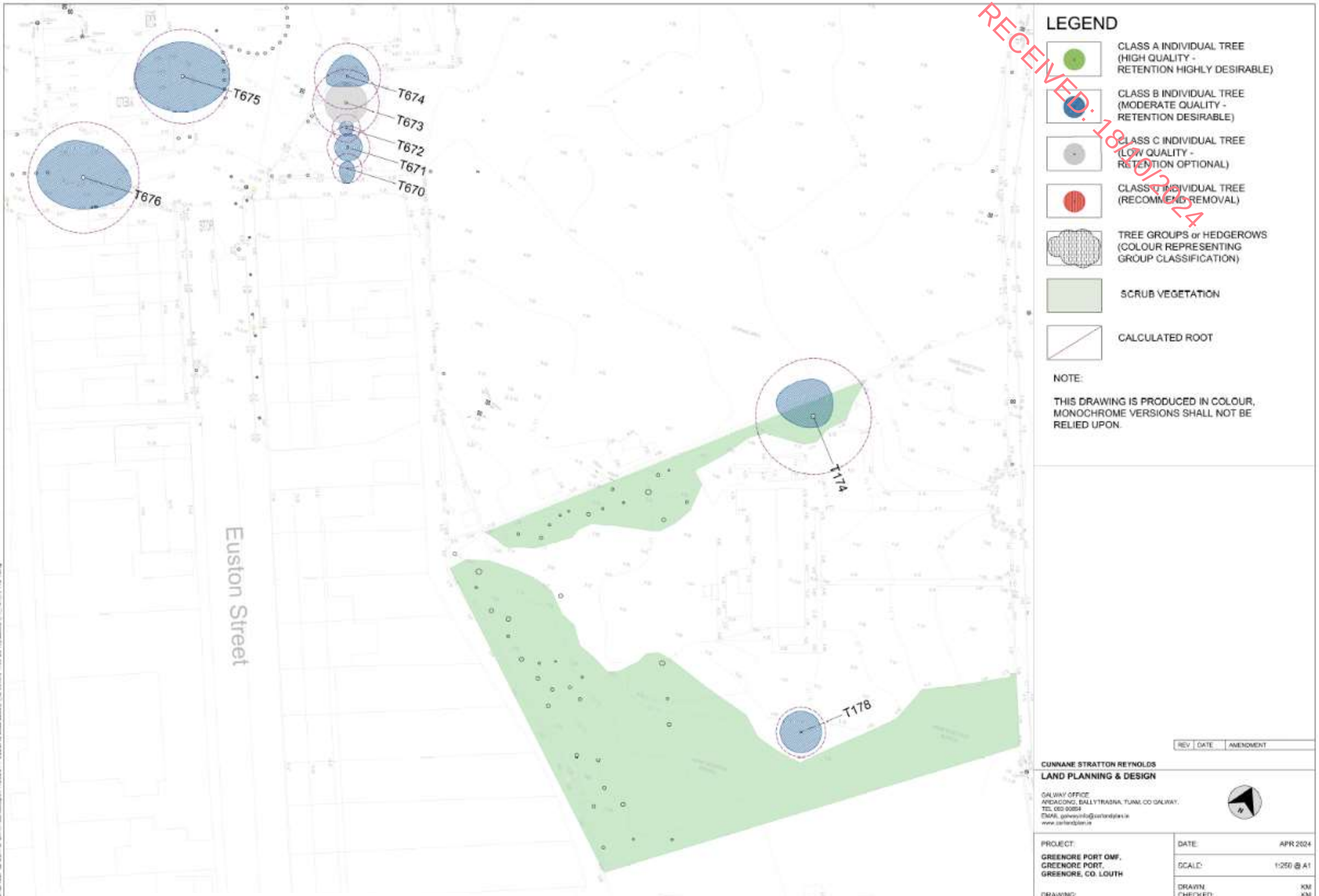

Figure 5. Tree classification and constraints plan

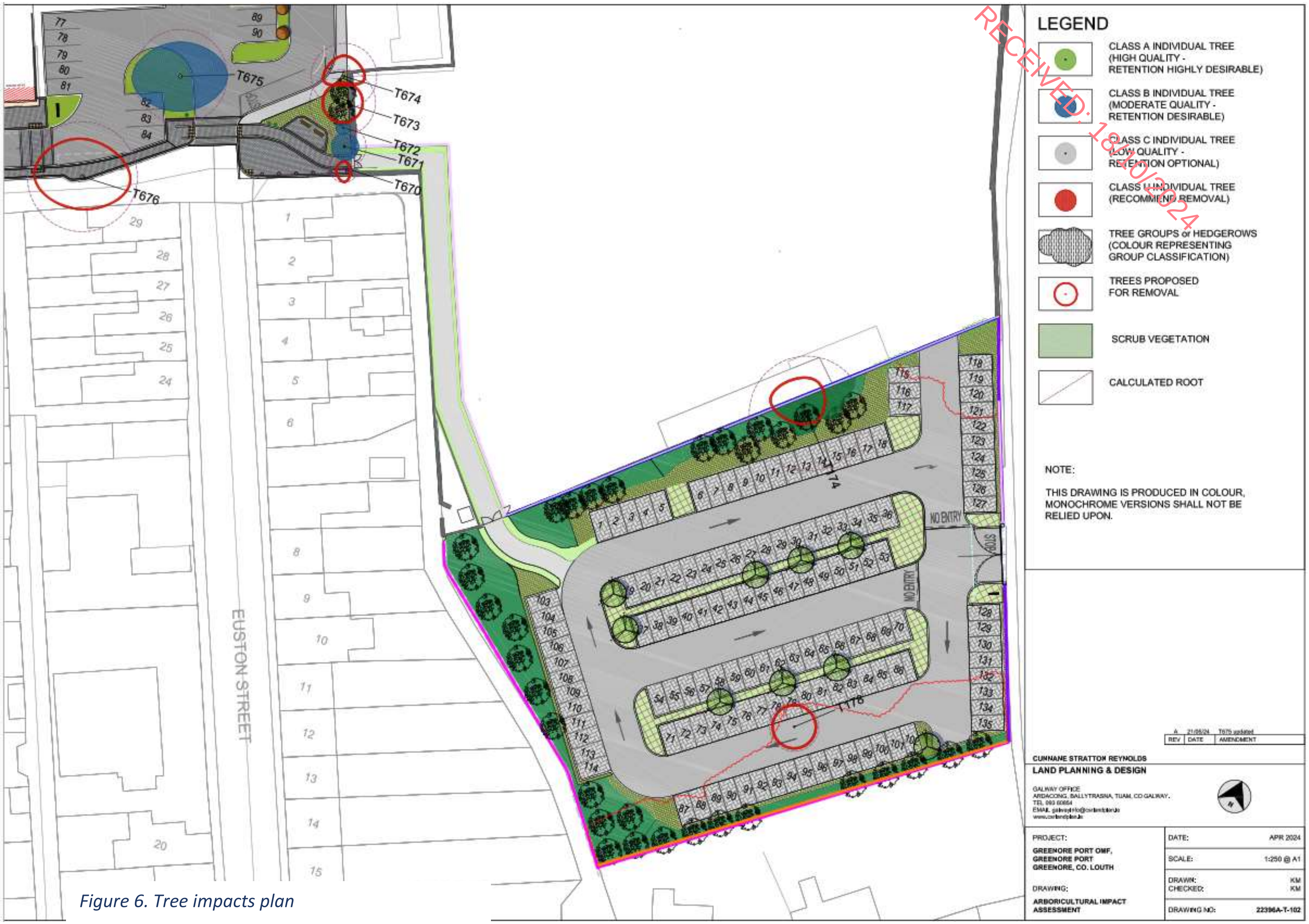

Figure 6. Tree impacts plan

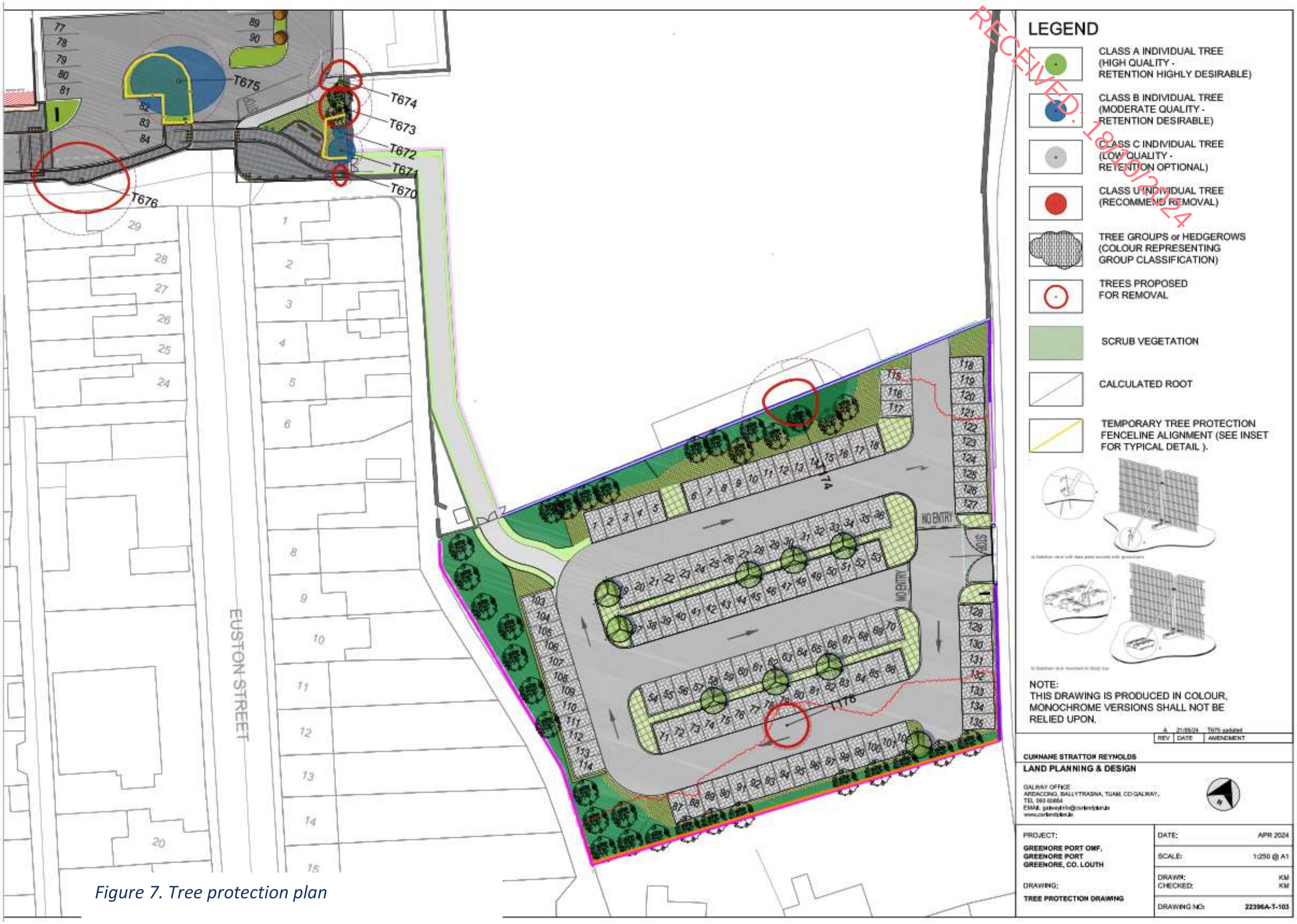

Figure 7. Tree protection plan

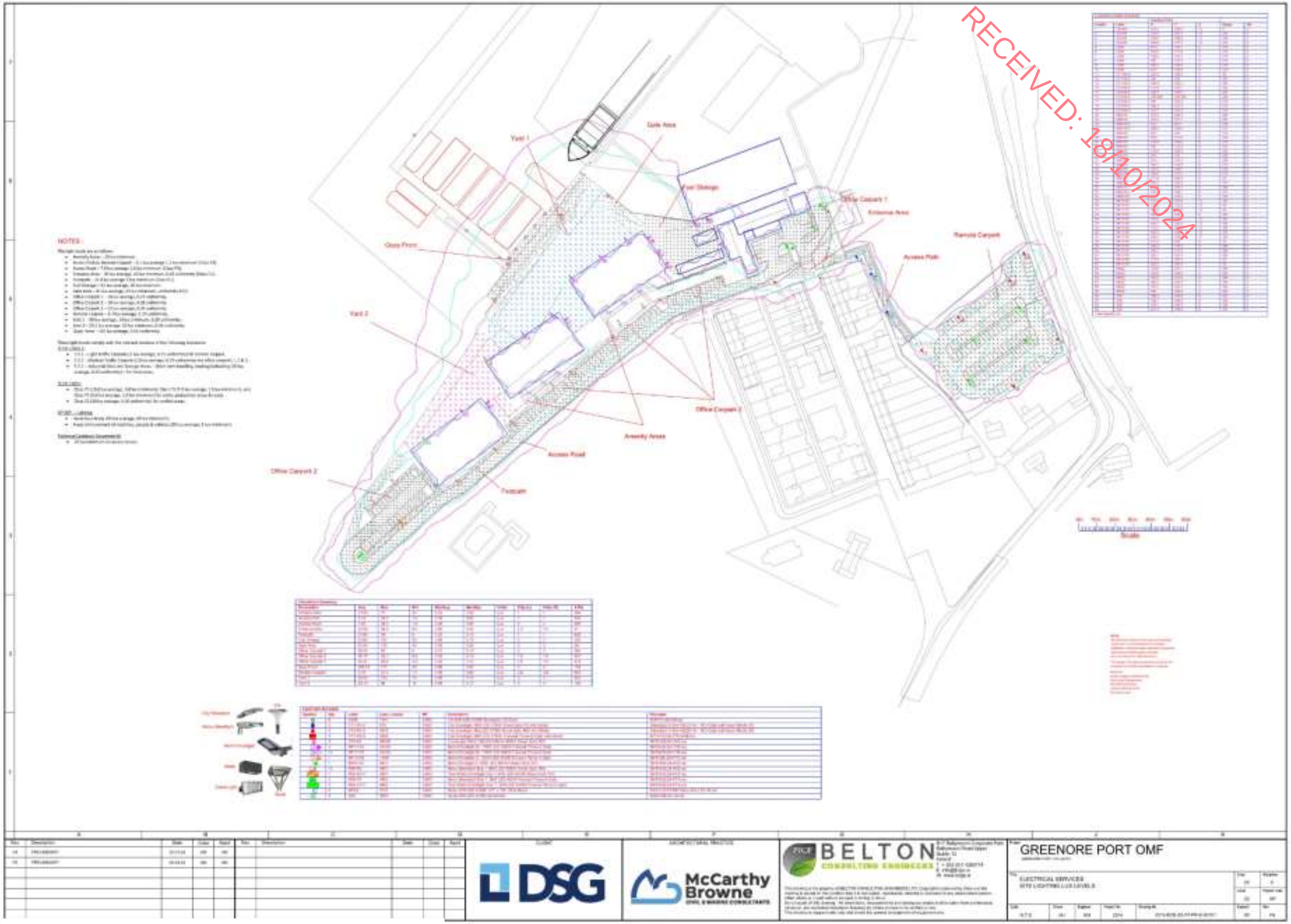

Figure 8. Site lighting lux levels

Bat Survey

This report presents the results of site visits by Bryan Deegan and Frank Spellman on the 3rd August 2023 and the 22nd of May 2024. Bat emergent and detector survey was carried out. Trees on site were examined for bat roosting potential.

Survey Methodology

As outlined in Marnell et al. 2022 '*The presence of a large maternity roost can normally be determined on a single visit at any time of year, provided that the entire structure is accessible and that any signs of bats have not been removed by others. However, most roosts are less obvious. A visit during the summer or autumn has the advantage that bats may be seen or heard. Buildings (which for this definition exclude cellars and other underground structures) are rarely used for hibernation alone, so droppings deposited by active bats provide the best clues. Roosts of species which habitually enter roof voids are probably the easiest to detect as the droppings will normally be readily visible. Roosts of crevice-dwelling species may require careful searching and, in some situations, the opening up of otherwise inaccessible areas. If this is not possible, best judgement might have to be used and a precautionary approach adopted. Roosts used by a small number of bats, as opposed to large maternity sites, can be particularly difficult to detect and may require extensive searching backed up by bat detector surveys (including static detectors) or emergence counts.'* In relation to the factors influencing survey results the guidelines outlines the following *'During the winter, bats will move around to find sites that present the optimum environmental conditions for their age, sex and bodyweight and some species will only be found in underground sites when the weather is particularly cold. During the summer, bats may be reluctant to leave their roost during heavy rain or when the temperature is unseasonably low, so exit counts should record the conditions under which they were made. Similarly, there may be times when females with young do not emerge at all or emerge only briefly and return while other bats are still emerging thus confusing the count. Within roosts, bats will move around according to the temperature and may or may not be visible on any particular visit. Bats also react to disturbance, so a survey the day after a disturbance event, may give a misleading picture of roost usage.'*

The survey involved the methodologies outlined in Collins (2016) which included the roost inspection methodologies i.e. external methodology outlined in section 5.2.4.1 and the internal survey outlines in section 5.2.4.2 of the guidelines. In addition, the methodologies for Presence absence surveys (Section 7) was carried out for dust emergent surveys.'

As outlined in Collins (2016) 'The bat active period is generally considered to be between April and October inclusive (although the season is likely to be shorter in northern latitudes). However, because bats wake up during mild conditions, bat activity can also be recorded during winter months.'

Survey Results

Trees as potential bat roosts.

A ground level roost assessment was carried out upon arrival to the site and used to examine the trees and structures on site for features that could form bat roosts. Potential roosting features include heavy ivy growth, broken limbs, areas of decay, vertical or horizontal cracks, cracks in bark, roof rafters, cracks in buildings, attic spaces, stone walls etc. All trees and buildings on site were assessed for bat roosting potential.

In 2023 two trees that were clad in ivy and formed a health and safety risk were felled in consultation with NPWS. No trees of bat roosting potential are noted within the survey area in 2024.

The residential house is of bat roosting potential due to gaps in the rear roof rafters. However, during the 2023 internal inspection and 2024 external inspection and emergent surveys no bats, evidence of bats or bat roost were identified.

A derogation license is therefore not required for the proposed development.

Emergent/detector surveys.

An emergent/detector survey was carried out during the 2023 & 2024 surveys.

The detector surveys were undertaken within the active bat season and the transects covered the entire site multiple times during the night. Weather conditions were good with mild temperatures greater than 10°C after sunset. There was no rainfall during the survey. Insects and swallows were observed in flight to the front and rear of the house during the survey until approximately 10 pm.

As outlined in Collins (2016) in relation to weather conditions '*The aim should be to carry out surveys in conditions that are close to optimal (sunset temperature $10^{o}C$ or above, no rain or strong wind.), particularly when only one survey is planned…. Where surveys are carried out when the temperature at sunset is below $10^{o}C$ should be justified by the ecologist and the effect on bat behaviour considered.*' There no constraints in relation to the surveys carried out. All areas of the site were accessible and weather conditions were optimal for bat assessments in the area surrounding the residential site. Winds were considered optimal in 2023 and borderline in 2024, for assessing foraging behaviour in the port area, however, temperature and precipitation metrics remained optimal.

At the dwelling two holes in the roof rafters on the rear corners of the house were surveyed from the rear of the house for emerging bats. These holes were assessed upon arrival to the site for markings indicating recent bat contact, of which none were observed. An acoustic survey was carried out on the grounds of the residential site using a*n Echo meter touch 2 Pro* detector to determine bat activity, including immediately adjacent to potential roost entrances on the residential building. Transect surveys were also carried out in the port area, including within two buildings (equipment and grain storage sheds – the former open hydro unit) within the proposed development site. Bats were identified by their ultrasonic calls coupled with behavioural and flight observations.

In 2023, two common pipistrelle bats were noted at the residential site and emerged from the heavily ivy clad trees on the southern portion of the treeline, to the left of the house. As outlined above, these trees have been felled prior to the 2024 survey in consultation with the NPWS.

In 2024, a single Soprano Pipistrelle (*Pipistrellus pygmaeus*) was noted foraging near equipment storage building adjacent to the north boundary of the proposed development site, within the port area. No bats were observed emerging from onsite trees or buildings within or proximate to the subject site. Activity was restricted to within this port area storage shed. No activity was recorded within the grain storage building (former open hydro) proposed for removal, the remaining port area, or residential site.

The port area is generally brightly lit throughout, apart from the building interiors as witnessed during this survey.

Figure 9. *Equipment storage building where individual Soprano Pipistrelle was observed foraging (yellow).*

Review of local bat records

The review of existing bat records (sourced from Bat Conservation Ireland's National Bat Records Database) within a $2km^2$ grid (Reference grid J21F) encompassing the study area reveals that none of the nine known Irish species have been observed locally. The National Biodiversity Data Centre's online viewer was consulted to determine whether there have been recorded bat sightings in the wider area. This is visually represented in Figures 9 & 10. The following species were noted in the wider area: Common Pipistrelle (*Pipistrellus pipistrellus*), Lesser noctule/Leisler's bat (*Nyctalus leisleri*) and Soprano pipistrelle (*Pipistrellus pygmaeus).*

*Figure 10. Common Pipistrelle (*Pipistrellus pipistrellus*) and Lesser noctule/Leisler's bat (*Nyctalus leisleri*) (Orange) (Source: NBDC) (Site: red circle).*

*Figure 11. Soprano pipistrelle (*Pipistrellus pygmaeus*) (purple) (Source: NBDC) (Site: red circle).*

Evaluation of Results

The bat surveys comply with bat survey guidance documentation including Marnell et al (2022) and Collins (2016).

No bats were noted emerging from the existing structures within the proposed development site.

Two common pipistrelle bats were observed in 2023 at the residential site and an individual Soprano Pipistrelle was recorded foraging within a storage building to the north of the proposed development site within the wider port area in 2024.

In 2023 & 2024 no bats were noted transiting through or foraging within the port area inside the proposed site outline.

The site is of relatively low importance to the local bat population.

The site is currently well-lit from the existing floodlights within the subject site, and from light spill of the adjacent residential area street lighting.

Potential Impact of the development on Bats

The storage building that sits outside the proposed development area is comprised of metal with limited structure available inside for roosting, and so is of low value for roosting.

No bats were noted roosting, emerging, foraging or transiting throughout the remainder of the site.

No trees of bat roosting potential are noted on site.

The proposed development is not in proximity to sensitive bat areas.

The potential for collision risk and impact on flight paths in relation to bats is considered low due to the low level of bat activity on site and the buildings would be deemed to be clearly visible to bats.

The site is currently well-lit from the existing floodlights within the subject site, and from light spill of the adjacent residential area street lighting.

There are no predicted significant negative impacts on bat species from the proposed development.

Mitigation Measures

As outlined in Marnell et al. (2022) "*Mitigation should be proportionate. The level of mitigation required depends on the size and type of impact, and the importance of the population affected*." In addition as outlined in Marnell et. al (2022) '*Mitigation for bats normally comprises the following elements:*

- *Avoidance of deliberate, killing, injury or disturbance – taking all reasonable steps to ensure works do not harm individuals by altering working methods or timing to avoid bats. The seasonal occupation of most roosts provides good opportunities for this*
- *Roost creation, restoration or enhancement – to provide appropriate replacements for roosts to be lost or damaged*
- *Long-term habitat management and maintenance – to ensure the population will persist*
- *Post-development population monitoring – to assess the success of the scheme and to inform management or remedial operations.*'

No bats were noted roosting on site. No trees of bat roosting potential are noted on site. As a result, no mitigation measures are required in relation to bats.

However, as good practice and applying the precautionary principle a pre demolition survey will be carried out.

Predicted Residual Impact of Proposed Development on Bats

No trees of bat roosting potential are noted on site (2024). No bats were observed utilising the buildings on site. The proposed development is not in proximity to sensitive bat areas. The potential for collision risk and impact on flight paths in relation to bats is considered low due to the low level of bat activity on site and the buildings would be deemed to be clearly visible to bats. The site is currently well-lit from the existing floodlights within the subject site, and from light spill of the adjacent residential area street lighting. There are no predicted significant negative impacts on bat species from the proposed development.

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APPENDIX 11.7

SEAL SURVEY
CARLINGFORD LOUGH
2023

VOLUME III

APPENDICES TO
ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

Seal Survey Carlingford Lough

Assessment of Abundance and Distribution of Harbour and Grey Seals in Carlingford Lough

Breffni Martin

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24th November 2023

Final Issue

CONTENTS

1.0 Introduction

1.1 Context

To support an application for a propsoed Operations and Management Facility at Greenore Port, a seal survey in Carlingford Lough was carried out. Any observations of cetaceans, notably resident dolphins, were also recorded.

1.2 Scope

The scope of this report is confined to Carlingford Lough and its known haul out sites in July (post-pupping) and August (moulting) 2023.

1.3 Description of Carlingford Lough

Carlingford Lough is a drowned glacier-cut valley formed at the end of the last ice age. The mouth of the Lough, the area under study, is relatively shallow (less than 3 metres) due to the deposit of moraine and the decreased erosive force of the glacier meeting the sea, a feature typical of a fjord, while the inner part of the Lough is relatively deep (up to 30 metres) (Baxter, 2009). A shipping channel has been dredged to 8 metres to facilitate access for shipping.

At high water (MHWS) two islands (skerries) remain exposed, Green Island, essentially a shingle bank on dipping limestone, running north to south near Greencastle, and Blockhouse Island, a limestone reef, running east to west near Haulbowline lighthouse. At low water (MLWS) several reefs of dipping limestone are exposed, along with several individual boulders and outcrops to the west of Blockhouse Island. A large basalt intrusion (The Black Rock) and several smaller ones (eg Earl's rock) are exposed to the north of Greenore Point. Several reefs are also exposed at Mill Bay and further north (eg Carriganean). Extensive sandflats are exposed in this area, consisting of creeks and pans and a deeper channel from which the White Water and Causeway Water delta over the sand and mudflats. Further to the north-west a sandbank, the Killowen Bank, extends out into the Lough bounding a shallow inlet to rock outcrop at Carrigaroan.

On both north and south shores extensive aquaculture is practiced, primarily oyster cultivation using trestles and bags between the high and low water marks – see Appendix 1. The area is also marked by considerable recreational activity, particularly in the summer, involving swimming, kayaking, sailing, boating, jet skiing, and related activities. Cargo ships regularly pass through the channel to Warrenpoint port and Greenore port, typically with several passes per day in all seasons.

Because the large body of water narrows between Greenore Point and Greencastle, ebb and flow tidal velocities can be significant, reaching 5 knots per hour. The Lough is fed by several rivers; these in turn attract migratory fish such as trout and salmon. Significant numbers of mackerel are regularly caught off Greenore point during the summer.

The benthos consists of a mosaic of habitats including deep holes, tidal rapids supporting biogenic *Modiolus modiolus*, coarse gravel with cobbles and boulders, mud and sand flats, rocky outcrops and other rocky substrates supporting extensive growths of *Lamanaria* and *Fucus* species as well as green algae.

According to the JNCC Marine Habitat Classification system, the intertidal rock habitats are dominated by the habitat type "*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid-eulittoral rock" merging into "*Fucus serratus* on moderately exposed lower eulittoral rock".

These habitats support a rich ecosystem including red and brown algae, soft corals, hydroids, bryozoans, large sponges, anemones, mussels, brittle stars, crustaceans, and other invertebrates. Fish include pollack, spurdog, flounder, rockling, dogfish, conger, wrass, mackeral, and ray.

The Lough is relatively protected by the mountains to the north and south and is probably in the rain shadow of Slieve Foye, though on occasion squalls can blow up, particularly in easterly airflows. Surface temperatures typically range from about 6 ^{o}C to about 17 ^{o}C between summer and winter. Water quality is generally good despite the discharge of untreated sewage into the Lough at various locations. According to the AFBI SMILE project "Organic-rich anoxic sediments with a high sulphide content can be found in the waters near the tidal limit, but water quality within the main Lough is good and it is not thought to be eutrophic. Nitrogen inputs associated with fresh water (concentrations of N decline seawards down the Lough) can feed or limit the algal growth within the Lough. Nutrient enrichment and algal bloom development within the Lough are low compared with some other coastal sites, and it has been suggested that plankton blooms are associated with localised enrichments, and a net export to the Irish Sea occurs with the ebbing tides."

The Lough is designated as a Special Protection Area by both the UK and Irish governments and is a Ramsar site. Terns (mainly common terns, historically roseates) breed on Green Island with variable success. Protected habitats on the county Louth shoreline are included in a Special Area of Conservation and include the sand and mudflats, Atlantic Salt Meadow, Salicornia and Zostera beds, and vegetation of stony banks and drift lines.

Given the above facts the outer part of the Lough should be a suitable ecosystem for grey and particularly harbour seals.

1.4 Harbour Seals

Harbour seal (*Phoca vitulina concolor*) adults measure 140-185cm and weigh 8-16kg at birth and up to 130kg as adults. Harbour seals divide their time between foraging at sea and hauling out on to rocky shores or inter-tidal sandbanks to rest, or to give birth and to suckle their pups. They feed on various fish, including herring, sand eels, whiting, flatfish, shrimps/crabs and squid. Adults are thought to be faithful to favoured haul-out areas from year to year while young animals wander extensively; adults may travel up to 50km to feed and remain at sea for several days. Haul out/nesting sites vary with season, weather, feeding opportunities, disturbance, and other factors. Hunting is poorly understood. Females give birth to a single pup typically in June; pups can swim and dive when just a few hours old (MacDonald, 1993).

The ICUN has classified the Western Atlantic Harbour Seal as "least threatened" though its population trend is "unknown".

1.5 Grey Seals

Grey seals (*Halichoerus grypus grypus*) show marked sexual dimorphism with males up to 210cm in length and females up to 180cm weighing 235kg and 155kg respectively.

Grey seals are found in a few locations in the Irish Sea mainly hauling out on exposed rocky coasts and sometimes on sand banks; they feed on sand eels and cod but are opportunistic "probably take whatever fish are most abundant". They will often take offal discarded from fishing boats and harbours (author's observation). About two-thirds of greys seals' time is spent at sea hunting and feeding (Lyons, 2004).

At low tide they haul out sometimes separately, sometimes in groups, especially when moulting in spring. In autumn they breed, typically starting in late September and finishing in November. Grey seal pups are typically born in large colonies or rookeries of tens to many thousands of cows and weigh about 14kg at birth and have soft white fur and remain on land where they suckle from their mother for about 21 days (Anderson, 1990).

The Western European population of grey seals has been increasing in recent years and has been classified by the ICUN as "least threatened".

1.6 Diet in Carlingford Lough

A study (Wilson, 2012) undertaken by Tara Seal Research in August/September 2009/10 examining seal scat during the harbour seal moulting season found "*The diet was found to consist principally of small gadoid fish, such as cod, haddock and whiting, and also flatfish such as flounder and plaice, and dragonet. All these types of fish have relatively low energy density. The remains of relatively high energy fish, such as herring, sand eel, mackerel and garfish, were occasionally found.*"

1.7 Previous Surveys

A preliminary survey (Wilson, 2012) was undertaken by Tara Seal Research over the years 2008 to 2011 assessing abundance of harbour and grey seals, and harbour seal productivity. This was the basis of the methodology, both operational and statistical, that was requested by DAERA, the competent authority. Prior to the 2008-11 survey, surveys were undertaken by both NPWS (south of a notional border separating the north and south of the Lough) and NIEA (north of that border). Follow up surreys on foot of a Car Ferry development were made in 2015 and 2017 (Martin, 2015 - 17). A thermal imaging survey was also carried out in 2018 (Morris, 2018).

2.0 Methodology

2.1 Reconnaissance of haul outs prior to survey

Counts were made from the count points listed below where possible; in two cases, Carrigroan and Mill Bay it was impossible to reach the actual count points on low tides because they were exposed (Mill Bay) or the water was too shallow (Carrigarean) – however despite this it was possible to make good counts at these locations on all occasions. To obtain accurate counts it was often necessary to move several tens or hundred meters either side of the actual count point to observe animals obscured by rocks, sand banks, oyster trestles or other seals. Several sites were checked from the shore either immediately before or after counts (eg Carrickbrada, "Seal Rock" and Carrigaroan).

As each haul-out was approached several wide-angle shots were taken to capture all animals; subsequently, on approach, detailed shots were taken of each animal or group of animals moving in a right to left arc with a GPS enabled camera using a 100-400mm lens. On some occasions a segment of video was taken to back up photography and a dictaphone was used to supplement photography with a verbal description. A second observer was used during the most challenging counts (August/September). Distances were verified using a laser range finder. At the end of each count results were compiled and verified.

During surveys, effort was made to ensure that the survey boat approached haul out sites obliquely, at slow speed (<5 knots) while observing the response of seals to the approach. High visibility clothing was avoided, as well as any unnecessary movement on the boat. All surveys started out at Greenore mainly following an anticlockwise route; this significantly improved photography as the sun was to the east and south during most surveys, behind the survey boat.

2.2 Equipment

- Canon EOS 6D GPS-enabled
- 100 – 400mm IS EF Canon lens
- Monarch 10 x 42 binoculars
- Leica 20 – 60x Televid terrestrial telescope (from land)
- Viking 6x25 7 deg Laser Range Finder
- Roland R2 dictaphone/throat mic
- Canon Legria 41x optical HD video camera
- eTrex Vista GPS unit
- 6.1m Tornado RIB equipped with Yamaha 115 hp outboard and a Garman GPS 451s

2.3 Detailed description of count points and haul outs

Please refer to map included in Appendix 2.

2.3.1 Ballyedmond

This haul out consists of a sandy creek leading to a rocky outcrop (Carrigaroan), but enclosed by the Killowen sand bank, making seal access and flight difficult. Aquaculture activities now span most of the area to the north and east. The focus of seal activities is at Dickies Rock, apparently a nursery area.

2.3.2 Seal Rock

Identified as “Black Rock” on the Admiralty maps, this is a basaltic intrusion separated from the main mudflats and reefs by a deep channel. The name Seal Rock referred to in the 2008-11 report is otherwise unknown (i.e. not marked on any map or known as such locally).

2.3.3 Carriganean

The haul out is about 200 metres south of Carriganean rocky outcrop and sand bank along a relatively shallow sandy creek. Again, there is considerable aquaculture activity in the vicinity.

2.3.4 Mill Bay

This refers to the many rocky outcrops immediately west of the Greencastle pier. The White Water channel runs alongside these rocks. On some tides, there is a section of exposed sand along the river channel.

2.3.5 Green Island

Two count points Vs and Vn refer to Green Island and its associated rocky outcrops of dipping limestone. The north part features many nooks and crannies, while the south is more open. The permanently exposed part of the island is essentially a shingle bank. The results from the north and south count points are summed for simplicity.

2.3.6 Blockhouse Island

This is a very exposed rocky island with the remnants of several man-made structures “blocks” on view.

2.3.7 Blockhouse Reefs

This refers to dipping limestone and single rocks/boulders immediately to the south and east of Blockhouse Island and including Goose Rock, Haulbowline Rocks and Long Rock. There are no reefs.

2.3.8 Greenore

This refers to Cooley Long Rock and Carrickbrada dipping limestone and a few single rocks in the immediate vicinity. Carrickbrade was not counted in the 2008-11 surveys. This area is several kilometres from Greenore.

2.4 Count Methodology – Targets vs Actual

The count methodology followed the count points and transects set forth in the 2008-11 survey (Wilson, 2012). Given the relatively narrow windows for each set of counts, finding days when tide and weather were suitable during daylight hours was challenging. Calm sea with a sea state of 0 or 1 produced the best conditions for photography from a moving boat and it was possible to achieve this on most outings especially for the first two sets of counts.

Criterion	Target	Actual
Weather	Relatively calm (slight sea state) and dry conditions	Sea state < or = 2 on all counts
Tide	Count to straddle low tide	Counts straddled low tide by at least 30 minutes either side.
Approach distance	Minimum 150 metres	Yes – typically 200+ metres
Count periods	Harbour seal pupping	17-June-23
	Harbour seal moulting	27-Aug-23
	Grey seal abundance	17-June-23; 27-Aug-23

2.5 Statistical methodology

Since only two counts were undertaken, raw results were compared to estimated count data using the bounded count methodology from pervious counts and literature.

3.0 Results

3.1 Abundance

All planned counts were successfully completed in good conditions and tides, and without incident. Tables summarising the results are provided in Appendix 3.

3.1.1 Harbour Seals Post-pupping and Grey Seals

A total of 110 adults and nine pups were recorded while twenty-four grey seals were recorded.

3.1.2 Harbour Seals Moulting and Grey Seals

A total of 206 common seal adults with seven pups was recorded while a total of 40 grey seals were noted.

3.2 Distribution

The overall distribution pattern saw harbour seals occupying the inner less exposed parts of the Lough around Mill Bay, Green Island North and "Seal Rock" while grey seals occupied the more exposed outer parts around Blockhouse Island and reefs.

3.3 Disturbance

There was a constant low level of disturbance stemming from aquaculture activities and shipping, with container and bulk vessels traversing the survey area several times per day serving Warrenpoint and Greenore ports. No other disturbance was noted on either count.

4.0 Discussion

4.1 Abundance

4.1.1 Harbour Seals

The bounded count statistical method used to estimate abundance was developed for the harbour seals pacific sub-species in the Straits of Georgia, British Columbia in a mosaic of habitats including tidal islets, reefs, boulders, and sandbars. Though there are slight differences between the lifecycle, and diet of each sub-species, and significant differences in climate and tidal dynamics, the method has been widely used in a number of contexts and may be sufficiently robust estimate for comparative purposes.

Table 1 Harbour Seal estimates 2008 - 2017

	Harbour seals	
Date	adult	pup
July 2008	178	54
Aug/Sept 2008	350	nc
July 2011	187	43
Aug/Sept 2011	376	nc
July 2015	222	29
Aug/Sept 2015	359	nc
July 2017	344	23
Aug/Sept 2017	297	nc
June 2023	110	9
August 2023	206	7

The data shows an apparent decrease in common seal abundance however account should be taken of the fact that the previous counts were based on multiple repeat counts. On any given count an unknown number of seals were in the water and were not assessed. Taking multiple counts and applying the bounded count methodology can be used to estimate this unknown. Raw data from 2017 post-pupping produced a range of 164 to 280, while moulting produced a range of 91 to 289. Furthermore the Aerial thermal-imaging surveys of harbour and grey seals conducted by the DAERA (DAERA, 2018) estimated common seals at 255 in 2018.

4.1.2 Grey seals

Grey seals are thought to range more widely than harbour seals and to spend more time in the water hunting and feeding, though specific animals are known to be highly individualistic in their behaviour. During the survey it was noted that some distinctive animals (notably males) regularly used the same haul out over a succession of counts. The statistical method used in relation to harbour seals is not applicable so it is challenging to get an estimate of absolute abundance in Carlingford Lough, however given the relatively small numbers, a visual comparison with data gathered in the previous survey should be sufficient for the purposes of this assessment.

Table 2 Grey seal counts

Year	July					Aug/Sept				
2008	Nc*	nc	nc	nc	nc	21	34	38	18	15
2009	12	10	16	20	30	nc	nc	nc	nc	nc
2011	8	8	47	39	nc	40	44	32	28	15
2015	23	17	52	40	60	64	48	35	73	57
2017	53	53	17	88	64	74	58	56	39	65
2023	24	nc	nc	nc	nc	40	nc	nc	nc	nc

*nc = no count

The data shows no discernible annual pattern except that grey seal numbers are consistent with those observed on previous counts.

4.1.3 Distribution

Harbour seals primarily occupied the inner part of the Lough, "Seal Rock", Carrigenean, Mill Bay and Green island. During August/September they had a pronounced preference for the north part of Green Island. An exception to this was that on occasions harbour seals would gather at Carrickbrada in the Greenore count area.

Grey seals primarily occupied the outer more exposed parts of the outer Lough at Blockhouse Island and reefs and the Cooley Long Rock.

4.1.4 Disturbance

Apart from the disturbance caused by the survey boat (see methodology) the main source of disturbance was people gathering periwinkles or other shellfish. Typically, seals would enter the water in the vicinity of the collector and haul out elsewhere. This was not directly observed during the survey but was observed from the shore during the reconnaissance visits.

Figure 1 P indicates mother with pup crossing; A indicates adult crossing points

Other disturbances may arise from passing shipping, fishing boats and recreational craft, up to the point of possible collision when animals are crossing the lough. This effect is accentuated during and after pupping when pups are at risk of separation from their mother. This is particularly risky during mid-June to mid-July. At other times of the year adults may cross the paths of shipping routes but are considerably less prone to collision, in particular because shipping entering the lough and leisure craft tend to be low speed (5 knots or less). Various bylaws regulate the speed of leisure craft.

5.0 Conclusions

The July post-pupping population of harbour seals in Carlingford Lough is consistent with previous boat-based surveys and literature. Grey seal numbers are also consistent with previous surveys. Pups are at risk of separation from mother when crossing from Black Rock to Green Island while adults may be at some risk crossing from Ballytrasna to Green island and Green island to Blockhouse island.

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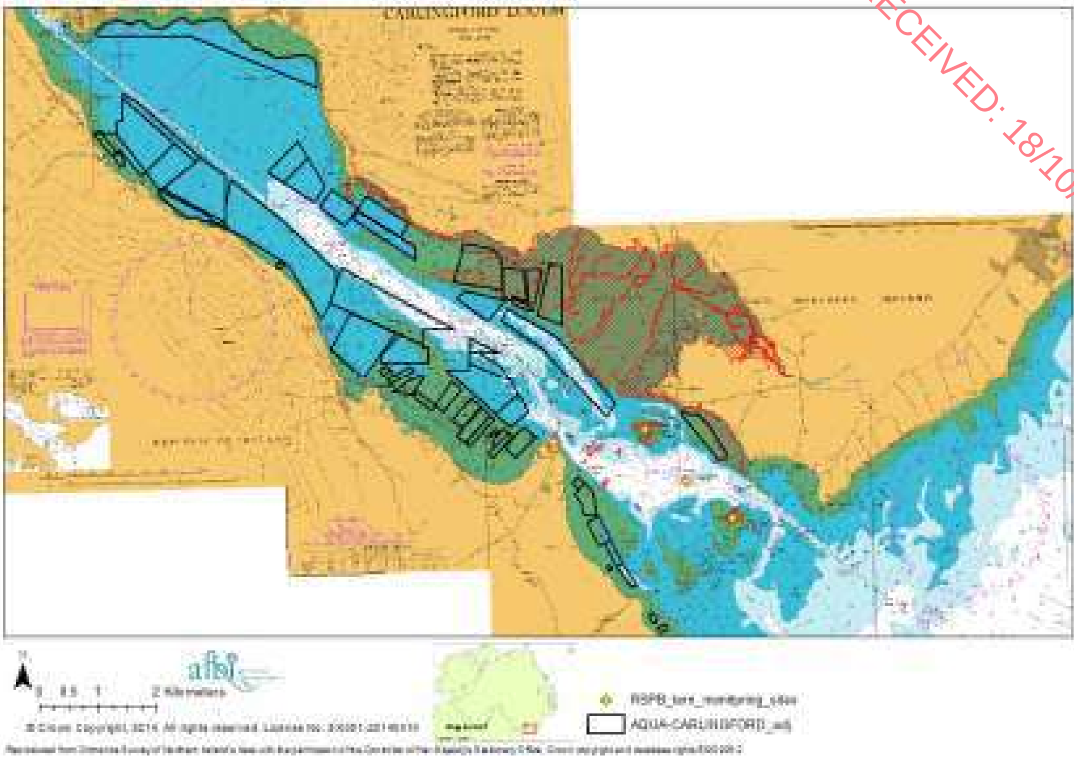
Appendix 1: Aquaculture concessions Carlingford Lough



Appendix 2: Seal haul outs Carlingford Lough

Appendix 3: Abundance and Distribution Summary Data

June 2023		Common seals		Grey seals
		adults	pups	all ages
Greenore	Carrickbrada	15	1	
	Cooley Long Rock			8
Blockhouse reefs	Blockhouse rocks			11
Blockhouse island	Blockhouse island south	1		5
	Blockhouse island north	43	2	
Green island	Green island south			
	Green island north			
Mill bay	Mill Bay rocks			
Carrigarean	Mill bay channels			
Carrigaroan	Carrigarean creek	26		
Ballyedmond	Carrigaroan (from shore)	8	4	
Seal Rock	Black Rock	14	2	
	total	107	9	24
	water	3		
	total + water	110	9	24

August 2023		Common seals		Grey seals
		adults	pups	all ages
Greenore	Carrickbrada	4		
	Cooley Long Rock			3
Blockhouse reefs	Blockhouse rocks			13
Blockhouse island	Blockhouse island south	6		9
	Blockhouse island north	59	2	
Green island	Green island south			
	Green island north	74	3	9
Mill bay	Mill Bay rocks			
Carrigarean	Mill bay channels			
Carrigaroan	Carrigarean creek	37		
Ballyedmond	Carrigaroan (from shore)	8	2	
Seal Rock	Black Rock	14		
	total	202	7	34
	water	4		6
	total + water	206	7	40

APPENDIX 11.8
VISUAL SURVEYS FOR MARINE MAMMALS AT THE PROPOSED WINDFARM SITE AT ORIEL

VOLUME III
APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

Visual Surveys for Marine Mammals at the Proposed Windfarm Site at Oriel

Site surveys off the Proposed Oriel Windfarm © Simon Berrow/IWDG

IWDG Consulting

Final Report to Oriel Windfarm Limited

Visual Surveys for Marine Mammals at the Proposed Windfarm Site at Oriel

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Citation: Berrow, Simon and O'Brien, Joanne (2020) Visual Surveys for Marine Mammals at the Proposed Windfarm Site at Oriel. Final Report to Oriel Windfarm Limited. Irish Whale and Dolphin Group. 23 pp.

Executive Summary

In order to describe the marine mammal community off Oriel, Co Louth within the site of a proposed offshore windfarm boat-based visual surveys were carried out. Dedicated single platform line-transect surveys were carried out each month, when sea conditions were suitable, according to a standardised design.

A total of 1081km of track-line was surveyed during 12 days between June 2019 and May 2020. Over one-half (62.2%) was surveyed in sea-state ≤2 and 87.1% in sea-state ≤3. No visual surveys were carried out in September and November 2019 and between February and April, due to no suitable weather windows being available and latterly restrictions associated with Covid-19. Five of the seven surveys (71%) were full surveys carried out over two days but on two occasions (2 October and 19 May 2020) only one day was available resulting in 6 and 8 of the 11 track-lines being surveyed. On one occasion (17-18 July 2019) conditions were poor for the whole survey and data are to be treated with caution. On the 1 December conditions were poor but improved on the second day (2 December) and the number of track-lines surveyed each day were modified to maximise survey effort in favourable sea-states. The distribution and relative abundance of all marine mammals encountered, as well as other ETP (Endangered, Threatened or Protected) species of interest (basking sharks) were recorded. Distance sampling was used to produce a detection function based on the observed distribution of harbour porpoise and minke whale sightings, when the number of sightings per survey was >10. This enables estimates of absolute abundance to be made. Overall density estimates were also generated for harbour porpoise using all the data from all surveys combined and stratified by sea-state.

A total of 140 on-effort sightings were recorded of at least five marine mammal species (Table 3). This included one sighting of a single basking shark. One cetacean sighting and one seal sighting could not be identified to species level. Most sightings (67.6% of those sightings identified to species level) were of harbour porpoise which were recorded during every survey. Most sightings were of individuals but larger group sizes were recorded in January and May 2020. Calves were recorded on two occasions, one in a group of 2 in January 2020 and one in a group of three in May 2020. Juveniles were recorded more frequently on six occasions, all in January. The next most frequently recorded species was grey seal (16.2%) recorded on five of the seven surveys and minke whale (13.2%), recorded on three of the seven surveys. Common seals were recorded on three surveys and accounted for only 2.2% of all sightings. Individual minke whales were recorded on 18 occasions, with 14 of these on survey 3 on 1-2 August 2019. They were also recorded on the July and October surveys. They occurred throughout the survey area with a tendency to be a little offshore. Marine mammals were distributed throughout the survey area, with a small tendency for more sightings towards the north and middle of the survey area, with fewer sightings to the south.

Density estimates were calculated for harbour porpoise from five surveys (surveys 1, 3, 5, 6 and 7) to run the DISTANCE model and for all survey days combined. Harbour porpoise density ranged from 0.18 porpoise per km^2 to 0.64 per km^2, and was 0.22 overall (Table 7). The estimate from survey 6 (0.65 porpoise per km^2) resulting in an abundance of 205±35 reflects the peak in abundance during January, which may be associated with a historical herring spawning ground (Mourne Spawning Ground) within the site (Dickey-Collas et al. 2001). The overall estimate from the pooled data is considered the most robust as it accounts for seasonal variation and provides a good average abundance estimate. The density of 0.22 porpoises per km^2 resulted in an overall abundance of 71±21 (CV=0.30) with 95% Confidence Interval of 36-140. Density and abundance estimates were also calculated with increasing sea-state. Density estimates ranged from 0.69 porpoises per km^2 (sea-state 0) to 0.27 porpoises per km^2 (sea-state ≤4). The most robust estimates are for sea-state ≤1, and sea-state ≤2, as the sample sizes were high (52-85 individuals). This resulted in an abundance estimate of 118±26 to 140±34 harbour porpoise in the survey area. A density estimate was calculated for minke whales from data obtained during survey 3 on 1-2 August 2019 as there were 14 sightings of individual minke whales. This resulted in a density of 0.01±0.02 minke whales per km^2, which gives an abundance estimate of 3±0.6 (95% CI 2-5 individuals) with a CV of 0.20.

Although the Irish Sea is recognised as an important area for harbour porpoise there is limited historical survey data for the area. Most relevant data was collected to the south off north County Dublin. Density estimates here

were much higher than within the survey area suggesting that although the site provides important habitats for harbour porpoise as they were recorded throughout the survey period, the site is not as important as protected sites to the south. The presence of harbour porpoise and seals throughout the year and minke whales in the summer and autumn, provides important site-specific data in which to inform industry on the distribution and abundance of marine mammals in the site of the proposed offshore windfarm.

1.0 Introduction

The Irish Whale and Dolphin Group (IWDG) were contracted by Aquafact to undertake baseline marine mammal surveys of the proposed windfarm site off Oriel, Co Louth. The site was defined by Oriel Windfarm Limited and covered an area east of Dundalk bordered by Clogherhead to the south, Carlingford Lough to the north out east to the 50m contour. Marine mammal surveys were to be carried out in association with seabird surveys being undertaken by the Galway-Mayo Institute of Technology (GMIT) and survey design and fieldwork was agreed collectively to provide the best possible outputs.

The aims of the marine mammal surveys were to:

i) Provide a species list of marine mammal species that occur in the survey area;
ii) Provide data on the seasonal occurrence of these species within the site; and
iii) Provide density and abundance data of species within the site.

The IWDG were contracted to carry out monthly boat-based surveys from June 2019 to May 2020. Surveys were to be carried out over two contiguous days each month in sea-state ≤3, but ideally sea-state ≤2. This report provides the final deliverable by the IWDG on the boat-based surveys for marine mammals in the proposed windfarm site at Oriel.

2.0 Methodology

Dedicated marine mammal surveys were carried out to describe the marine mammal community, its distribution and abundance and derive density estimates. The survey site and line-transect survey design is shown in Figure 1. The area surveyed was 320 km^2. Marine mammal surveys were concurrent with seabird surveys.

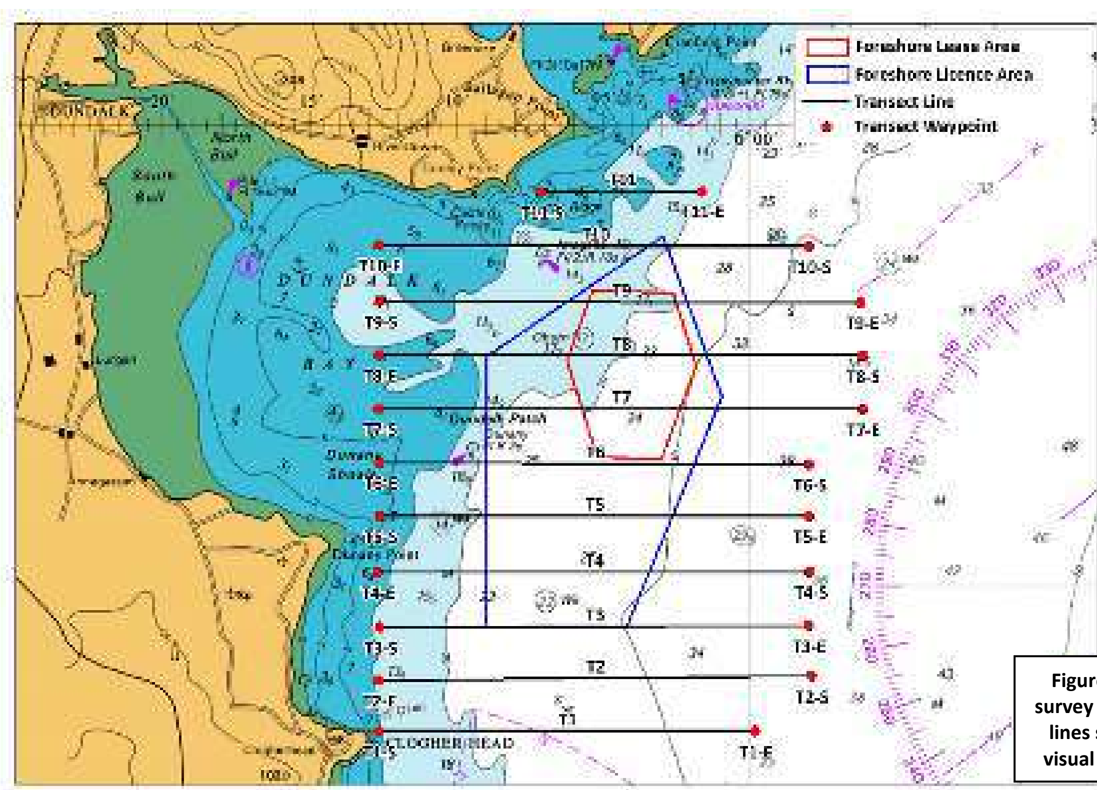


Figure 1. Location of survey area and transect lines surveyed during visual surveys off Oriel

2.1 Survey platform

The vessel used for each survey was the *MV Fastnet Petrel*, provided by Fastnet Shipping Ltd. *MV Fastnet Petrel* is an 18M DNV Classed Windfarm Service and Survey Support Vessel (Figure 2). The vessel proved to be excellent, providing fast passage to the start of each track-line, stability and an observation platform height of 4m above the waterline.

Figure 2. *MV Fastnet Petrel* used for line-transect surveys off Oriel

2.2 Survey methodology

Conventional single platform line-transect surveys were carried out within the boundaries of the site along the pre-determined track-lines (Figure 1). Transect lines were designed to try and obtain full coverage of the licensed area. Track-lines were evenly spaced 2.0km apart and provided by Aquafact and Oriel Windfarm Limited. The same track-lines were maintained through surveys in 2006-08 and 2018 onwards for consistency. These were provided to the IWDG, GMIT Seabird Team and were chosen to provide equal coverage of the area. Lines were surveyed from north to south and south to north depending on prevailing weather conditions. Two days were required to survey all 11 track-lines. Surveys were to be carried out in Beaufort force/sea-state 2 or less. Low swell (<1m) and in good light conditions with visibility of 6 km or more.

The survey vessel travelled at a speed of 15-16 km hr^{-1} (10-12 knots), which was 2-3 times the average speed of the most abundant species likely to be recorded in the survey area (harbour porpoise and dolphins) as recommended by Dawson *et al.* (2008). One primary observer was positioned on each bridge wing, which provided a platform height above sea-level of around 4m. The starboard bridge wing was shared with the seabird team. Primary observers watched with the naked eye from dead ahead to 90° to port or starboard depending on which side of the vessel they were stationed. All sightings were recorded. Calves/juveniles were defined as individual's ≤ half the length of the accompanying animal (adult) and in very close proximity to it. Small animals seen alone were also classified as juveniles. Sightings off-effort while transiting between track-lines or to the study site were also recorded but not included in the analysis of abundance and density.

During each transect the position of the survey vessel was tracked continuously through a GPS receiver connected to a laptop computer, while survey effort data including environmental conditions (sea-state, wind strength and direction, glare, etc.) were recorded every 15 minutes using LOGGER software (© IFAW). One person operated LOGGER and communicated with the primary observers via VHF radios. During good weather conditions, LOGGER was positioned behind the wheel house at the same height as the primary observers and during poorer weather in the cabin, situated immediately below the wheel house. When a sighting was made the position of the vessel was recorded immediately and the angle of the sighting from the track of the vessel and the estimated radial distance of the sighted animal(s) from the vessel were recorded. The angle was recorded to the nearest degree using an angle board attached to the vessel immediately in front of each observer. Accurate distance estimation is important for distance sampling. Personal measuring sticks (Heinemann 1981) were used by each primary observer to assist in distance estimation.

2.3 Density and abundance estimation

Distance sampling was used to derive a density estimate and to calculate a corresponding abundance estimate for the whole area. The software programme DISTANCE (Version 6, University of St Andrews, Scotland) was used for calculating the detection function, which is the probability of detecting an object on the vessel's track-line. The detection function is used to calculate the density of animals on the track-line of the vessel. In this survey we assumed that all animals on the track-line were observed, i.e., that g(0) = 1, given the strict operational and environmental conditions under which surveys took place. The DISTANCE software allows the user to select a number of models in order to identify the most appropriate one for the data. It also allows truncation of sighting outliers when estimating variance in group size and testing for evasive movement prior to detection.

To calculate density we used "survey" as the sample regime with sightings as the sampling observation. Estimates of density and thus abundance were calculated if there were ten or more sightings of a species recorded during each survey. Buckland *et al.* (2001) recommended the minimum number of observations required for robust estimates to be around 40-60 records. We pooled all data from all surveys to derive an overall density estimate, which was necessary in order to meet this criteria to use the DISTANCE software model. We also used "sea-state" as the sample regime with sightings as the sampling observations for all surveys combined to stratify the effect of sea-state on sightings. When pooling data we had to assume that each survey was representative of the natural occurrence of marine mammals within the study area and there were no significant changes in distribution within the site between surveys nor any significant immigration into, or emigration out of, the site. Clearly, although this is not the case over the 10month study period, pooled estimates provide an overall abundance estimate in the site which can be used for risk assessments.

We fitted the data to a number of models available in the DISTANCE software. We found that a Half-Normal model with cosine adjustments best fitted the data according to the Akaike Information Criterion delivered by the model. The recorded data were grouped into equal distance intervals of the size and number depending on the species of interest and prevailing sea conditions. Porpoise data were truncated at between 300-500m depending on the survey and minke whale data at 700m. The DISTANCE model determines the influence of cluster size on variability by using a size-bias regression method with the log(n) of cluster size plotted against the corresponding estimated detection function g(x).

A Chi-squared test associated with the estimation of each detection function was calculated by the DISTANCE model. If found to be statistically significant it indicated that the detection function was a good fit and that the corresponding estimates were robust. The proportions of the variability accounted for by the encounter rates, detection probability and group size (cluster size) are presented with each detection function. Variability associated with the encounter rate reflects the number of sightings on each track-line. The detection probability reflects how far the sightings were from the track-line and cluster size reflects the range of estimated group sizes recorded on each survey.

2.4 Mapping cetacean survey and encounter data

Maps of the study area and associated survey data were created in Irish Grid (TM65_Irish Grid) with ArcMap 10.2 while maps of the prescribed survey area were obtained from Aquafact. Data concerning transects, effort, sightings, abundance and density were stored in a single MS Access database, which was queried and processed via GIS to produce distribution maps.

3.0 Results

It was planned to carry out dedicated visual surveys each month for 12 months from June 2019 to May 2020. Visual surveys for marine mammals have to be carried out in favourable sea-states, which were considered to be sea-state ≤3, but ideally sea-state ≤2 as the ability to detect small cetaceans, such as harbour porpoise, declines considerably above sea-state 2. These conditions were not always available, especially during winter months and a total of only seven surveys were carried out over a 12 month period (Table 1). No visual surveys were carried out in September and November 2019 and February to April 2020 due to no suitable weather windows being available and latterly restrictions associated with Covid-19.

Table 1. Overall environmental conditions during surveys off Oriel from June 2019 to May 2020

Date	Swell (m)	Visibility (km)	Wind strength (knots)	Wind direction	Cloud Cover	Precipitation
19-20 June 2019	0	11-15km	7	270°	3/8	None
17-18 July 2019	0	5-10km	15	195°	4/8	CL/None
1-2 August 2019	0	16-25km	9	209°	1/8	None
2 October 2019	0	21-25km	11	270°	6/8	None
1-2 December 2020	0	21-25km	12	305°	6/8	None
20-21 January 2020	0	16-20km	7	290	7/8	None
19 May 2020	0	11-15km	6	180°	6/8	None

On five of the seven surveys (71%) were full surveys carried out over two days but on two occasions (2 October and 19 May 2020) only one day was available resulting in 6 and 8 of the 11 track-lines being surveyed. On one occasion (17-18 July 2019) conditions were poor for the whole survey and data are to be treated with caution. On the 1 December conditions were poor but improved on the second day (2 December) and the number of track-lines surveyed each day were modified to maximise survey effort in favourable sea-states. Environmental conditions during the seven surveys carried out were favourable for the majority of survey effort (Table 2).

Table 2. Sightings data during surveys off Oriel from June 2019 to May 2020

Sample Day	Date	Total effort (km)	Sea-state (% of total survey time)					Total No. sightings	Total No. animals
			0	1	2	3	4		
1	19-20 June 2019	175.0	5.1	16.6	38.2	32.7	7.4	14	15
2	17-18 July 2019	174.7	0.0	0.0	1.1	43.7	55.2	6	6
3	1-2 August 2019	170.3	3.5	68.3	20.6	7.6	0.0	35	39
4	2 October 2019	92.5	0.0	25.9	60.2	13.8	0.0	13	14
5	1-2 December 2020	167.0	0.0	3.0	48.3	40.7	18.0	14	20
6	20-21 January 2020	168.0	8.9	51.2	14.9	25.0	0.0	41	77
7	19 May 2020	133.9	17.2	45.9	37.0	0.0	0.0	17	28
Total		**1081.4**						**140**	**199**

A total of 1081 km of track lines were surveyed in sea conditions up to sea-state 4 over 12 days. Of this a total of 672 km of track line (62.2%) was sampled in sea-state ≤2 and 889.0 km of track-line (87.1%) in sea-state ≤3 or less (Table 2.2). Sea conditions were very good for five of the seven surveys, with sea-state ≤1 predominating for three surveys (surveys 3, 6 and 7).

3.1 Marine mammal sightings

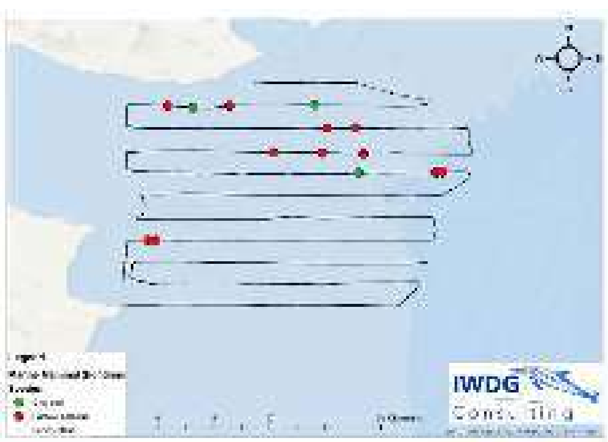
A total of 140 on-effort sightings were recorded of at least five marine mammal species (Table 3). This included one sighting of a single basking shark. One cetacean sighting and one seal sighting could not be identified to species level. Most sightings (67.6% of those sightings identified to species level) were of harbour porpoise which were recorded during every survey. The next most frequently recorded species was grey seal (16.2%) recorded on five of the seven surveys and minke whale (13.2%), recorded on three of the seven surveys. Common seals were recorded on three surveys and accounted for only 2.2% of all sightings (Table 3).

Table 3. Number of sightings (individuals) of marine mammals during surveys off Oriel from June 2019 to May 2020
HP = Harbour porpoise, CD – Common dolphin, MW = Minke whale, GS = Grey seal, CS = Common seal

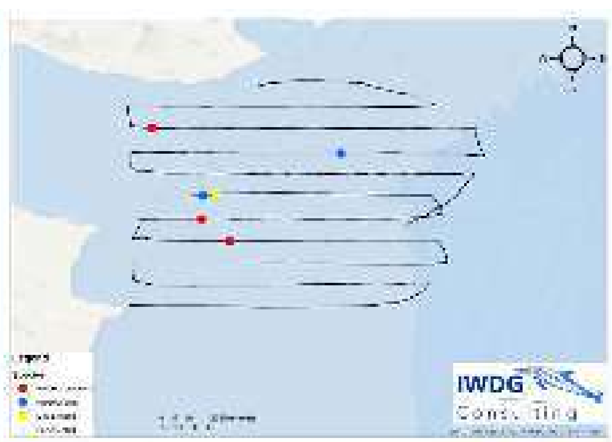
Date	HP	CD	MW	GS	CS	Others
19-20 June 2019	11(12)	-	-	3(3)	-	
17-18 July 2019	3(3)	-	1(1)	-	1(1)	
1-2 August 2019	15(19)	-	14(14)	4(4)	-	1 basking shark, 1 cetacean sp.
2 October 2019	8(9)	-	3(3)	2(2)	-	
1-2 December 2020	11(15)	1(3)	-	-	1(1)	1 seal sp.
20-21 January 2020	34(70)	-	-	6(6)	1(1)	
19 May 2020	10(21)	-	-	7(7)	-	

3.2 Marine mammal distribution

The distribution of each sighting during each survey is shown in Figure 3a-g. Marine mammals were distributed throughout the survey area, with a small tendency for more sightings towards the north and middle of the survey area, with fewer sightings to the south.

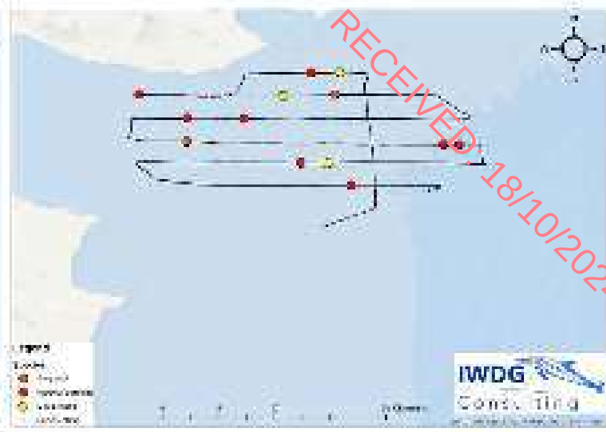


3a. 19-20 June 2019



3b. 17-18 July 2019

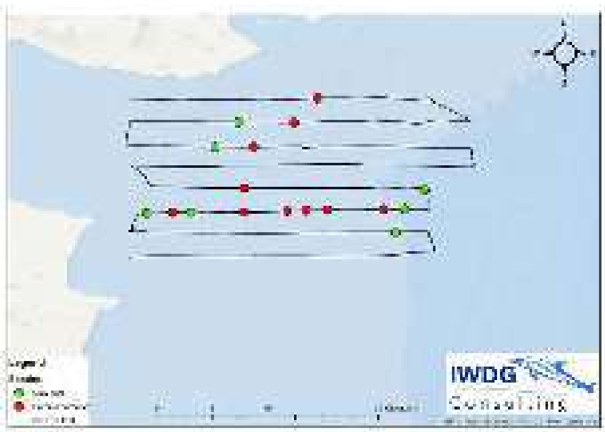
3c. 1-2 Aug 2019



3d. 2 October 2019

1-2 December 2020

3f. 20-21 January 2020



3g. 19 May 2020

Figure 3a-f. Distribution of all marin mammal sightings by survey (1-7) off Oriel from June 2019 to May 2020

3.2.1 Harbour porpoise (*Phocoena phocoena*)

Harbour porpoise were the most frequently recorded species accounting for 67.6% of all sightings identified to species level and 76.4% of all individuals counted and were recorded on all surveys. They occurred throughout the survey area (Figure 4). Most sightings were of single individuals but larger group sizes were recorded in January and May 2020 (Table 7).

Calves were recorded on two occasions, one in a group of 2 in January 2020 and one in a group of three in May 2020 (Table 4). Juveniles were recorded more frequently on six occasions, all in January. Single individuals were recorded in groups of 2 on one occasion, groups of three on three occasions and groups of four individuals on two occasions. The adult to calf ratio was 1.4% and juveniles 4.3%. Harbour porpoise calves are born during summer and typically wean over the winter and the presence of calves during spring and juveniles over winter is consistent with this pattern. Harbour porpoise are widespread and abundant in the Irish Sea with some of the highest densities in Ireland recorded off north County Dublin (Berrow et al. 2014). The area off Oriel certainly provides good habitats for this species and their continued presence was to be expected.

Table 4. Number of adults, juvenile and calves recorded for harbour porpoise off Oriel from June 2019 to May 2020

Sample Day	Date	Group Composition			
		Total	Ad	Juv	Calf
1	19-20 June 2019	12	12	0	0
2	17-18 July 2019	3	3	0	0
3	1-2 August 2019	19	19	0	0
4	2 October 2019	9	9	0	0
5	1-2 December 2020	15	15	0	0
6	20-21 January 2020	70	63	6	1
7	19 May 2020	21	20	0	1
Total		**149**	**141**	**6**	**2**

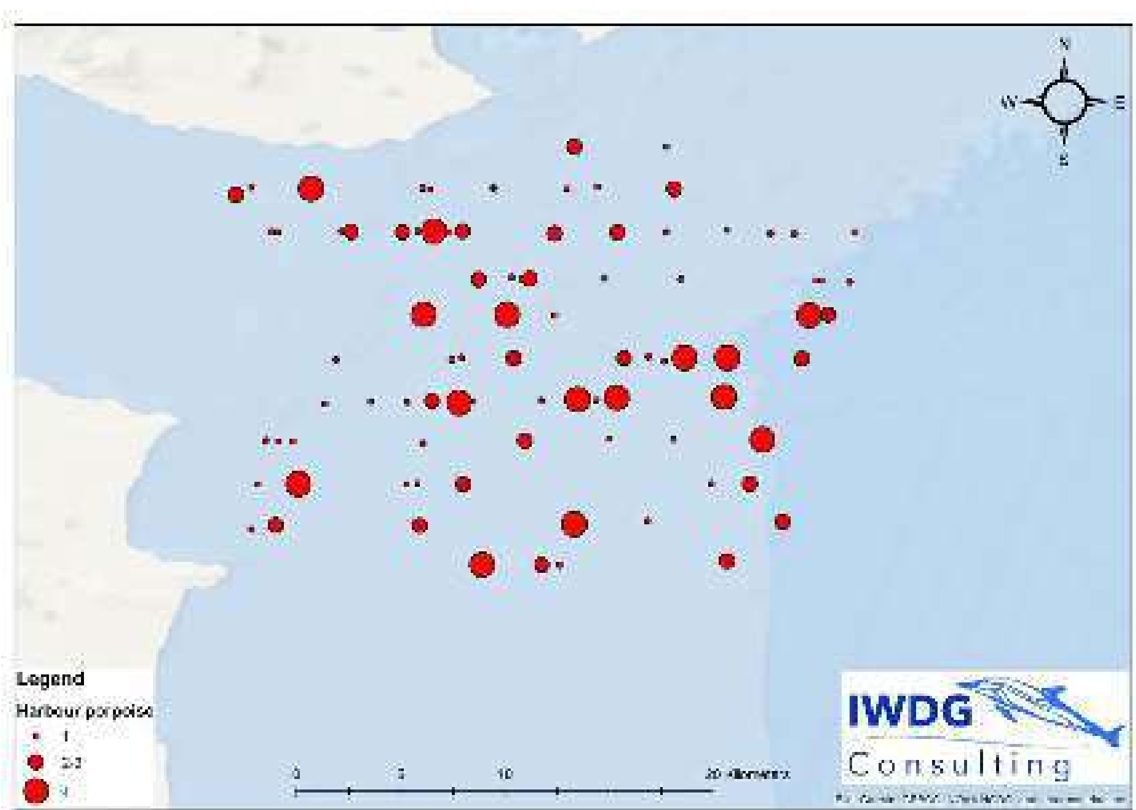


Figure 4. Distribution and group size of harbour porpoise sightings off Oriel from June 2019 to May 2020

3.2.2 Minke whale (*Balaenoptera acutorostrata)*

Individual minke whales were recorded on 18 occasions, with 14 of these on survey 3 on 12 August 2019. They were also recorded on the July and October surveys. They occurred throughout the survey area with a tendency to be a little offshore (Figure 6). Minke whales are seasonally abundant in Irish coast waters, typically recorded from May through to October (Berrow et al. 2010) but also occur in the winter offshore in large numbers (Rogan et al. 2019). Rogan et al. (2019) did not record any minke whales in the Irish Sea during winter.

There are few abundance estimates available for small inshore areas in Ireland thus that density estimate calculated from data collected in August 2019 is useful and provides an estimate of the number of whales exposed to the proposed windfarm during construction and operation.

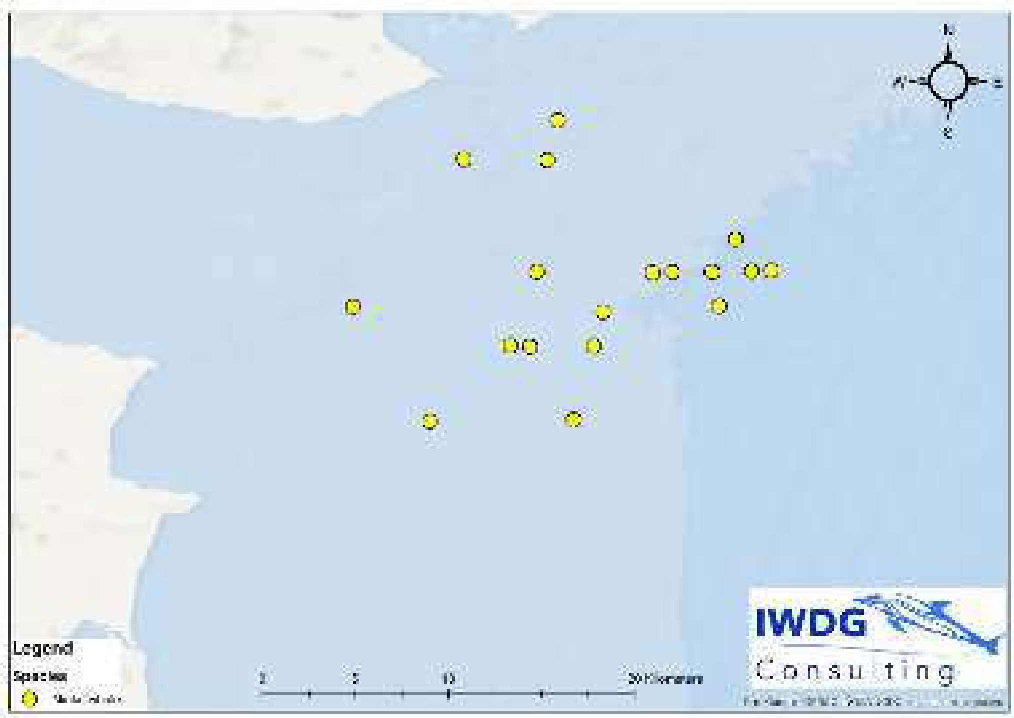


Figure 5. Distribution of minke whale sightings off Oriel from June 2019 to May 2020

3.2.3 Common dolphin (*Delphinus delphis*)

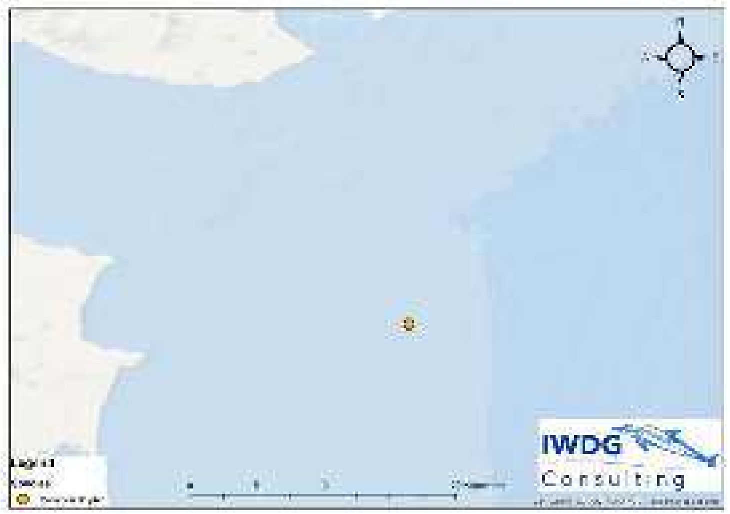


Figure 6. Distribution of the common dolphin sighting off Oriel from June 2019 to May 2020

Only one group of three common dolphins were recorded on 2 December 2019 (Figure 4). Common dolphins are thought to be most abundant in the Irish Sea in the autumn entering from the south and moving north (Wall et al. 2013) so this single sighting is consistent with the suspected distribution. Rogan et al. (2019) did not record any common dolphins in the Irish Sea during summer or winter, in two consecutive years (2015 and 2016) during the ObSERVE Aerial survey.

3.2.4 Grey (*Halichoerus grypus*) and common seal (*Phoca vitulina*)

Grey seals were the second most frequently recorded species accounting for 16.2% of sightings and 11.3% of individuals recorded. They were recorded on five of the seven surveys and in all seasons sampled and in consistent numbers per survey. All sightings were of individual animals. Only three sightings of common or harbour seals were recorded, one each in July, December and January, all of single individuals (Table 3) and one in November, again of single individuals. Seals were distributed throughout the study area with a tendency to be more inshore (Figure 7). Common seals were recorded in the northern half of the study area.

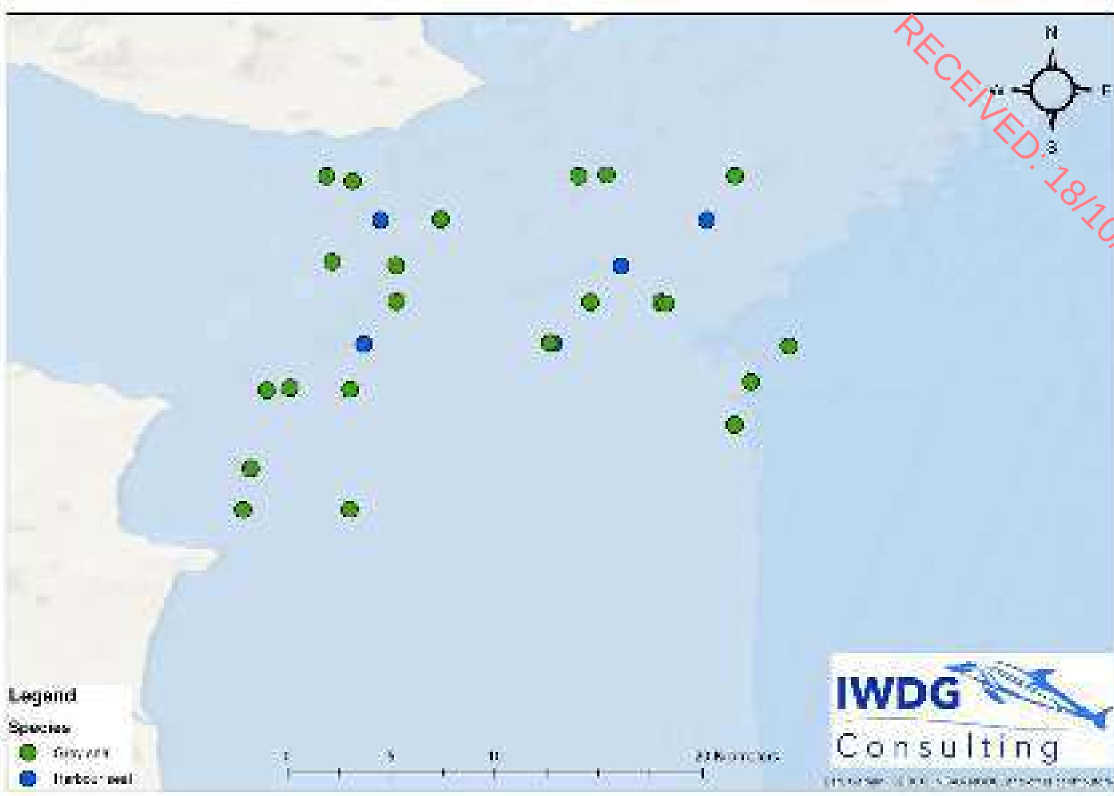


Figure 7. Distribution of grey and common (harbour) seal sightings off Oriel from June 2019 to May 2020

During an aerial survey of common seals carried out during August and September 2012, Duck and Morris (2013) counted 40 on 31 August 2012 in Carlingford Lough making it the single most important site for this species on the east coast of Ireland and 90 in total between Carlingford and north Dublin. Grey seals were also frequently recorded, with 48 counted between Carlingford and Dunany Point and 172 from Lambay Island to Dublin Bay. These counts showed a 14-31% decline in harbour seals since 2003 and an increase of between 18-23% in grey seals (Duck and Morris 2013). We might have expected to record more common seals in the survey area as the site is close to Carlingford. Common seals are not as mobile as grey seals, typically foraging within 10km of their haul-out site (Thompson et al. 1998).

3.2.5 Other Endangered, Threatened or Protected (ETP) species

A single sighting of a basking shark *Cetorhinus maximus* was recorded on survey 3 on 1 August.

<u>3.3 Density and abundance estimation</u>

Density estimates were calculated if there were sufficient sightings during each survey (≥10). All data from every survey were then pooled to derive an overall detection function for harbour porpoise. Porpoise data was then stratified by sea-state to explore the effect of sea-state on sightings and derive the best density and abundance estimates. Chi-squared values delivered by the model are presented, and the results from the models with a poor fit should be treated with caution. The Effective Strip Width gives an idea of the actual area surveyed and typically increases with decreasing sea-state and thus increased detectability of the species recorded.

3.3.1 Harbour porpoise

Sufficient harbour porpoise sightings were made during five surveys (surveys 1, 3, 5, 6 and 7; Table 6) to run the DISTANCE model and for all survey days combined. The goodness of fit for surveys 1, 6 and 7 were good but poor for survey 5. The Effective Strip Width was also variable between surveys (Table 6). Most variability on surveys 1 and 3 was attributed to the detection probability rather than cluster size since group size was consistent. Group size increased and was more variable on surveys 6 and 7, resulting in more variability associated with this parameter (Table 6). Overall, most variability was attributed to encounter rate (89.3%), which is shown in the large variation in the number of sightings per survey (Table 6).

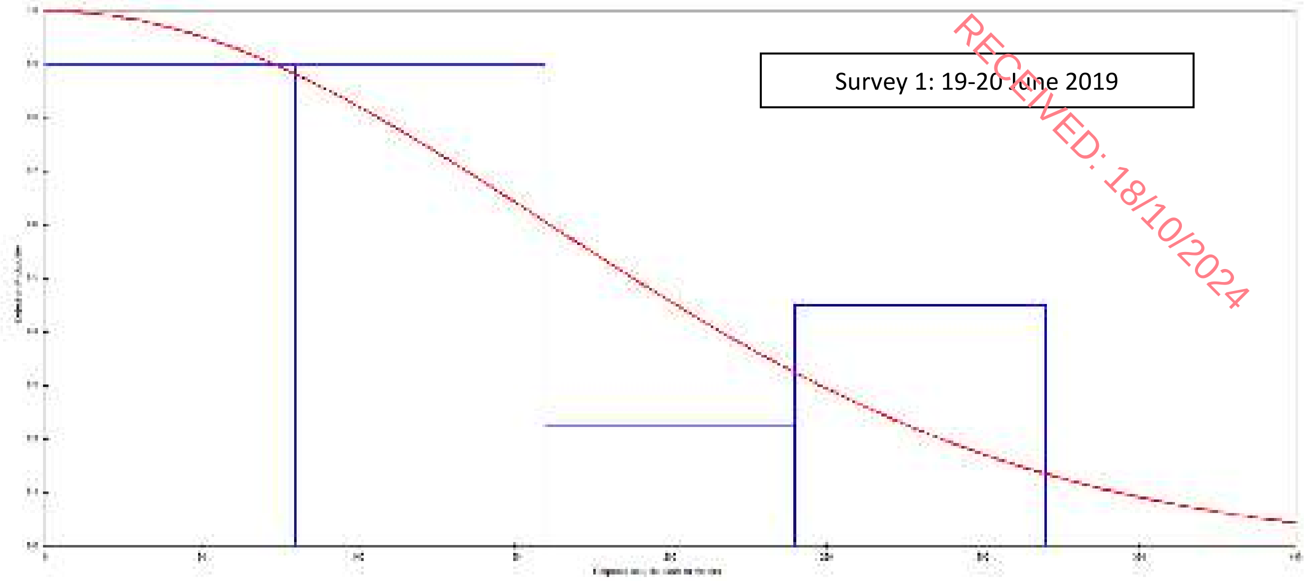
Table 6. Model data used in the harbour porpoise abundance and density estimation process for each survey off Oriel

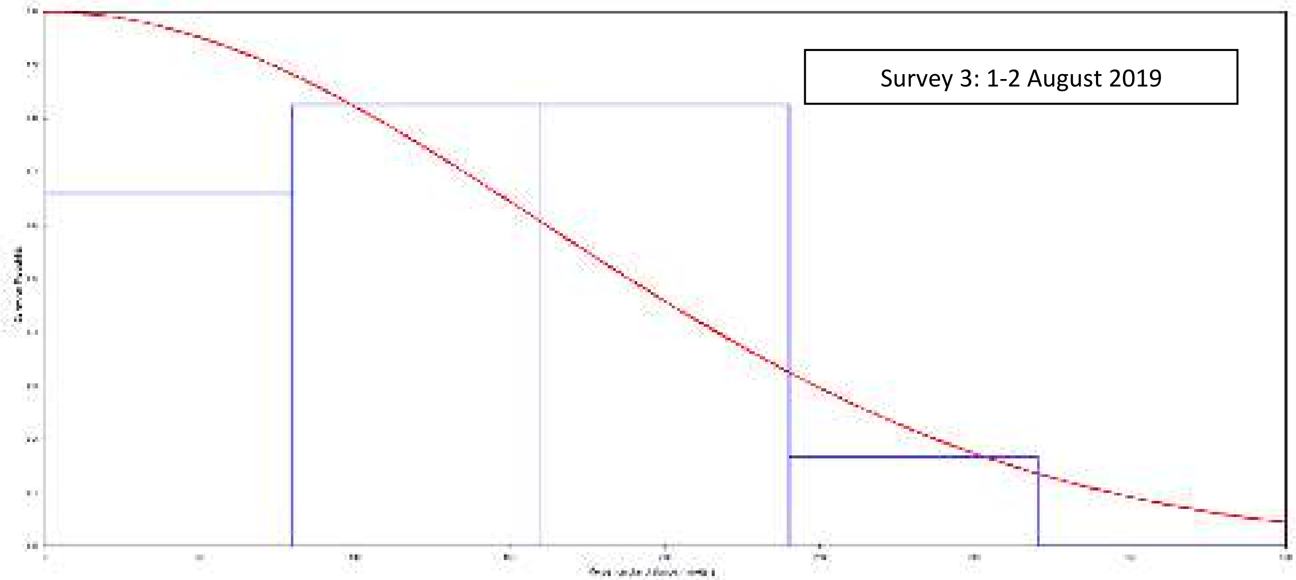
Survey	Sample size	Chi^2 P value	Effective Strip Half-Width (m)	Mean Group Size ±SE	Variability (D)		
					Detection	Encounter	Cluster
Survey 1	11	0.66	197	1.10±0.01	91.9	-	8.1
Survey 3	15	0.31	198	1.06±0.12	94.9	-	15.1
Survey 5	11	0.19	303	1.37±0.15	79.9	-	20.1
Survey 6	**34**	**0.67**	**328**	**2.06±0.17**	**69.1**	**-**	**30.9**
Survey 7	10	0.66	457	2.22±0.36	65.3	-	34.7
Overall	**92**	**0.69**	**283**	**1.62±0.09**	**7.7**	**89.3**	**3.1**

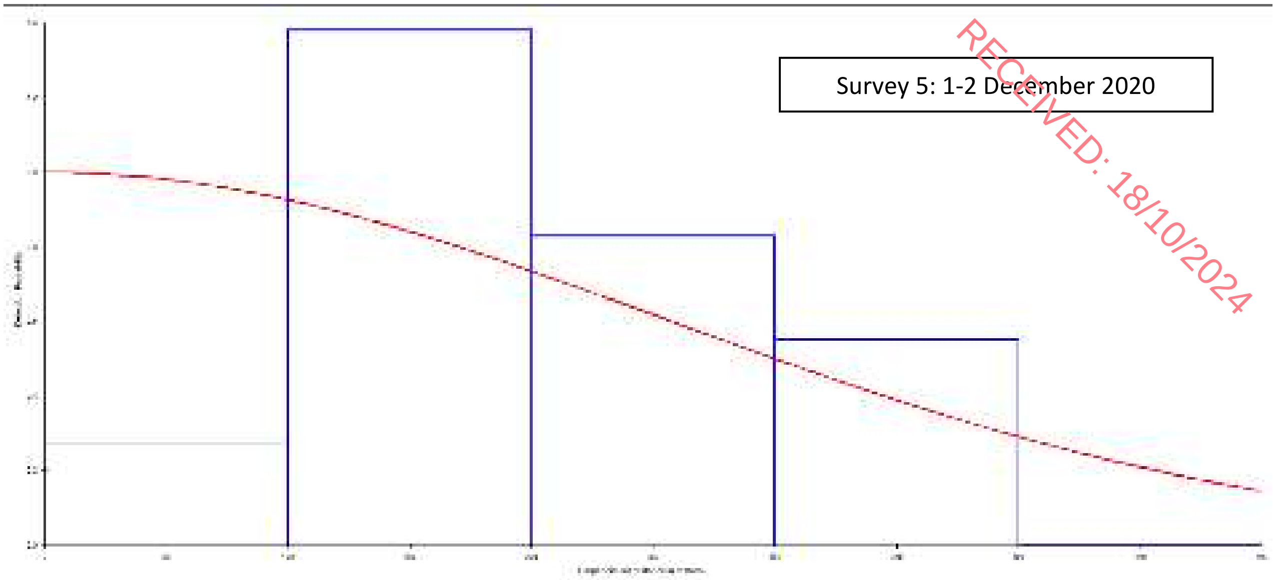
Table 7. Estimated density, abundance (N) and group sizes of harbour porpoise recorded during each survey off Oriel
The best estimates are highlighted in **bold** font

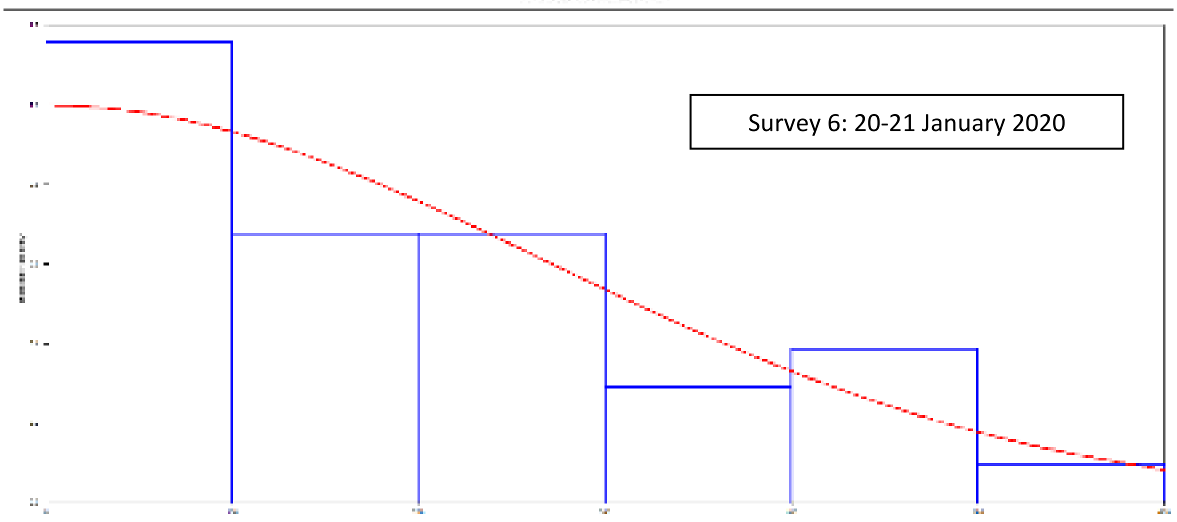
Survey Day	N (95% CI)	SE	CV	Density (per km^2)	Mean Group Size (95% CI)
Survey 1	58 (34-100)	15	0.25	0.18±0.05	1.09 (1.00-1.31)
Survey 3	76 (47-121)	17	0.23	0.24±0.05	1.27 (1.04-1.55)
Survey 5	45 (24-84)	13	0.29	0.14±0.04	1.36 (1.00-1.74)
Survey 6	**205 (145-288)**	**35**	**0.17**	**0.64±0.11**	**2.06 (1.74-2.43)**
Survey 7	59 (25-138)	24	0.41	0.19±0.07	2.22 (1.52-3.24)
Overall	**71 (36-140)**	**21**	**0.30**	**0.22±0.07**	**1.62 (1.45-1.92)**

Harbour porpoise density ranged from 0.14 porpoise per km^2 to 0.64 per km^2, and was 0.22 overall (Table 7). The estimate from survey 6 (0.65 porpoise per km^2) resulting in an abundance of 205±35 reflects the peak in abundance during January, which may be associated with a traditional herring spawning ground within the site (Dickey-Collas et al. 2001). The overall estimate from the pooled data is considered the most robust as it accounts for seasonal variation and provides a good average abundance estimate. The density of 0.22 porpoises per km^2 resulted in an overall abundance of 71±21 (CV=0.30) with 95% Confidence Interval of 36-140 (Table 7).


Survey 1: 19-20 June 2019


Survey 3: 1-2 August 2019


Survey 5: 1-2 December 2020


Survey 6: 20-21 January 2020


Survey 7: 19 May 2020

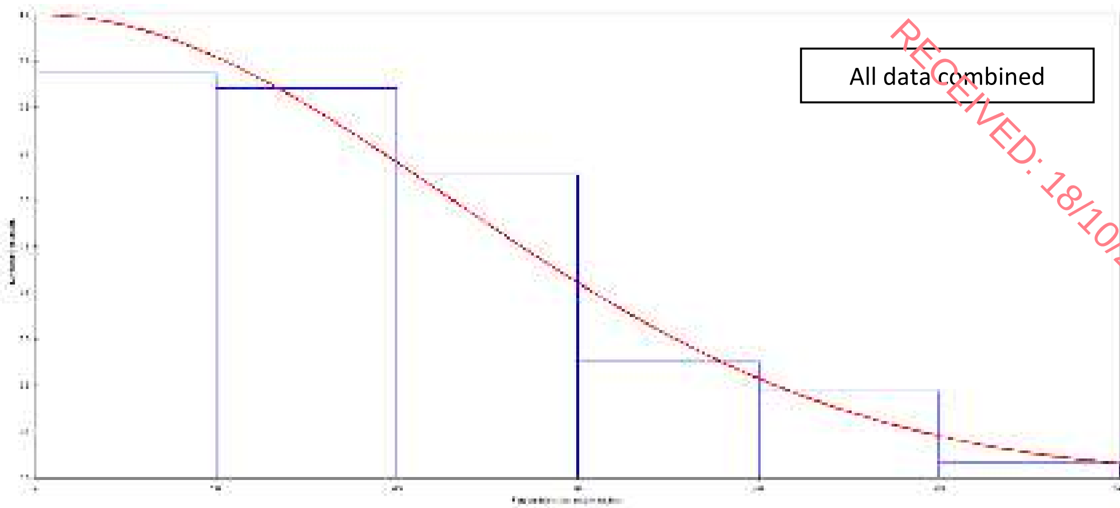


Figure 8. Detection function plots for harbour porpoise off Oriel

Density and abundance estimates were also calculated with increasing sea-state, and are shown in Tables 8 and 9. Detection functions for harbour porpoise are also presented in Figure 9. As sea-state increased the density estimate declined. This is to be expected as more porpoises will go undetected at higher sea-states resulting in false negatives and an under-estimation of actual density.

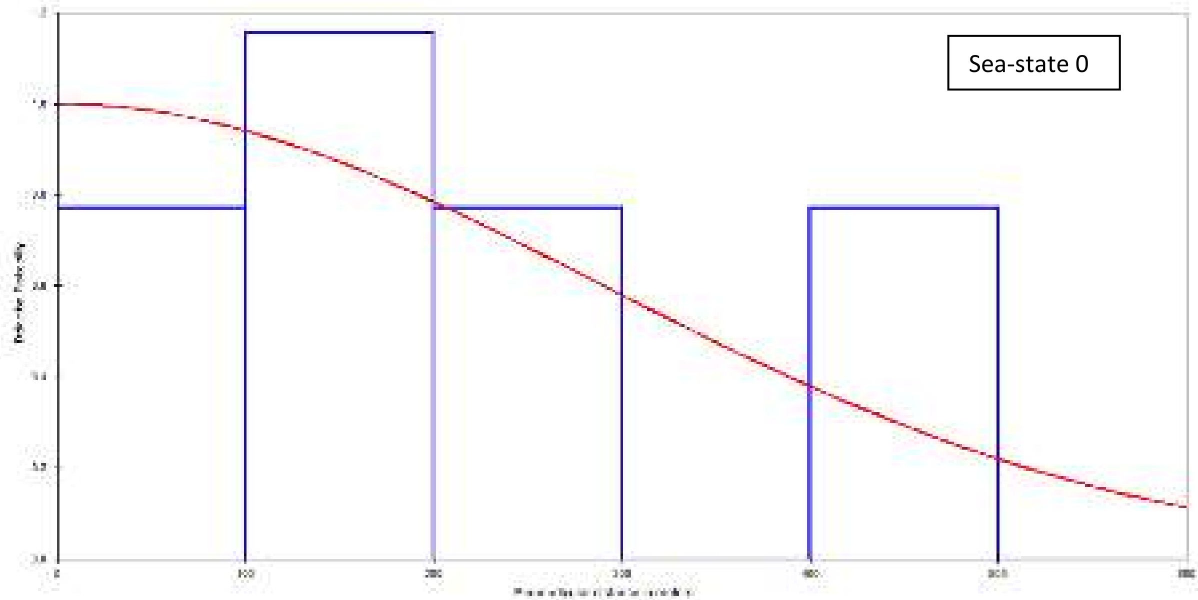
Table 8. Model data used in the harbour porpoise abundance and density estimation process in increasing sea-state for each survey off Oriel

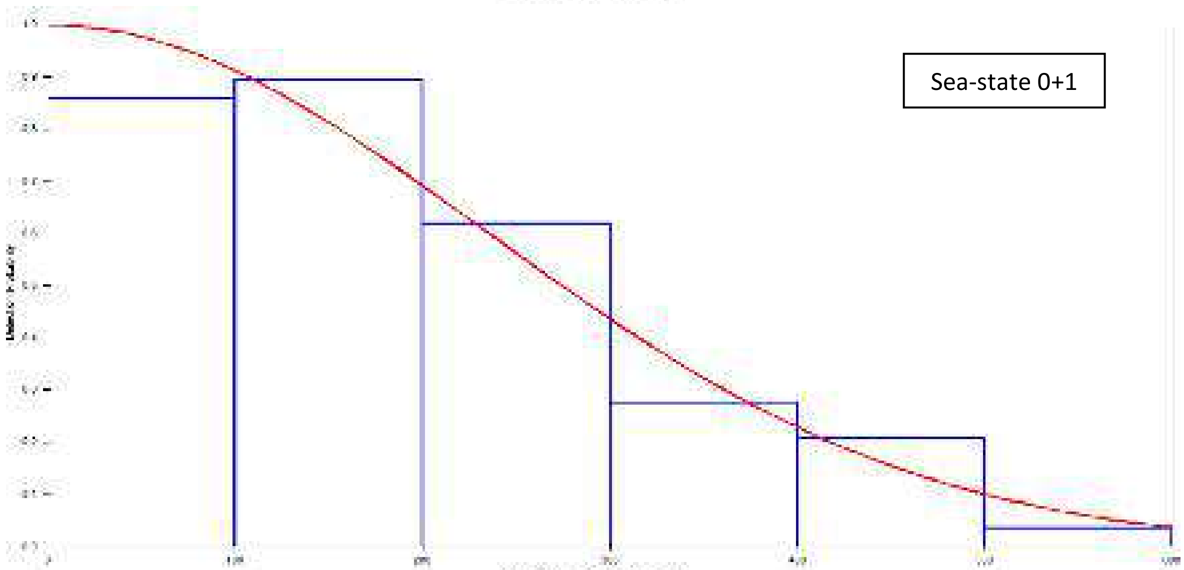
Survey	Sample size	Chi^2 P value	Effective Strip Half-Width (m)	Mean Group Size ±SE	Variability (D)		
					Detection	Encounter	Cluster
0	10	0.79	346	2.45±0.34	54.4	14.7	30.9
0+1	**52**	**0.86**	**273**	**1.70±0.13**	**19.5**	**71.2**	**9.3**
0+1+2	**85**	**0.78**	**288**	**1.64±0.09**	**15.3**	**78.6**	**6.1**
All sea-states (≤4)	92	0.69	283	1.62±0.09	10.8	84.9	4.3

Density estimates ranged from 0.69 porpoises per km^2 (sea-state 0) to 0.27 porpoises per km^2 (sea-state ≤4). There was only 53km of effort in sea-state 0 with 10 sightings which are too few to trust model outputs. The most robust estimates are for sea-state ≤1, and sea-state ≤2, (Table 8) as the sample sizes were high (52-85 individuals). The chi-squared values are high, suggesting a reasonable good fit of the detection function with low CVs (0.22-0.25) (Table 9). This resulted in an abundance estimate of 118±26 to 140±34 harbour porpoise in the survey area.

Table 9. Estimated density, abundance (N) and group sizes of harbour porpoise recorded during each survey off Oriel
The best estimates are highlighted in **bold** font

Sea-state	N (95% CI)	SE	CV	Density (per km^2)	Mean Group Size (95% CI)
0	224 (101-494)	87	0.39	0.69	2.44 (1.78-3.36)
0+1	**140 (83-235**	**34**	**0.25**	**0.44**	**1.71 (1.46-1.99)**
0+1+2	**118 (75-187)**	**26**	**0.22**	**0.37**	**1.64 (1.46-1.84)**
All sea-states (≤4)	88 (53-146)	22	0.25	0.27	1.62 (1.46-1.82)





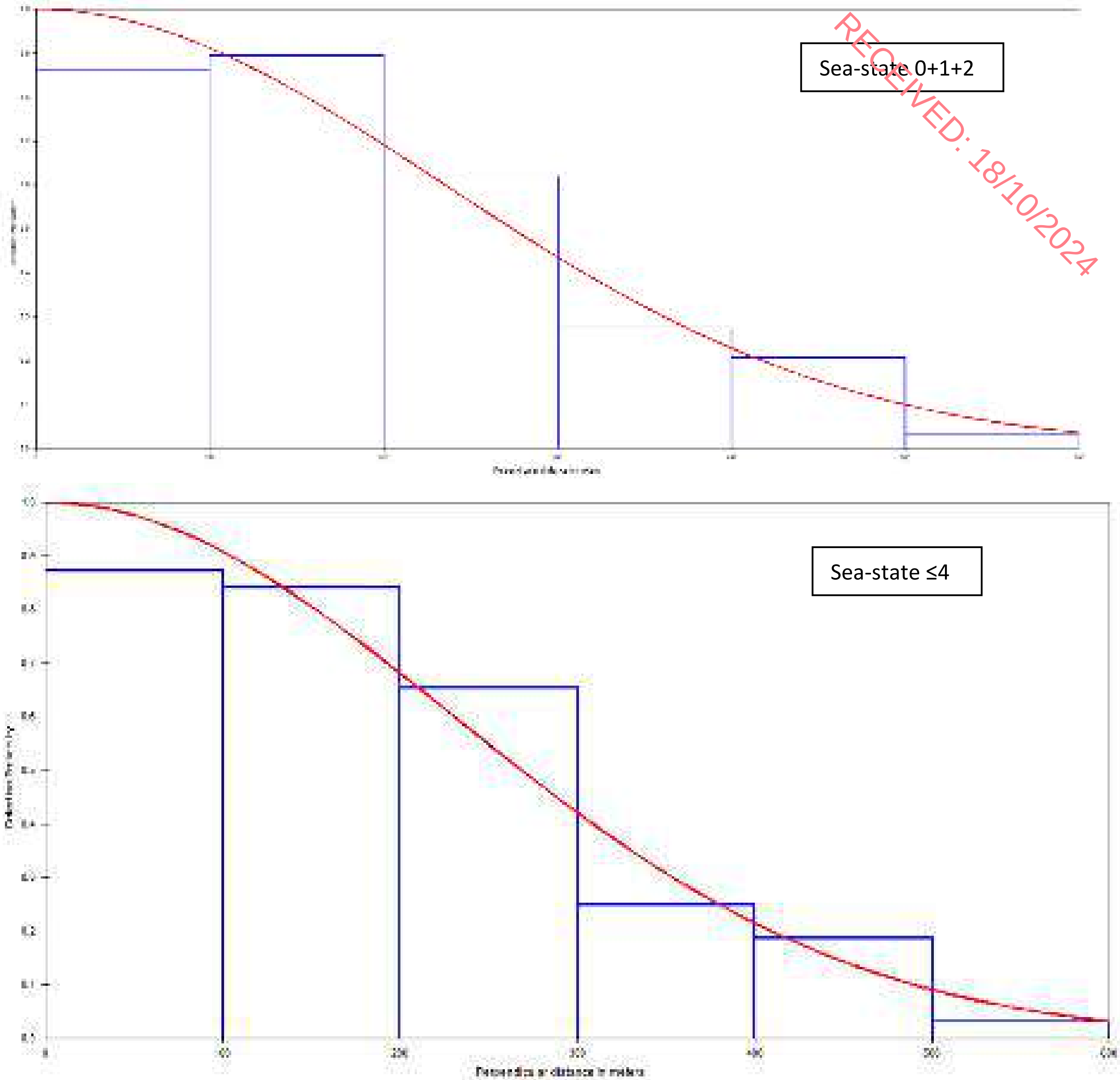


Figure 9. Detection function plots for harbour porpoise off Oriel in increasing sea-states

3.3.2 Minke whale

A density estimate was calculated for minke whales from data obtained during survey 3 on 1-2 August 2019 as there were 14 sightings of individual minke whales. The detection function is shown in Figure 10 and is a good fit (P=0.71). The Effective Strip Width was estimated at 259m which resulted in a density of 0.01±0.02 minke whales per km^2. This gives an abundance estimate of 3±0.6 (95% CI 2-5 individuals) with a CV of 0.20.

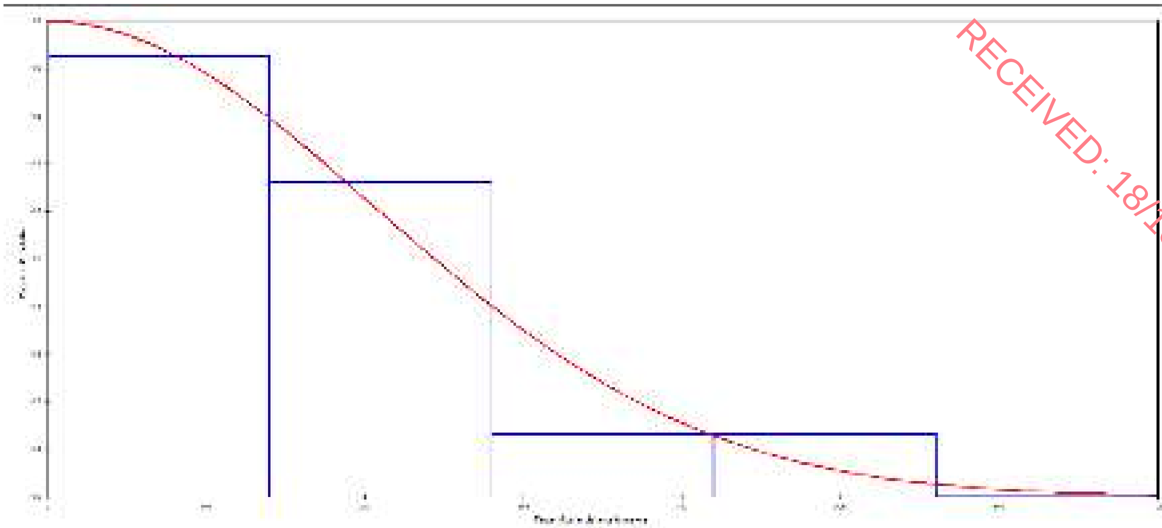


Figure 10. Detection function plots for minke whale during survey 3 off Oriel

4.0 Discussion

The Irish Sea is recognised as an important habitat for a range of marine mammals (Berrow 2010; Wall et al. 2013. The regular presence of harbour porpoise and seasonal occurrence of minke whales were to be expected, as well as grey seals. Although marine mammal species diversity is less than recorded off the south and west coasts of Ireland, abundance of species such as harbour porpoises are higher in the Irish Sea than elsewhere (Berrow et al. 2014). Minke whales are also frequently recorded in the Irish Sea during the summer (Berrow et al. 2010; Wall et al. 2013). We might have expected to record bottlenose dolphins in the study area as they are frequently observed off the east coast (Berrow et al. 2010). They are highly mobile and individuals recorded off the east coast are considered part of the inshore population which uses all Irish coastal waters (O'Brien et al. 2009). They typically pass through sites on the east coast, rarely staying for long in an area. Other species such as Risso's dolphin, killer and humpback whales have also been recorded although not frequently (Berrow et al. 2010; Wall et al. 2013). The western Irish Sea front is a well-known feature (Simpson et al. 2009) that runs to the east of the study area. High productivity leading to increased marine predators including seabirds have been reported (Begg et al. 1997). This feature varies in its position and zone of influence and the effect of this front on marine mammals should not be ignored.

Overall marine mammals were observed throughout the study area (Figure 11). Clearly harbour porpoise and grey seals occur at the site, with both groups having different sensitivities to potential impacts. Minke whales occur seasonally during the summer and autumn and are more sensitive to low frequency sounds, which they use for communication and navigation.

As is to be expected harbour porpoise were by far the most frequently recorded cetacean species observed on every survey. They occur all year round at the study site, with increases in the winter. Porpoise abundance is likely to be more consistent throughout the year but with offshore movements in early spring (March-April) though to be associated with calving (Berrow et al. 2010).

Although both resident seal species breeding in Ireland were recorded in the study site, most sightings were of grey seals which occurred in every month of survey. Although grey seals are highly mobile and welsh Scottish breeding seals also use Irish waters to forage an important breeding site for grey seals occur on the Saltee Islands, to the east of the study area. Clearly the study area is an important foraging area for seals and were recorded throughout the site.

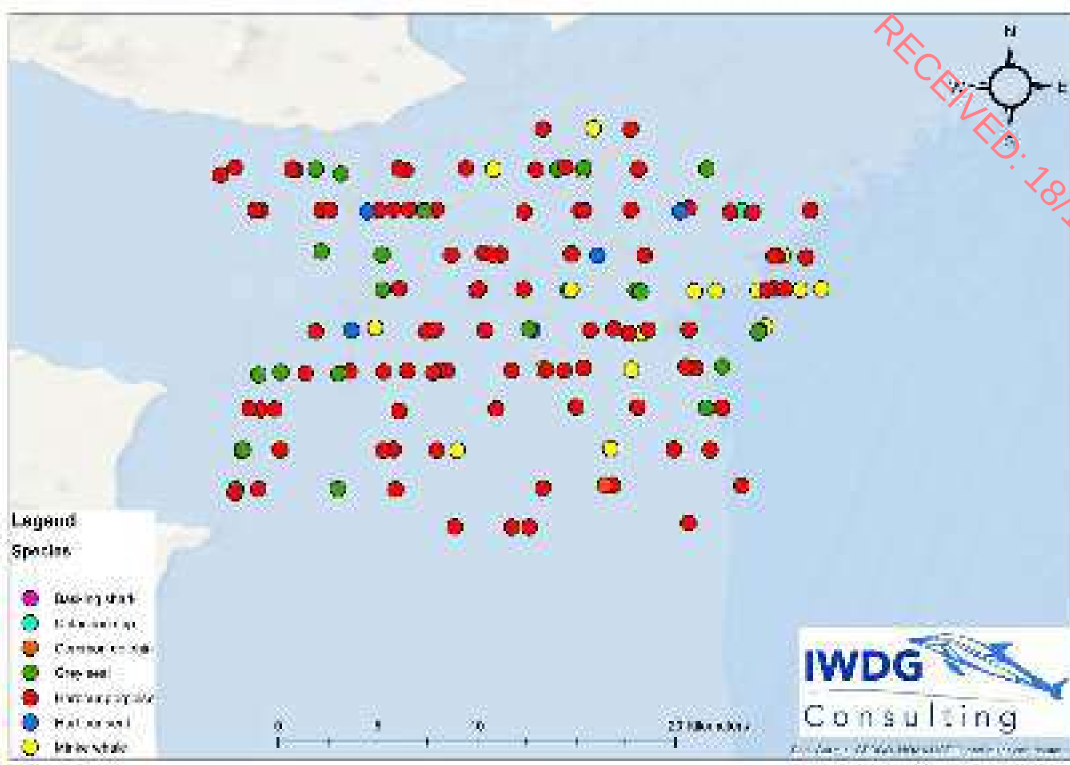


Figure 11. Distribution of all marine mammal sightings off Oriel

All marine mammals are protected in Ireland through national and EU legislation. All species occur on Annex IV of the EU Habitats directive and are entitled to strict protection while harbour porpoise, is listed on Annex II which require the designation of Special Areas of Conservation. The proposed windfarm site at Oriel is 47.8km from the North Channel SAC which list harbour porpoise as a primary reason for selection of the site and the Rockabill to Dalkey Island SAC, which is around 50 km to the south. The boundary of Strangford Lough SAC, which is designated to protect common (harbour seals) lies approximately 50km to the northeast of the site. Murlough SAC, which lists common (harbour) seal as present as a qualifying feature but not a primary reason for site selection, lies around 35km to the northwest. All marine mammals are highly mobile and all individuals occurring at the site are part of a much wider population. No population structuring at a local scale has been recognised or is expected and thus risk assessments should consider connectivity between this site and other sites, including other offshore windfarm sites.

4.1. Abundance estimates

Distance sampling was used to estimate absolute abundance. The use of distance sampling and modelling to derive density and abundance estimates in Ireland using a single observation platform has been discussed by Berrow et al. (2014). Statistical interpretation using distance sampling rests on several assumptions (Buckland et al. 2001). These include the assumption that objects are spatially distributed according to some stochastic process. If transect lines are randomly placed within the study area we can safely assume that target objects are uniformly distributed with respect to track-line in any given direction. Density and abundance estimates presented here for harbour porpoise and common dolphin are a minimum as g(0) is not = 1, meaning animals on the track-line are missed and not included in the estimates however without a double-platform survey the proportion missed cannot be quantified but for harbour porpoise could be up to 30-40%. These assumptions are sometimes violated but this technique has been widely used in Ireland allowing comparisons in density estimates within and between sites to assess periods or areas of greater importance for cetacean species. However, density and abundance estimates presented here for harbour porpoise can be used in risk assessments to determine the number of individuals exposed to potentially negative impacts during construction and operation.

Abundance estimates of marine mammals from the North Irish Sea are scarce. Berrow et al. (2014) derived a density estimates of 1.19 harbour porpoise per km^2 in Dublin Bay (CV=0.24) and 2.03 harbour porpoise per km^2 in North County Dublin (CV=0.22) to the east of the study area during summer 2008. These were the two of the highest density estimates of eight sites sampled by Berrow et al. (2014). Dedicated site surveys of the Rockabill to Dalkey Island SAC funded by the NPWS and conducted during the summer (June to September) returned density estimates of 1.59 porpoises per km^2 in 2011 (Berrow *et al.* 2011) of 1.44±0.09 porpoises per km^2 (CV = 0.06) in 2013 (Berrow and O'Brien, 2013) and 1.55±0.17 porpoises per km^2 (CV=0.10). Density estimates of between 0.22 and 0.27 porpoises per km^2 in the present study are very low compared to densities recorded further south, but it should be remembered these surveys were carried out between June and May and in a range of sea-states, while the NPWS surveys were carried out in optimal conditions. Monthly dedicated boat-based surveys, using the same methodology as the present study, were carried out between April 2015 and January 2017 off Portmarnock, Co Dublin to the south of the present survey area. Density estimates varied between 0.97 and 2.29 porpoises per km^2 with a mean density estimate of 1.32 harbour porpoise per km^2 (Meade et al. 2017), which is again much higher than reported off Oriel. Even the highest density estimate (0.69 harbour porpoise per km^2) is below the minimum of the range of estimates further south.

5.0 Acknowledgements

We would like to thank Fastnet Shipping Ltd and skippers Nicky Fortune and Walter Rankin and their crew for providing an excellent vessel and contributing to the success of these surveys. This survey project was contracted by Parkwind through Aquafact and we would particularly like to thank Caroline Roche and Brendan O'Connor of Aquafact and Richard Church of Parkwind for their support throughout.

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APPENDIX 11.9
STATIC ACOUSTIC MONITORING (SAM) AT THE PROPOSED WINDFARM SITE AT ORIEL

VOLUME III
APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

Static Acoustic Monitoring (SAM) at the Proposed Windfarm Site at Oriel

Mooring deployments - Oriel Windfarm © Simon Berrow/IWDG

IWDG Consulting

Final Report to Oriel Windfarm Limited

Static Acoustic Monitoring (SAM) at the Proposed Windfarm Site at Oriel

Joanne O'Brien, Morgane Pommier and Simon Berrow

IWDG Consulting

Irish Whale and Dolphin Group,
Merchants Quay, Kilrush, County Clare

Citation: O'Brien, J., Pommier. M. and Berrow, S. (2020) Static Acoustic Monitoring (SAM) at the Proposed Windfarm Site at Oriel. Final Report to Oriel Windfarm Limited. Irish Whale and Dolphin Group. 23 pp.

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1 Executive Summary

Static Acoustic Monitoring (SAM) was carried out between 2019 and 2020 to complement boat-based visual surveys and describe the long-term presence of harbour porpoise off Co Louth within the site of a proposed offshore windfarm. Between November 2019 and November 2020 a total of 685 days of SAM data were collected across the site. Large data gaps exist due to the multiple losses of equipment and moorings experienced over the monitoring period.

SAM using self-contained click detectors (C-PODs) was conducted at four sites. SAM datasets were then used to explore the temporal presence of harbour porpoises within their detection range. Generalized linear mixed-effect models were used to associate porpoise presence with factors such as season, diel, tidal cycles and phases. Results showed porpoises to be present on average 99% of days monitored. Harbour porpoises were the most frequently detected species with dolphins rarely detected. Of a total of 592 days of SAM data collected across all sites, most were obtained at SAM 3. At this site harbour porpoises were recorded on 99% of days with a mean of 1.08 detections per hour. This was followed by SAM 4 with 135 days of data during which porpoises were also recorded on 99% of days, with a mean of 4.21 detections per hour and at SAM 2 where porpoises were recorded on 100% of the 103 days monitored and returned the number of detections with a mean of 9.44 detections per hour. At the floating LIDAR site, a total of 179 days were monitored with porpoise detections on 90% of days and a mean of 2.96 detections per hour. Dolphins were recorded on 29% of days at SAM 2 but the overall number of detections were low, with detections on 1% of days at SAM 3 and no dolphins recorded at the other sites. Results across all days monitored show porpoises to be present on average over 99% of days monitored. Season appeared to influence porpoise presence differently across sites, with winter and summer overall important periods for porpoise presence. The effect of diel cycle also varied across location, although night, morning and/or evening phases often yielded more detections than day phases (except at the LIDAR site). Tidal cycle and tidal phase only affected detection rate at some locations, where slack low water coincided with increased detections.

Although the Irish Sea is recognised as an important area for harbour porpoise there was little previous dedicated survey effort for marine mammals at this site. The results presented here, combined with the results from dedicated boat-based visual surveys (Berrow and O'Brien 2020) provide an excellent assessment of the marine mammal community potentially exposed to the windfarm development. These data will help to inform planning and any mitigation required.

2 Introduction

Static Acoustic Monitoring (SAM) involves the detection and recording of cetacean vocalizations or echolocation clicks and is a very valuable tool for the exploration of fine scale habitat use by the various odontocete species. SAM is especially useful for monitoring small vocal cetaceans since it can be carried out without the interference of weather conditions or daylight restrictions and, most importantly, does not negatively impact upon the animals. In order to evaluate the importance of an area, it is fundamental that the presence of small cetaceans at a site is fully understood and this requires monitoring over time scales of at least years. An evaluation of a site must be underpinned through scientific research from dedicated survey effort. Visual monitoring of cetaceans can provide numbers for density and abundance estimation but will be biased due to factors such as observer effect and unfavourable sea conditions. Therefore, a complete dataset cannot be gathered, necessitating the requirement of SAM. Through SAM, informative datasets, robust enough to detect distinctive trends in presence across a range of factors, can be achieved much more rapidly than visual means. Small cetaceans rely on sound production through the use of echolocation signals for foraging, orientation and communication. Dolphins have the ability to echolocate across a wide range of frequencies (200Hz to 150kHz, Evans, 1973). Harbour porpoise signals are characterised as being narrow-band, high frequency clicks peaking between 110 and 150kHz, while the average click has a duration of 2µs with a mean source level of 150dB re 1µPa @ 1m (Møhl and Andersen 1973; Goodson and Sturtivant, 1996; Au *et al.,* 1999; Carlström, 2005; Villadsgaard *et al.,* 2007; Verfuß *et al.,* 2007). The reliance on sound by these animals, coupled with the fact they seem to continuously, or regularly echolocate, makes SAM a very valuable tool for determining the presence of dolphins and porpoise and assessing their fine scale habitat use. The main advantage of SAM is that it can provide information on harbour porpoises that can go undetected visually for up to 95% of the time (Read & Westgate, 1995). Patterns of cetacean presence have been described over seasonal scales (Canning *et al*., 2008, Bolt *et al*., 2009; Simon *et al*., 2010; Gilles *et al*., 2011; O'Brien *et al.,* 2013), diel cycle (Carlström, 2005; Todd *et al*., 2009; O'Brien *et al.,* 2013) and tidal patterns (Marubini *et al*., 2009; O'Brien *et al.,* 2013). In order to evaluate the importance of an area, it is fundamental that the presence of small cetaceans at a site is fully understood and this requires monitoring over varying time scales depending on monitoring methods. The Irish Whale and Dolphin Group (IWDG) were contracted by Aquafact to undertake Static Acoustic Monitoring using C-PODs for 12 months at the proposed windfarm site off Oriel, Co Louth. The site was defined by Parkwind and covered an area east of Dundalk bordered by Clogherhead to the south, Carlingford Lough to the north out east to the 50m contour. SAM was carried out from November 2019 to November 2020. The aims of the SAM were to:

i) Provide data on the seasonal occurrence of porpoises and dolphins within the site,

ii) Provide data on small cetaceans during times when no visual surveys are taking place

iii) Allow for comparisons of this site to other areas when long-term SAM has taken place.

3 Methodology

3.1.1 Study area

The Oriel Windfarm project is located in the Irish Sea off the coast of Co. Louth, East of Dundalk Bay. Following an extensive review of sites in the Irish Sea, the Oriel location was chosen as a suitable site to develop an offshore windfarm (www.orielwindfarm.ie). SAM was initially planned for a total of five sites, including a control, but after the loss of moorings and equipment this had to be revised. The longer-term SAMs were at locations SAM 2, 3 and 4 and the floating LIDAR site (Figure 3.1).

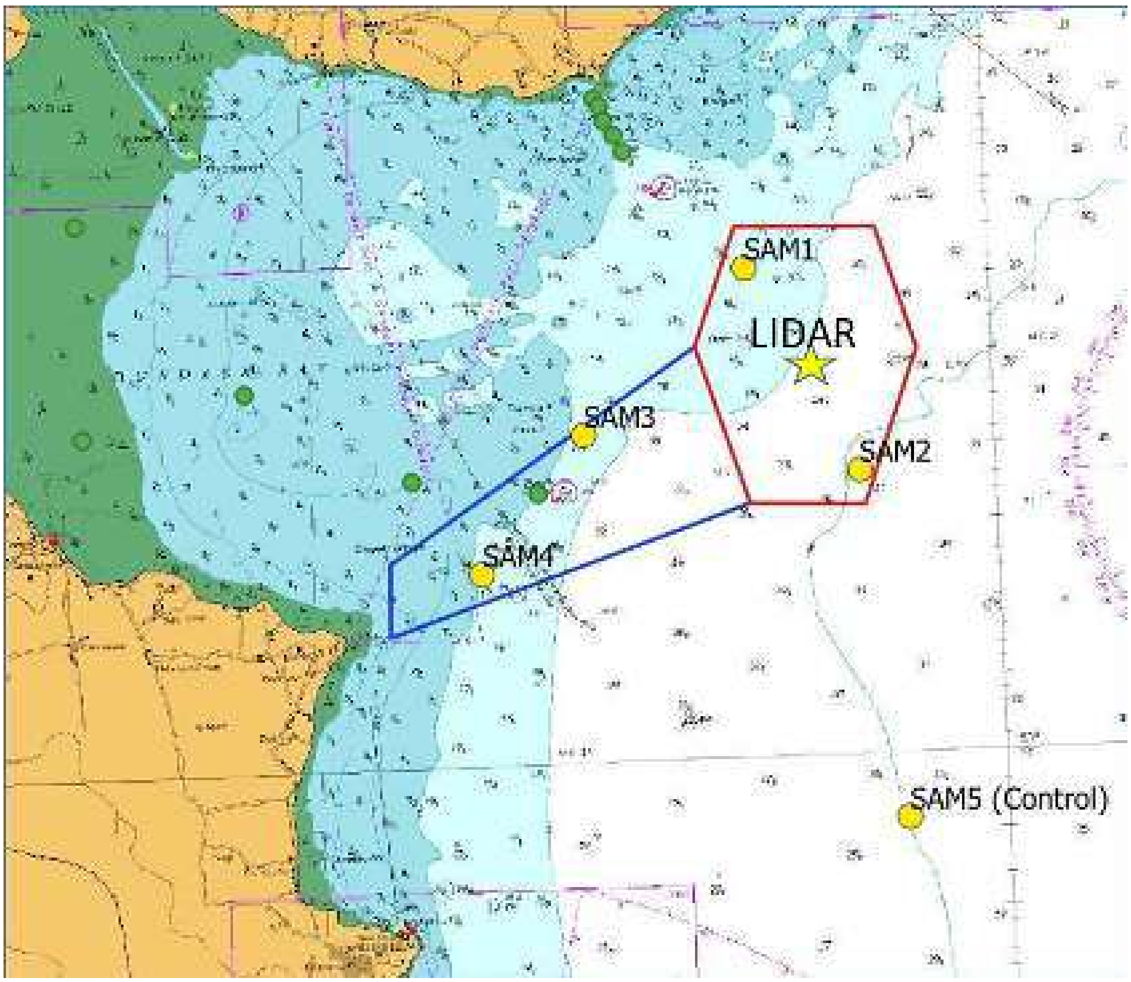

Figure 3.1: Original location of all SAM moorings.

3.1.2 C-PODs

The C-POD is a fully automated, static acoustic monitoring system which can detect porpoises, dolphins and other toothed whales by recognising echolocation click trains these animals make in order to detect their prey, orientate themselves and interact with one another (Figure 3.2). These units are designed and manufactured by Chelonia Ltd and they are the only commercially available instruments with click train recognition software which produces fully automated, accurate data on the behaviour and identification of odontocetes (see www.chelonia.co.uk). A single C-POD can monitor both porpoise and dolphins simultaneously through identifying characteristic click parameters which can be assigned to either harbour porpoise or dolphin species. Once deployed at sea, C-PODs operate in a passive mode and are constantly listening for tonal clicks within a frequency range of 20 to 160 kHz. When a tonal click is detected, the C-POD records the time of occurrence, centre frequency, intensity, duration, bandwidth and frequency of the click. Internally, the C-POD is equipped with a Secure Digital (SD) flash card, and all data are stored on this card. Dedicated software, C-POD.exe, provided by the manufacturer, and is used to process the data from the SD card when connected to a PC via a card-reader. This allows for the extraction of data files under pre-determined parameters as set by the user. Additionally, the C-POD also records temperature over its deployment duration. It must be noted that the C-POD does not record actual sound files, only information about the tonal clicks it detects.

Figure 3.2: C-POD unit by Chelonia Ltd

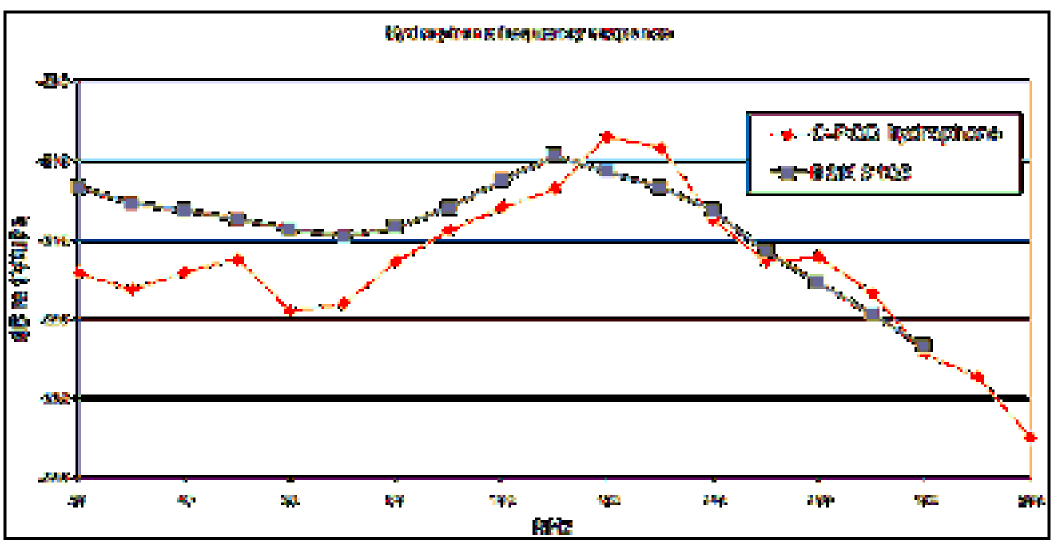

Figure 3.3: Threshold for detection across various frequency bands between 20 and 200 kHz for the C-POD (note 1Pa p-p is the SI unit for pressure and correctly represents the threshold) © Chelonia Ltd.

The C-POD detector is a sound pressure level detector with a threshold of 1Pa peak to peak at 130 kHz, with the frequency response shown below (Figure 3.2, 3.3, www.chelonia.co.uk). An estimated detection distance of 797.6m ±61m (75% of groups recorded<400m) for C-PODs and bottlenose dolphins was generated in the Shannon Estuary, while distances estimates of 441m ±42m (92% <400m) were generated for the harbour porpoise in Galway Bay (O'Brien *et al,* 2013).

Through the C-POD.exe software (example Figure 3.4), data can be viewed, analysed and exported. Additionally, the software can be used to change settings of individual SD cards. The software includes automatic click train detection, which is continually evolving as Chelonia Ltd receives more feedback from their clients. C-POD.exe can be run on any version of Windows and requires an external USB card reader, which reads the SD card into the directory. Version 2.044 (October, 2014) was used for all analyses. C-POD.exe software allows the user to extract click trains under five classification parameters but only the porpoise like category was used for this analysis of the long-term dataset.

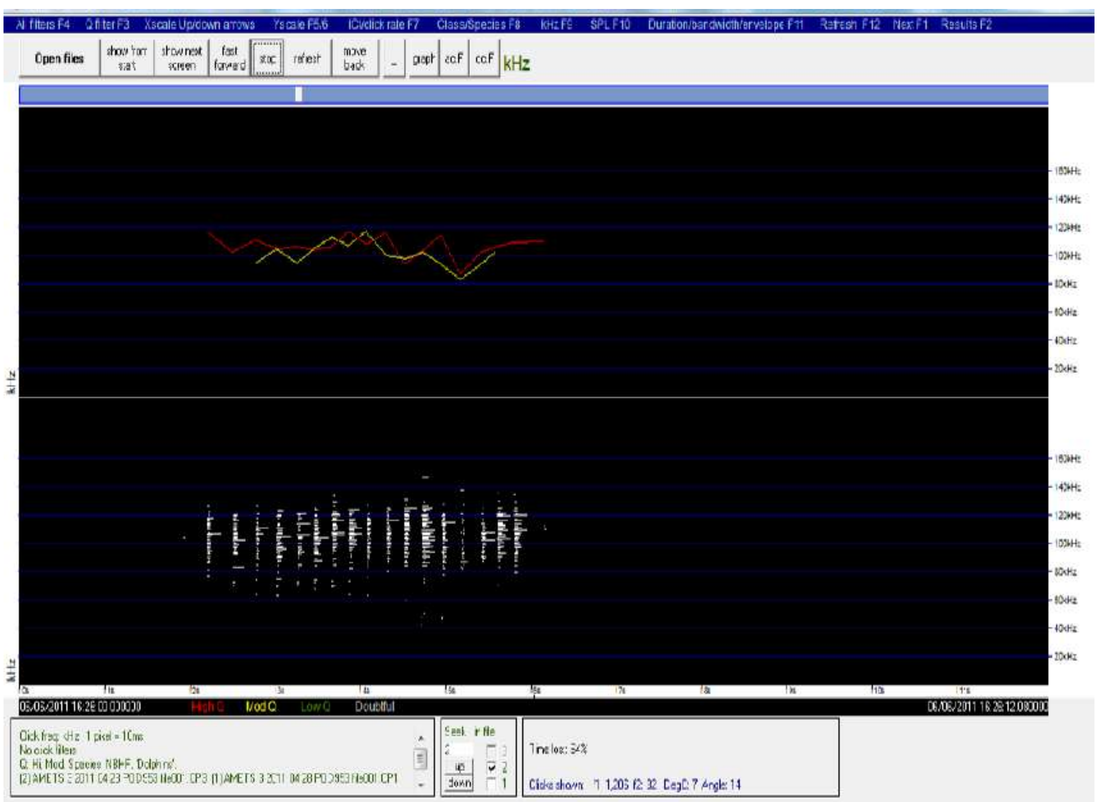

Figure 3.4: Screen grab of C-POD.exe, showing a harbour porpoise click train ((i) porpoise-like, but other categories include (ii) dolphins, iii) other train sources, iv) unclassed, v) boat sonars)

SAM once deployed is independent of weather conditions and thus ensures high quality data is collected but only at a small spatial scale. C-PODs can be deployed on a mooring for 3-4 months before recovery and downloading of data. Data was recovered and analysed three to four times a year. This data was analysed as detection positive minutes (DPM) to generate an acoustic index of activity. This technique provides large datasets to enable changes in activity to be identified at high resolutions. DPM's provide high quality data on seasonal, diel and tidal occurrence. Data was compared across sites, provide opportunities for assessing cetacean activity at the MRE Test site prior to the deployment of any devices.

3.1.3 C-POD calibration

Calibration of equipment is important in order to compare results across units. Chelonia LTD, the manufacturers of C-PODs, calibrates all units to a standard prior to dispatch. These calibrations are carried out in the lab under controlled conditions and thus Chelonia highly recommend that further calibrations are carried out in the field prior to their employment in monitoring programmes instead of further tank tests (Nick Tregenza *pers comms*). All C-PODs deployed during this present study were calibrated during field trials in the Shannon Estuary by the IWDG.

Field calibrations are important where projects employ several units aimed at comparing detections across a number of sites. If units of differing sensitivities are used, then these data do not truly reflect the activity at a site. For example, a low detection rate may be attributed to a less sensitive C-POD, with a lower detection threshold, which in turn leads to a lower detection range, while the opposite holds for a very sensitive unit. It is fundamental that differences between units are determined prior to their deployment as part of any project, to allow for the generation of correction factors which can be applied to the resulting data. Field trials should be carried out in high density areas in order to determine the detection function (O'Brien *et al.* 2013). The field calibration of new units should be carried out in conjunction with a reference C-POD, where a single unit is used solely for calibrations and is deemed a reference. This allows for the incidence where new units are acquired over the course of a project to be calibrated with the reference. All units used for SAM were deployed in the Shannon Estuary prior to deployment for up to 28 days to allow enough time to establish if sensitivity would be a confounding factor between units before been deployed as part of the present study.

Upon recovery of the units, data were extracted under two categories, 1) Narrow Band High Frequency (NBHF) (porpoise band) and 2) Other (dolphin band) using the C-POD.exe software (Version3.0.0.030, November 2019, October, 2014). These data were in the form of Excel.xlsx files using C-POD.exe software and analysed as Detection Positive Minutes (DPM) across hourly segments. Statistical analyses were carried out using the program R (R Development Core Team, 2011). All combinations of C-POD pairs were modelled using an orthogonal regression of DPM across hourly segments. This was compared to a null model, assuming no variation in C-POD detections, a = 0 and b = 1, and used to assess C-POD performance. An error margin of ±20% DPM per hour was plotted along the null model to distinguish between an acceptable level of variation in C-POD performance and problematic variation due to faulty or highly sensitive units (Tregenza pers comm.). From these graphs it is possible to determine successful or unsuccessful C-POD combinations. The mean intercept and gradient values of the orthogonal model for each C-POD pair were extracted and used to create centipede plots where, deviation from 0 on the horizontal axis, of mean intercept values and deviation from 1 on the horizontal axis, of mean gradient values indicated deviations from the null model. This was also used to identify if only one or two POD combinations were unsuccessful and also the extent of variability within the intercept and gradient values. Results were then used to highlight poor performing units or very sensitive units, if they existed and a correction factor can be generated and applied to the data.

3.1.4 SAM Data Analyses

All C-POD data were analysed using only high and moderate probability clicks. Both dolphin and porpoise detections were extracted as detection positive minutes per day (DPM), and both were statistically analysed for trends. As recommended by the manufacturers, a validation overview was carried out on the data, where 10% of all detected trains were visually inspected on cpod.exe to verify they were in fact of harbour porpoise origin. Of this 10% very few trains were classified as false positives, and therefore analysis of the porpoise detections proceeded with the classification of hourly variables into the following categories; season (spring, summer, autumn and winter), diel cycle (morning, day, evening and night-time), tidal state (ebb, flood, slack high, slack low) and tidal phase (spring, neap). The term *PPM* represents the number of minutes in a day or an hour that harbour porpoises were acoustically detected and *DPM* represent the number of dolphin minutes. Seasonal categorisations were assigned according to the seasons; spring (February, March April), summer (May, June, July) autumn (August, September, October) and winter (November, December, January). Data files in the format porpoise minutes per hour (*PPM/h*) and dolphin minutes per hour (*DPM/h*) were classified into **morning, day, evening and night-time** categories, using local times of sunrise and sunset times, which were obtained from the U.S. Naval Observatory (www.aa.usno.navy.mil/data/docs/RS). Hourly data segments were further categorised into each of the four tidal states, where three hours were assigned to each state (one hour either side of the hour). Files were further split to correspond with tidal phase (spring and neap cycles) using admiralty data (WXTide 32) where two days either side of the highest tidal height was deemed spring, and two days either side of the least difference in tidal height between high and low tide was deemed neap, all other days were classified as transitional.

All data were analysed using the programme R. A GLM was fitted to the binomial data using the glm() function. For site 3 where three different deployment took place, C-POD ID number was further included as a random factor to take into account potential variability between units, using the glmer() function in the lme4 package. Akaike's information criterion (AIC) and a histogram of fitted residuals were used as diagnostic tools for model selection. Hosmer and Lemeshow goodness of fit (GOF) test was used to check that model fitted values didn't differ significantly from observed values. Wald chi-squared tests were computed for each variable and predicted proportions of Porpoise positive hours (PPH) were extracted across all levels using the RH package and displayed as box plots. A series of post hoc tests using a Tukey approach for pairwise comparison of means (lsmeans() R packages 'lsmeans' & 'multcomp') was conducted to locate significant differences. The cld() function (R packages 'multcomp') was used to group levels of each factor based on significant differences. Levels labelled with a common letter on the boxplots are not significantly differing from each other. R is a language and environment for statistical computing and graphics. It is free software, available at http://www.r-project.org/index.html. The software compiles and runs on a wide range of UNIX platforms, Windows and MacOS. R provides a wide variety of linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering and graphical techniques (R Development Core Team, 2020). R is designed around a true computer language, similar to the S language. The effective programming language includes conditionals, loops, user-defined recursive functions and input and output facilities.

3.1.5 Moorings

Two mooring types were used over the project duration (Figure 3.5a and 3.5b). Heavy weight mooring were established with 250kg of clumped chain and surface markers while Acoustic Release Arrays were also established. Equipment loss was experienced with both mooring types. Moorings were established with a foreshore licence from the Department of Housing, Planning and Local Government (FS 006840).

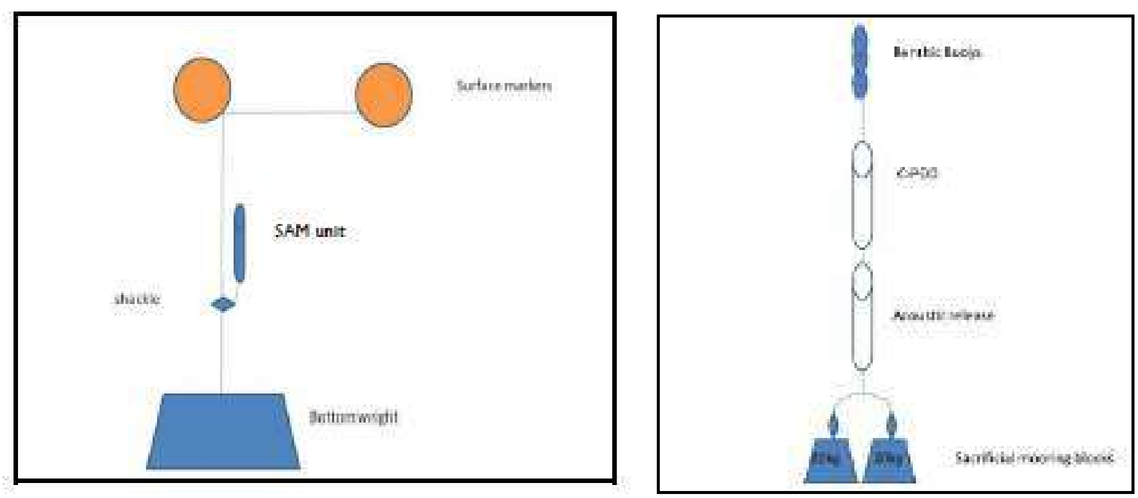

Figure 3.5a. CPOD deployed off heavy mooring, 3.5b. Acoustic Release system for deploying C-PODs.

4 Results

4.1.1 C-POD Calibrations

All units used during the present project were calibrated in the Shannon Estuary across three calibration trials in June and December 2019 and April 2020. Results from these trials are presented below (Figures 4.1-4.3) and show that there were some discrepancies between units. Further exploration into individual unit performance showed that C-POD performance was however within the acceptable error margin of ±20% DPM per hour (Figures 4.1-4.3) and therefore no correction factor was needed to be applied to the data to make them comparable (O'Brien *et al*. 2013). During analysis of the long-term dataset, differences in sensitivities between units is accounted for by inserting the C-POD number as a random factor when running the generalized linear mixed-effect models (GLMMs) and additionally all C-PODs were deployed randomly between sites over the duration of the study. C-PODs are constantly monitored to ensure they are performing as expected and not unit caused concern over the duration of this project.

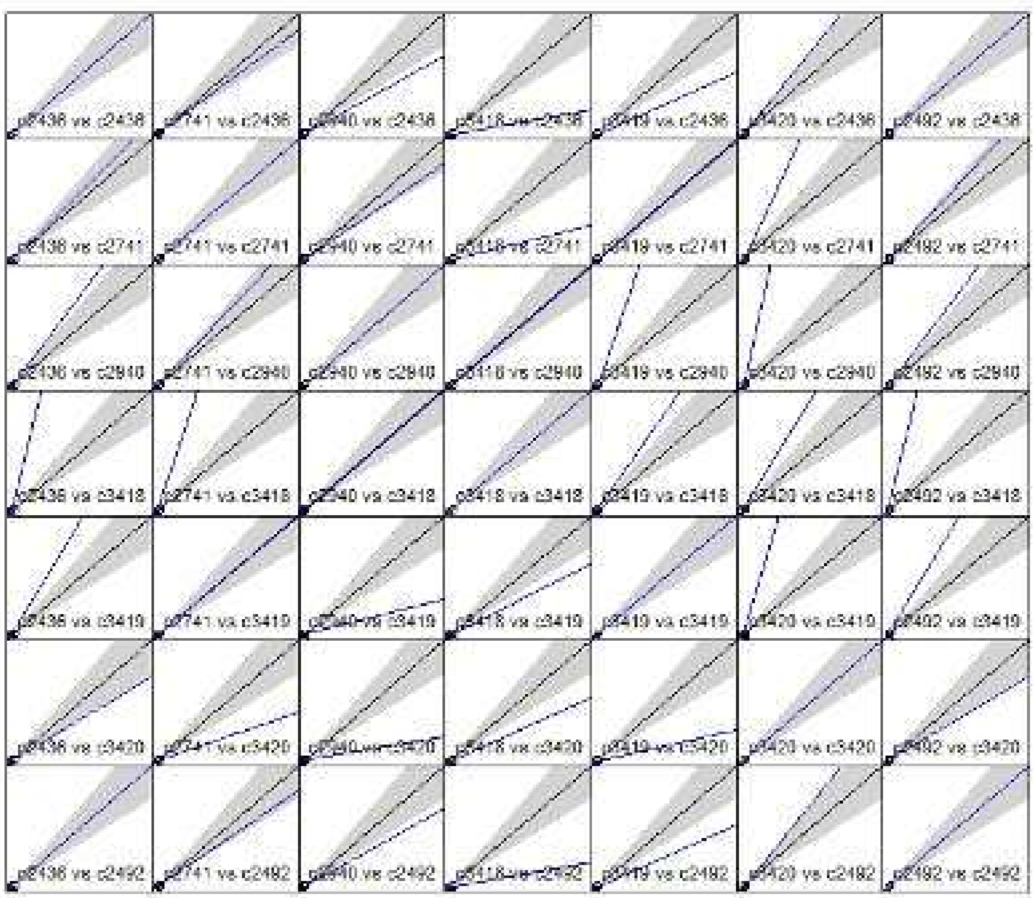

Figure 4.1: Orthogonal regression plot of C-POD comparisons in calibration trial (June-July 2019), in blue, with a null model where each unit performs exactly the same, in black and an acceptable error margin of ±20%, in grey from Calibration trials, June-July 2019.

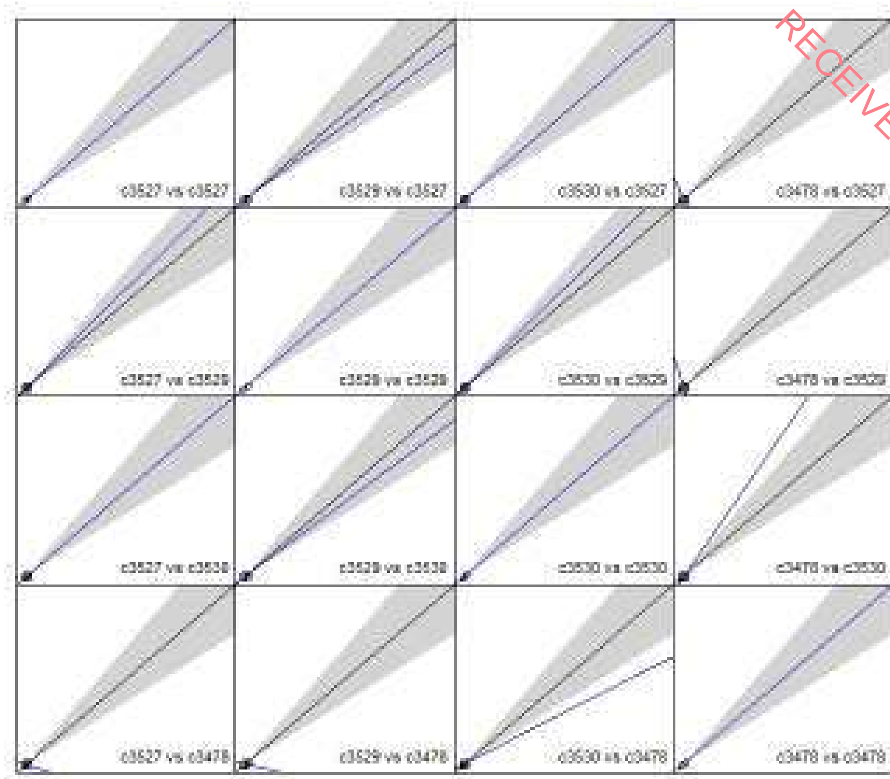

Figure 4.2: Orthogonal regression plot of C-POD comparisons in calibration trial 2, with a null model where each unit performs exactly the same, in black and an acceptable error margin of ±20%, in grey from Calibration trials, December 2019.

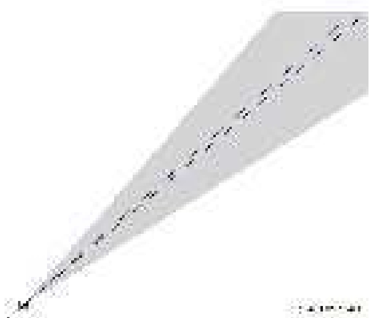

Figure 4.3: Orthogonal regression plot of C-POD comparisons in calibration trial 3, with a null model where each unit performs exactly the same, in black and an acceptable error margin of ±20%, in grey from Calibration trials, April 2020

4.1.2 Overview of SAM results

Species discrimination of SAM data was carried out using the dedicated software into two categories;

1) NBHF, which represent harbour porpoise detections and

2) Dolphin, which includes all dolphin detections.

It is not possible to differentiate between dolphin species with C-POD data due to similarities in their click characteristics and especially an overlap in frequency use. Results from this short deployment showed that porpoises were the most frequently detected species (Figures 4.4-4.7), while confirmed dolphin detections were only found in two locations during this deployment, in small numbers (Figures 4.8-4.9).

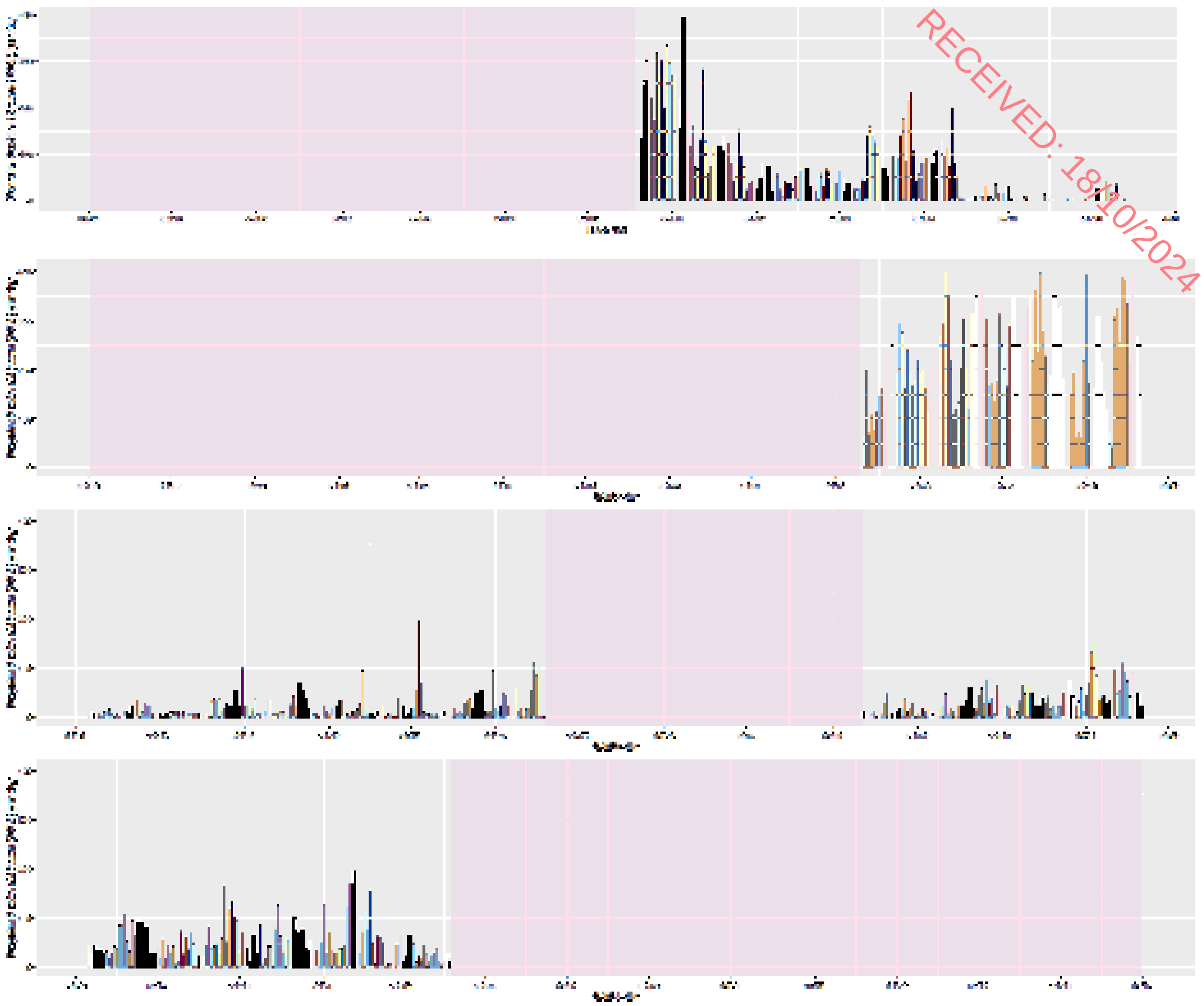

Figure 4.4-4.7: Number of Harbour Porpoise positive detections minutes (PPM) per day recorded across all locations (Lidar, SAM2, SAM3 and SAM4).

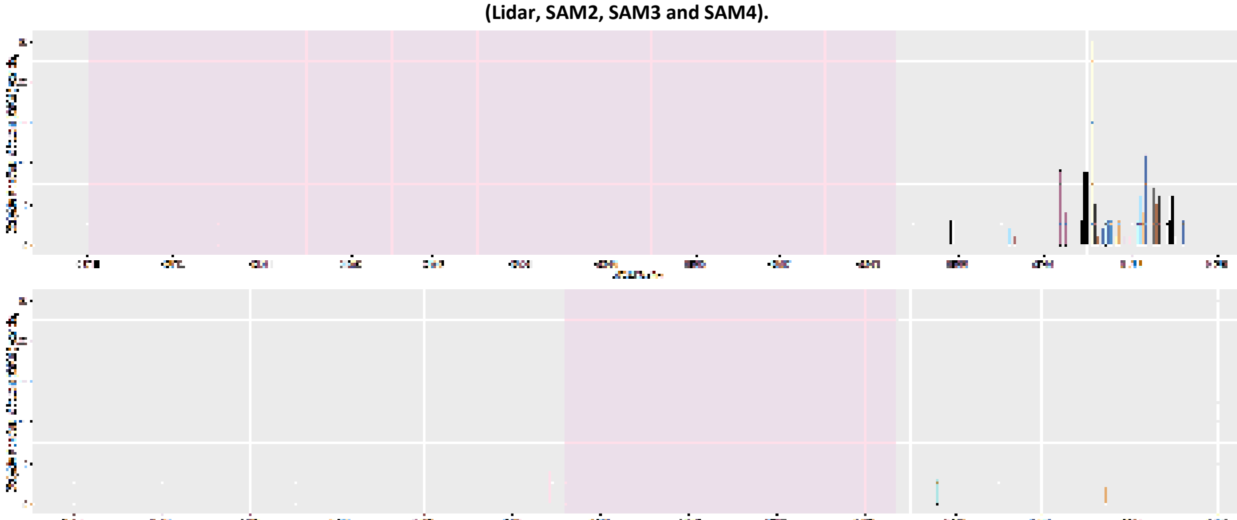

Figure 4.8-4.9: Number of Dolphin detections per day recorded across SAM2 and SAM3 locations.

Harbour porpoises were the most frequently detected marine mammal species (see Table 4.1, Porpoise Positive Minutes (PPM), Porpoise Positive Hours (PPH), Porpoise Positive Days (PPD)) with dolphins rarely detected (Table 4.1, Dolphin Positive Hours (DPH), Dolphin Positive Days (DPD)) (Table 4.1). Large gaps exist in the dataset due to the repeated loss of equipment at the site.

Most data were obtained from SAM 3, and porpoises were recorded at the site on 99% of days with a mean of 1.08 detections per hour. At SAM 4, 135 days of data were obtained and porpoises also recorded on 99% of days with a mean of 2.13 detections per hour and SAM 2 porpoises were recorded on 100% of 103 days monitored with a highest mean of 9.44 detections per hour. At the LIDAR site, a total of 179 days were monitored with porpoise detections on 90% of days and a mean of 2.96 detections per hour. Dolphins were recorded on 29% of days at SAM 2 but the overall number of detections were low, while at the remaining sites were never recorded with the exception of SAM 3 where detections were recorded on 1% of days.

Table 4.1: Summary of results from Static Acoustic Monitoring (SAM) programme November 2019-November 2020 (135-268 days).

Location	Effort (days)	Dates	PPH - %PPH	DPH - %DPH	PPD - %PPD	DPD - %DPD	Mean PPM/H	Mean PPM/D
2	103	11/08/2020 – 21/11/2020	2054 - 84%	54 - 2%	103 - 100%	30 - 29%	9.44	225
3	268	06/11/2019 –19/03/2020 19/03/2020 –18/04/2020 12/08/2020 –21/11/2020	1661 - 26%	3 – 0%	264 - 99%	3 - 1%	1.08	26
4	135	06/11/2019 – 19/03/2020	1514 - 47%	0 - 0%	134 - 99%	0 - 0%	2.13	51
LIDAR	179	19/05/2020 –12/08/2020 12/08/2020 – 13/11/2020	2008- 47%	29 - 1%	161 – 90%	23 - 13%	2.96	71

4.1.3 Generalized linear model (GLM) analyses

Generalized linear models (GLM) were carried out for the 3 sites (SAM 2, 3 and 4) where multiple deployments took place - to assess significant differences between monitoring locations, allowing for a detailed but preliminary assessment of fine scale use of the proposed Oriel Windfarm. Modelling was conducted for porpoise detections (PPH) but not for dolphins detections given the very limited presence reported in the datasets. Results were examined across temporal classes (season, diel, tidal cycle and tidal phase). Using the box plots below, results can be explained more easily. Tables 4.10-4.12 present the statistical significance of each factor at each site, and the differing levels within each variable.

4.1.3.1 SAM 2

At SAM 2, season was found to have a significant influence on detection rate (Wald test for “Season”: $Chi^2 = 239.3$, $p < 0.001$; Figure 4.10), with more porpoises being reported in autumn than in winter. Diel cycle also influenced porpoise presence (Wald test for “Diel”: $Chi^2 = 54.3$ $p < 0.001$), detected most often at night, followed by evening and morning, with least detections occurring during the day. No effect of tidal parameters (cycle or phase) were observed at this site over the deployment duration.

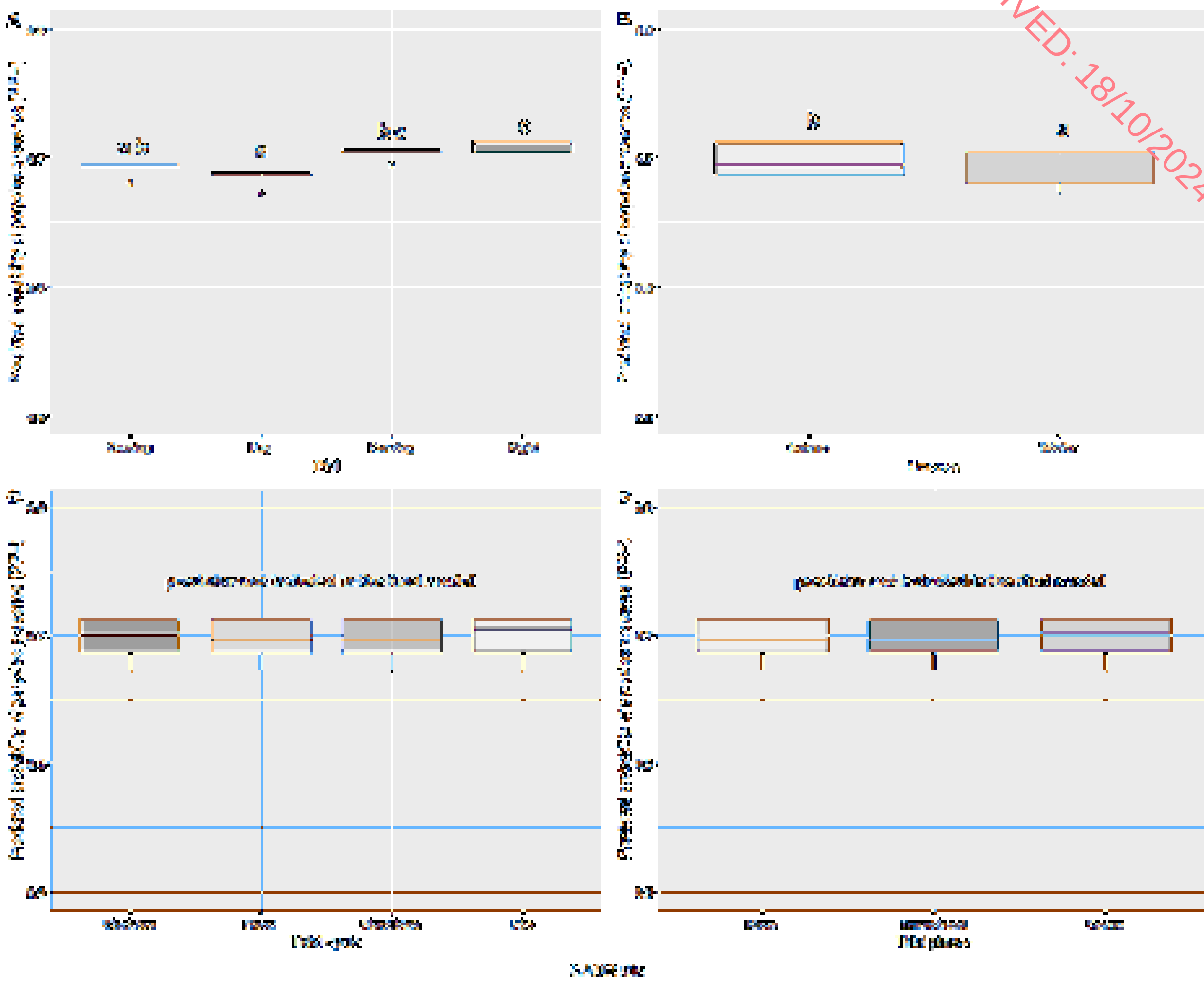

Figure 4.10 Predicted proportion of Harbour porpoise (NBHF) detection positive hours, in the narrow band high frequency channel at the SAM2 Site, across the variables of season, diel, tidal phase, and tidal cycle. Letters indicate groups of significant differences: levels sharing a letter are not statistically different from each other.

4.1.3.2 SAM 3:

At site 3, contrary to site 2, more detections occurred in winter and spring than in autumn (Wald test for “Season”: $Chi^2 = 33.9$, $p < 0.001$; Figure 4.11). Diel cycle also had a significant effect (Wald test for “Diel”: $Chi^2 = 532.1$, $p < 0.001$), with again a higher detection rate at night, lower during morning and evening, and minimal during the day. At this location, porpoises seemed to be present more often during slack-high tides than flood or slack high waters (Wald test for “Tidal cycle”: $Chi^2 = 20.9$, $p < 0.001$). Tidal phase was a significant factor in the model (Wald test for “Tidal phase”: $Chi^2 = 6.2$, $p = 0.045$), although no clear differences across levels were identified following the Tukey test.

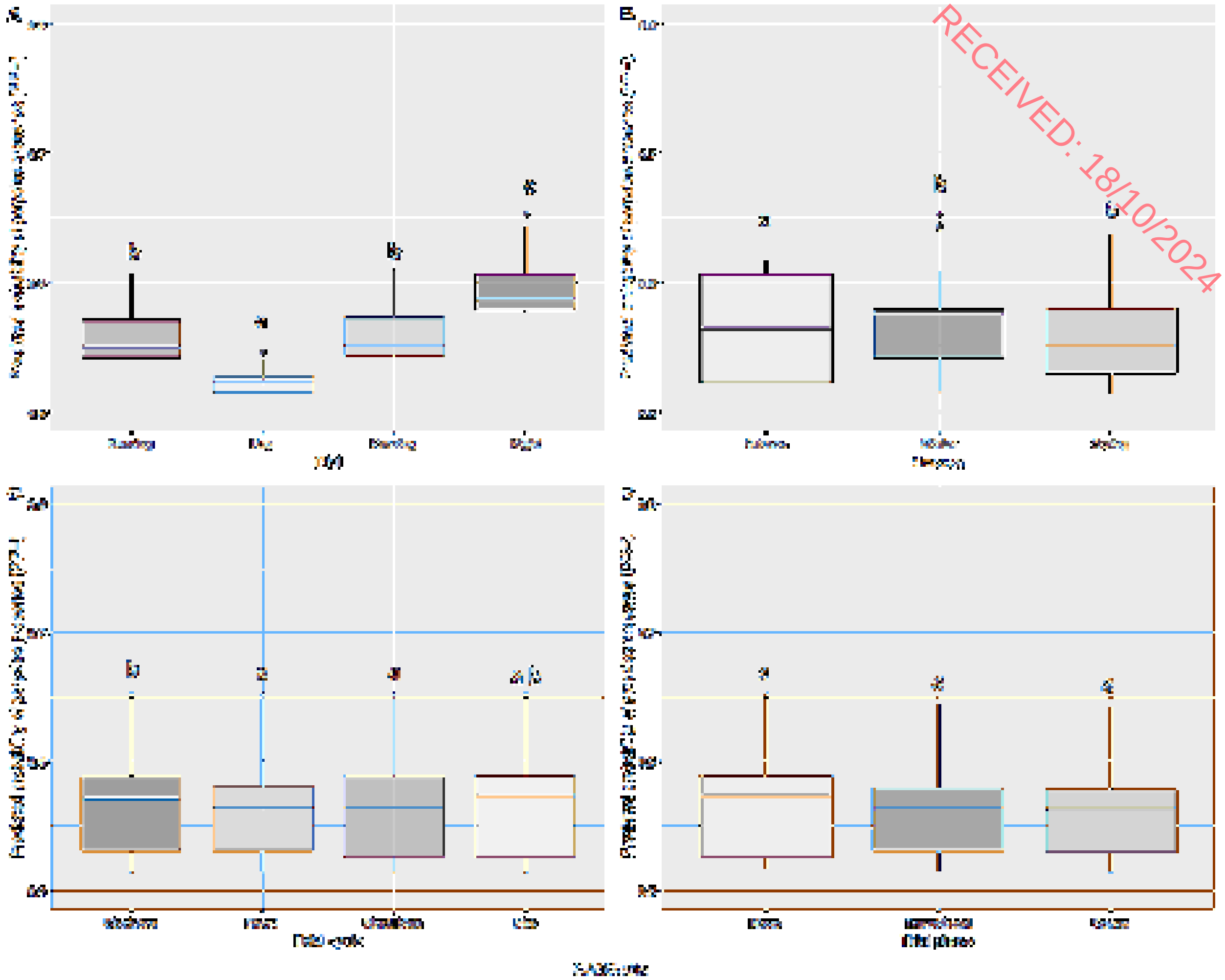

Figure 4.11. Predicted proportion of Harbour porpoise (NBHF) detection positive hours, in the narrow band high frequency channel at the SAM3 Site, across the variables of season, diel, tidal phase, and tidal cycle. Letters indicate groups of significant differences: levels sharing a letter are not statistically different from each other.

4.1.3.3 SAM 4

Significantly more porpoise detections were recorded during the winter months compared to spring months (Wald test for "Season": Chi² = 24.2, $p < 0.001$, Figure 4.12). Detection rate was significantly higher during morning than during the day and evening, and also higher during the night than during the evening (Wald test for "Diel": Chi² = 19.6, $p = 0.0002$, see Table 4.2 for detailed pairwise comparisons). At this location, slack low waters again, but also flood periods had higher presence than ebb periods (Wald test for "Tidal cycle": Chi² = 19.9, $p = 0.0002$). Tidal phase had no significant impact on porpoise detections at this location over the deployment period, even though the factor was included in the best model (Wald test for "Tidal phase": Chi² = 4.6, $p = 0.097$).

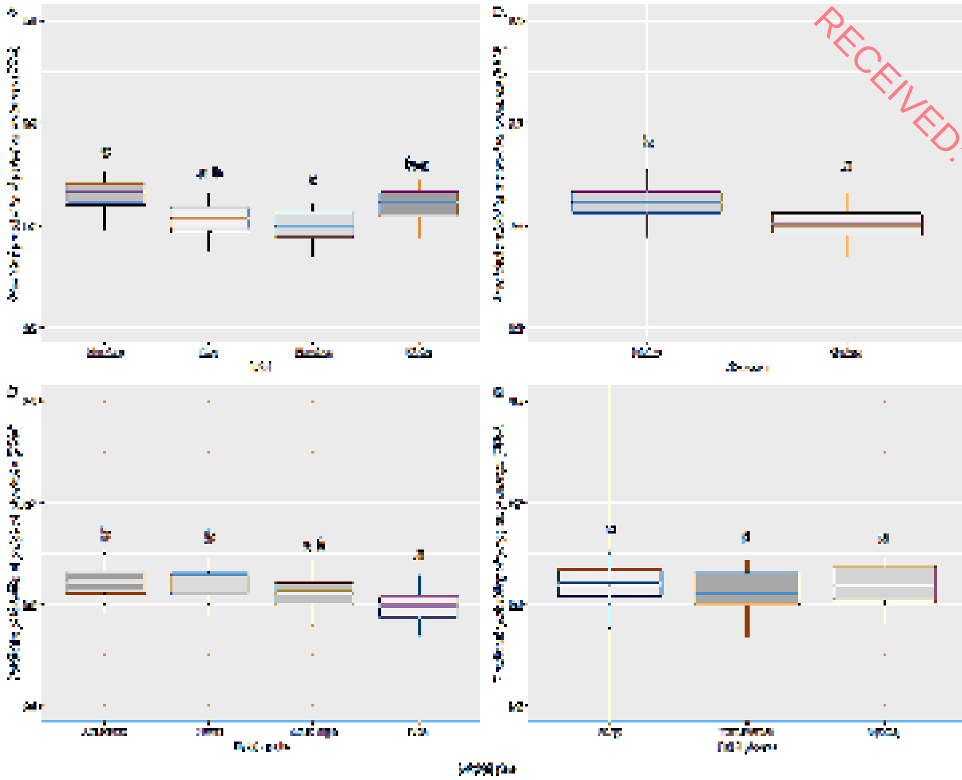

Figure 4.12. Predicted proportion of porpoise detection positive hours, in the narrow band high frequency channel at the control location of the SAM4 Site, across the variables of season, diel, tidal phase, and tidal cycle. Letters indicate groups of significant differences: levels sharing a letter are not statistically different from each other.

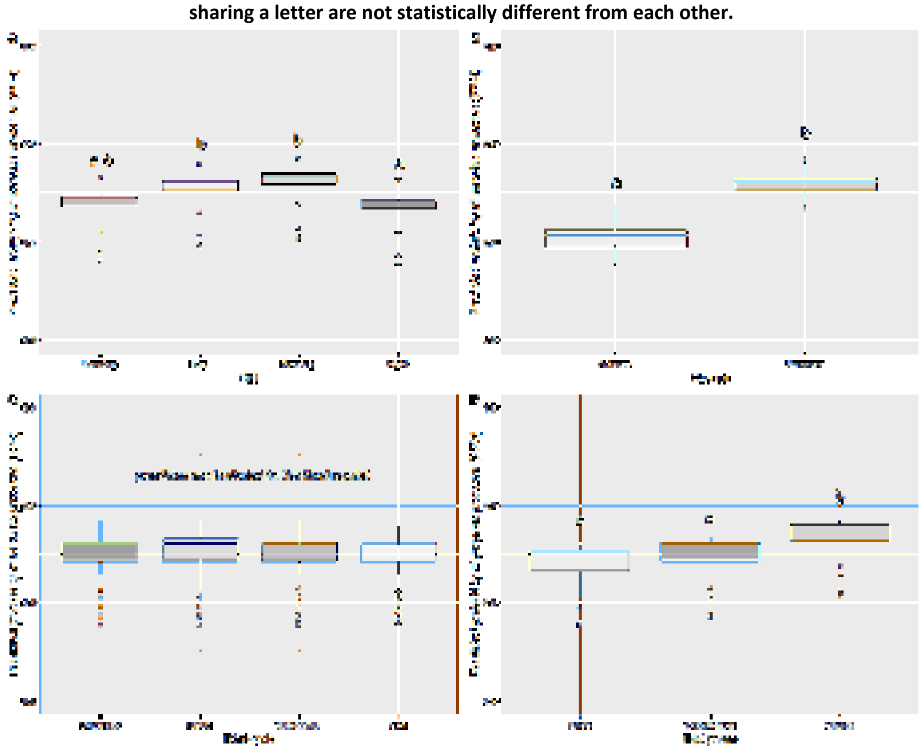

Figure 4.13. Predicted proportion of porpoise detection positive hours, in the narrow band high frequency channel at the control location of the LIDAR Site, across the variables of season, diel, tidal phase, and tidal cycle. Letters indicate groups of significant differences: levels sharing a letter are not statistically different from each other.

Table 4.2: Summary of overall predictors significance across datasets from the Oriel Sites; SAM2, SAM3, SAM4 and LIDAR (Wald Chi² test)

	SAM2	SAM3	SAM4	LIDAR
Season	***	***	***	***
Diel cycle	***	***	***	**
Tidal cycle	x	***	***	x
Tidal phase	x	*	.	***

Wald χ^2 test - Significance codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1. X indicates that the predictor wasn't included in the final model (lowest AIC)**

Table 4.3: Summary of Tukey test results used to locate significant differences between levels of each factors, across datasets from the Oriel Sites; SAM2, SAM3, SAM and LIDAR. Each pairwise comparison of least mean squares (LMS) (i.e each p-value) isn't presented for clarity, but have been used to build groups (a, b, c) within each factor. Levels sharing a common group (low case letter) do not statistically differ from each other (i.e Tukey adjusted p-value >0.05).

	SAM2		SAM3		SAM4		LIDAR	
	LMS	Group	LMS	Group	LMS	Group	LMS	Group
Season								
Winter	1.38 ± 0.1211	a	-0.976 ± 0.291	b	0.0135 ± 0.0539	b		
Spring	x		-0.957 ± .,292	b	-0.3611 ± 0.0672	a		
Summer	x		x		x		0.648 ± 0.0646	b
Autumn	1.75 ± 0.0722	b	-1.628 ± 0.3	a	x		-0.334 ± 0.1277	a
Diel cycle								
Morning	1.33 ± 0.1493	ab	-1.097 ± 0.296	b	0.0964 ± 0.1035	c	-0.0131 ± 0.1396	ab
Day	1.12 ± 0.0935	a	-2.307 ± 0.295	a	-0.2918 ± 0.477	ab	0.2826 ± 0.0817	b
Evening	1.73 ± 0.17	bc	-1.069 ± 0.296	b	-0.4282 ± 0.1050	a	0.4258 ± 0.1461	b
Night	2.08 ± 0.1086	c	-0.275 ± 0.287	c	-0.0715 ± 0.0559	bc	-0.0656 ± 0.1170	a
Tidal cycle								
Slack low	x		-0.982 ± 0.291	b	-0.0128 ± 0.0782	b	x	
Flood	x		-1.242 ± 0.290	a	-0.0481 ± 0.0723	b	x	
Slack high	x		-1.369 ± 0.292	a	-0.1997 ± 0.0795	ab	x	
Ebb	x		-1.155 ± 0.292	ab	-0.4346 ± 0.0836	a	x	
Tidal phase								
Neap	x		-1.06 ± 0.292	a	-0.0816 ± 0.0827	a	-0.0889 ± 0.1191	a
Spring	x		-1.27 ± 0.292	a	-0.1678 0.0836	a	0.4793 ± 0.1176	b
Transitional	x		-1.24 ± 0.287	a	-0.2720 ± 0.0532	a	0.0819 ± 0.0822	a

Results are averaged over the levels of other predictors in each model. Results are given on the logit (not the response) scale. Confidence level used: 0.95. Results are given on the log odds ratio (not the response) scale. P value adjustment: Tukey method for comparing a family of 2-4 estimates. Significance level used: alpha = 0.05. Groups are based on these p-values.

4.1.3.4 SAM LIDAR

At the LIDAR site, contrary to what was observed in other locations, porpoise presence was lowest at night, compared to the day and evening (Wald test for "Diel": $Chi^2 = 13.6$, $p = 0.0035$). There was a clear decrease in detection rate between summer and autumn (Wald test for "Season": $Chi^2 = 55.6$, $p < 0.001$). Tidal cycle did not influence detections but a higher PPH probability coincided with spring tides Wald test for "Tidal phase": Chi^2 = 15.8, p = 0.0004).

4.1.3.5 SUMMARY

In summary, results across all days monitored at each of the sites show porpoises to be present on average over 99% of days monitored. Season appeared to influence porpoise presence differently across sites, with winter and summer seemingly important periods, with more porpoise detections recorded. The effect of diel cycle also varied across location, although night, morning and/or evening phases often yielded more detection than day phases (except at the LIDAR site). Tidal cycle and Tidal phase only affected detection rate in some locations, where slack low water coincided with increased detections.

5 Discussion

Cetaceans live in an acoustic world and increasingly attempts have been made to develop acoustic monitoring techniques rather than relying on visual methods, where efficacy is dependent on light, weather conditions and sea-state, especially for species such as the elusive harbour porpoise. The reliance on sound by these animals is extremely important and therefore SAM is a very valuable tool for their determining presence and assessing fine scale habitat use by various odontocete species. The main advantage of SAM is that it can provide information on species that can go undetected visually for up 95% of the time (harbour porpoise; Read & Westgate, 1995). Patterns of cetacean presence have been described over seasonal scales (Canning *et al*., 2008, Bolt *et al*., 2009; Simon *et al*., 2010; Gilles *et al*., 2011; O'Brien *et al.* 2013) diel cycle (Carlström, 2005; Todd *et al*., 2009; O'Brien *et al.* 2013) and tidal patterns (Marubini *et al*., 2009; O'Brien *et al.* 2013). Although SAM can provide a much more complex account of cetacean activity at a site in comparison to visual monitoring, it fails to inform on the numbers present and hence the need for visual surveys. It is clear from the present report that SAM shows harbour porpoises to be present throughout the year with an increase in activity or numbers during winter and autumn Detections were highest across all locations during these months, but differences between locations occurred with diel and tidal cycles showing their use of a site is quite complex even at a small spatial scale.

The aim of the present study was to produce a robust assessment of the marine mammal community at the proposed Oriel Windfarm site and their use of the site. We have also produced a baseline dataset of cetacean occurrence across a 12 month period from November 2019 and November 2020. Large gaps exist in the dataset due to missing equipment on a number of occasions. A total of six deployments were lost over the duration of the project from different mooring types, including acoustic release arrays and heavy weight moorings. Two CPODs were washed up, one in Scotland (incl. an acoustic release) and one in Baltray, Co Louth and both recovered, with 3 units lost permanently.

Table 5.1: Monitoring results from SAM across Ireland

County	Site	Total days	DPD %	Total PPM	%DPM	Mean DPM/day	Mean DPM/hr	Reference
Louth	SAM 2	103	100	23,112	*	225	9.44	*Present study*
Louth	SAM 3	268	99	6381	*	26	1.08	*Present study*
Louth	SAM 4	135	99	6839	*	51	2.13	*Present study*
Louth	LIDAR	179	90	10,000	*	71	2.96	*Present study*
Dublin	Loughshinny	189	100	26,281	9.6	137	5.8	O'Brien *et al.* (2015)
Galway	Spiddal	572	89	27,902	3.4	48.8	2	O'Brien *et al.* (2013)
Kerry	Inishtooskert	264	80	3930	1.04	14.9	0.6	O'Brien *et al.* (2013)
Kerry	Wild Bank	289	80	2097	0.51	7.3	0.3	O'Brien *et al.* (2013)
Kerry	The Gob	52	49	3015	4.1	58	2.4	O'Brien *et al.* (2013)

From the data presented here, it is clear that the all sites monitored are important areas for harbour porpoises, with porpoises recorded on a daily basis across all sites monitored. However, looking at trends this presence differs between locations. Regarding season, autumn was the most significant season across three of the four sites, with night-time hours also yielding more detections at three of the four sites. This highlights the need for SAM as without it perhaps we are missing much of this activity during visual surveys. The states of the tide had a significant effect at two of the four sites, while tidal phase only had an effect at the inshore LIDAR site with more detections recorded during spring tides.

These results are similar to those found in other inshore areas, and comparing detections it can be seen these are important areas off Co. Louth even with the many data gaps that exist. Mean detection positive minutes per day from Co. Louth are higher than some important sites around the country, for example the Blasket Islands SAC in Co. Kerry, which is one of three designated areas for the species (Table 5.1).

5.1.1 Conclusion

In conclusion, SAM does not provide information on the numbers of animals using a site but gives an insight into habitat use across time which could not be determined from visual monitoring alone. Clearly, this area of Co. Louth is an important area for harbour porpoises. As harbour porpoises are listed on Annex II of the Habitats Directive, this species is entitled to strict habitat protection, and extreme care must be taken to ensure any development does not degrade this habitat or cause undue disturbance. These SAM results will serve to inform protocols of best practice for the area thus ensure small cetaceans are not negatively impacted upon. Mitigation measures should take into account the potential acoustic disturbance of marine mammals at the site and any associated noise input or long-term potential disturbance should be reviewed in order to minimise displacement and to prevent habitat exclusion or hearing impacts such Temporary Threshold Shift (TTS).

6 Acknowledgements

We would like to thank Fastnet Shipping Ltd and skippers Nicky Fortune and Walter Rankin and crew for providing an excellent vessel and building moorings these deployments and Eoin Grimes at Irish Commercial Charter Boats for the final SAM recovery. This survey project was contracted by Parkwind through Aquafact and we would particularly like to thank Brendan O'Connor of Aquafact and Richard Church of Parkwind for their support throughout.

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APPENDIX 11.10

BENTHIC SAMPLING DATA

VOLUME III

APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

Appendix 11.10 Benthic sampling data

Table 1. Environmental attributes (Grab samples)

Sample ID	1	2	3	4	5	6	7
Easting (ITM)	722151	722094	722172	722216	722222	722246	722163
Northing (ITM	810988	811016	811114	811119	811151	811128	811064
Lat	54.03359693	54.03386189	54.03472358	54.03475807	54.03504405	54.0348318	54.03427666
Long	6.13531523	6.1361736	6.13494418	6.13427087	6.13416645	6.13380954	6.1351016
Date	16/8/2023	16/8/2023	16/8/2023	16/8/2023	16/8/2023	16/8/2023	16/8/2023
Location	Greenore Port	Greenore Port	Greenore Port	Greenore Port	Greenore Port	Greenore Port	Greenore Port
Time	12:29	12:46	12:53	12:57	13:03	13:20	13:45
Depth (m)	12	3.5	5.1	10	13	12	6.5
Field description	Cobble/gravel	Shelly sand	Mud	Mud	Muddy gravelly sand	Coarse Sand	Mud
Folk: 1954	Sandy Gravel	Sandy Gravel	Slightly Gravelly Sandy Mud	Slightly Gravelly Muddy Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand
Layering (cm)	No	1-5cm	1cm	1cm	5cm	No	No
Anoxic	No	No	Strongly	Strongly	No	Strongly	Strongly
Colour	Grey	Grey	Grey	Brown	Grey	Grey	Brown
Weather	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Sea state	F1	F1	F1	F1	F1	F1	F1
Boat anchored	No	No	No	No	No	No	No
Grab contents depth (cm)	6	12	14	14	6	10	14
Sampler type	Day grab	Day grab	Day grab	Day grab	Day grab	Day grab	Day grab
Sieve Size	1mm	1mm	1mm	1mm	1mm	1mm	1mm

Table 2. Particle Size Analysis and Organic Carbon

		Sample ID						
		1	2	3	4	5	6	7
Medium pebble (gravel)	**>8 mm**	22.45	0.00	0.00	0.00	1.05	0.00	0.00
Small pebble (gravel)	**4-8 mm**	36.21	8.14	0.16	0.00	0.26	0.00	0.00
Granule	**2-4 mm**	16.34	30.95	1.53	2.72	1.56	0.02	1.70
Sand - very coarse	**1-2 mm**	6.76	32.97	1.05	2.68	2.21	0.16	1.83
Sand - coarse	**500-999 um**	3.49	14.20	2.03	2.32	1.95	0.72	1.88
Sand - medium	**250-499 um**	5.09	5.21	4.74	5.47	30.82	12.35	5.29
Sand - fine	**125-249 um**	7.34	2.56	16.12	29.03	52.28	75.15	26.22
Sand - very fine	**63-125 um**	0.73	1.82	20.73	18.55	4.97	7.79	25.72
Silt & Clay	**<63 um**	1.59	4.14	53.64	39.24	4.92	3.80	37.36
Folk classification		Sandy Gravel	Sandy Gravel	Slightly Gravelly Sandy Mud	Slightly Gravelly Muddy Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand
LOI %		1.64	4.07	8.41	7.24	2.12	2.34	7.28

Table 3. Macrofaunal data

					1	2	3	4	5	6	7
Phylum	**Aphia ID**	**Taxa**	**Qualifier**	**Authority**	**1.0 mm**	**1.0 mm**	**1.0 mm**	**1.0 mm**	**1.0 mm**	**1.0 mm**	**1.0 mm**
Porifera	132251	Sycon ciliatum		(Fabricius, 1780)	P						
Porifera	558	Porifera		Grant, 1836					P		
Cnidaria	1360	Actiniaria		Hertwig, 1882	1						
Platyhelminthes	793	Platyhelminthes		Minot, 1876	5	1					
Nemertea	152391	Nemertea			7	17					
Nematoda	799	Nematoda				8					2
Entoprocta	111796	Pedicellina		Sars, 1835					P		P
Annelida	137571	Tubificoides benedii		(d'Udekem, 1855)		1295	2			1	
Annelida	137582	Tubificoides pseudogaster		(Dahl, 1960)		13			4		1
Annelida	129266	Ophryotrocha		Claparède & Mecznikow, 1869	1						
Annelida	130041	Protodorvillea kefersteini		(McIntosh, 1869)	1	56					
Annelida	130130	Glycera tridactyla		Schmarda, 1861	1	7			3		
Annelida	130185	Nereimyra punctata		(Müller, 1788)	1						
Annelida	152249	Psamathe fusca		Johnston, 1836	2	5					
Annelida	130198	Syllidia armata		Quatrefages, 1866	5	2					
Annelida	130359	Nephtys hombergii		Savigny in Lamarck, 1818					2		
Annelida	130408	Perinereis cultrifera		(Grube, 1840)		1					
Annelida	130417	Platynereis dumerilii		(Audouin & Milne Edwards, 1833)	4				1		
Annelida	130616	Eteone longa	Aggregate	(Fabricius, 1780)	1	20					
Annelida	130632	Eulalia ornata		Saint-Joseph, 1888	7						
Annelida	129446	Eumida		Malmgren, 1865	1				1		
Annelida	334512	Phyllodoce mucosa		Örsted, 1843	51	12			1		
Annelida	939	Polynoidae		Kinberg, 1856	13	1					
Annelida	130599	Pholoe baltica		Örsted, 1843		2					

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Annelida	130601	Pholoe inornata		Johnston, 1839	10	17					
Annelida	129595	Sthenelais	Juvenile	Kinberg, 1856		1					
Annelida	131325	Odontosyllis ctenostoma		Claparède, 1868	5						
Annelida	131328	Odontosyllis gibba		Claparède, 1863	2						
Annelida	757970	Parexogone hebes		(Webster & Benedict, 1884)		5					
Annelida	131394	Sphaerosyllis taylori		Perkins, 1981		4					
Annelida	129680	Syllis		Lamarck, 1818	1						
Annelida	131431	Syllis garciai		(Campoy, 1982)		1					
Annelida	129533	Jasmineira		Langerhans, 1880	1						
Annelida	130967	Sabella pavonina		Savigny, 1822	2						
Annelida	560033	Spirobranchus lamarcki		(Quatrefages, 1866)	489	2					
Annelida	131106	Aonides oxycephala		(Sars, 1862)		17	1				
Annelida	131116	Dipolydora caulleryi		(Mesnil, 1897)		2					
Annelida	131169	Pseudopolydora pulchra		(Carazzi, 1893)					1		
Annelida	131170	Pygospio elegans		Claparède, 1863					1		
Annelida	152314	Spio decorata		Bobretzky, 1870					1		
Annelida	596189	Spio symphyta		Meißner, Bick & Bastrop, 2011		9					
Annelida	131187	Spiophanes bombyx		(Claparède, 1870)			1				
Annelida	129775	Ampharete acutifrons	Aggregate	(Grube, 1860)		2					
Annelida	129781	Ampharete lindstroemi		Hessle, 1917		3			1		
Annelida	129938	Aphelochaeta marioni		(Saint-Joseph, 1894)		8					
Annelida	129943	Caulleriella alata		(Southern, 1914)		16					
Annelida	152217	Chaetozone christiei		Chambers, 2000		7	2				
Annelida	129953	Chaetozone gibber		Woodham & Chambers, 1994					1		
Annelida	129964	Cirriformia tentaculata		(Montagu, 1808)	3	1					
Annelida	863124	Tharyx robustus		Blake & Göransson, 2015	5	9	1		2		2
Annelida	129808	Melinna palmata		Grube, 1870			5				
Annelida	131480	Amphitritides gracilis		(Grube, 1860)		1					
Annelida	131519	Pista mediterranea		Gaillande, 1970		14					
Annelida	129710	Polycirrus		Grube, 1850		2					

Annelida	129876	Capitella capitata	Species complex	(Fabricius, 1780)	1	6			1		
Annelida	129892	Mediomastus fragilis		Rasmussen, 1973		92	7				
Annelida	129220	Notomastus		M. Sars, 1851	1	58					
Annelida	130268	Magelona filiformis		Wilson, 1959			1				
Annelida	130514	Leitoscoloplos mammosus		Mackie, 1987			1				2
Annelida	146950	Galathowenia oculata		(Zachs, 1923)		21					
Annelida	130867	Sabellaria spinulosa		(Leuckart, 1849)	60						
Annelida	130980	Scalibregma inflatum		Rathke, 1843		1					
Annelida	136063	Thysanocardia procera		(Möbius, 1875)		1					
Arthropoda	101891	Ampelisca brevicornis		(A. Costa, 1853)			1				
Arthropoda	102043	Microdeutopus anomalus		(Rathke, 1843)	2						
Arthropoda	101368	Aoridae	Female	Stebbing, 1899	13				1		
Arthropoda	179538	Nototropis vedlomensis		(Spence Bate & Westwood, 1862)					1		
Arthropoda	101871	Pseudoprotella phasma		(Montagu, 1804)	6						
Arthropoda	101669	Cheirocratus	Female	Norman, 1867		1					
Arthropoda	225814	Monocorophium acherusicum		(A. Costa, 1853)	231	88			4		
Arthropoda	101537	Gammarus	Juvenile	Fabricius, 1775		2					
Arthropoda	101383	Gammaridae	Juvenile	Latreille, 1802	1						
Arthropoda	102605	Lysianassa ceratina		(Walker, 1889)	3						
Arthropoda	531364	Animoceradocus semiserratus		(Spence Bate, 1862)		1					
Arthropoda	102380	Microprotopus maculatus		Norman, 1867		8					
Arthropoda	110445	Bodotria scorpioides		(Montagu, 1804)					1		
Arthropoda	106782	Crangonidae		Haworth, 1825				1			
Arthropoda	106782	Crangonidae	Juvenile	Haworth, 1825					2		
Arthropoda	107188	Pisidia longicornis		(Linnaeus, 1767)	3	1					
Arthropoda	106763	Portunidae	Juvenile	Rafinesque, 1815	3	1					
Arthropoda	1130	Decapoda	Zoea	Latreille, 1802			1				
Arthropoda	118956	Lekanesphaera monodi		(Arcangeli, 1934)	1	2					
Arthropoda	134725	Anoplodactylus pygmaeus		(Hodge, 1864)		1					

Arthropoda	106215	Balanus crenatus		Bruguière, 1789	136	2			16		
Arthropoda	712167	Austrominius modestus		(Darwin, 1854)	2						
Arthropoda	1130	Decapoda	Zoea			3					
Mollusca	140103	Hiatella arctica		(Linnaeus, 1767)	1						
Mollusca	23091	Pharidae	Juvenile	H. Adams & A. Adams, 1856			1				
Mollusca	138998	Cerastoderma edule		(Linnaeus, 1758)		1					
Mollusca	140870	Gari fervensis		(Gmelin, 1791)		1					
Mollusca	141435	Abra nitida		(O. F. Müller, 1776)							1
Mollusca	146907	Fabulina fabula		(Gmelin, 1791)					1		
Mollusca	345281	Kurtiella bidentata		(Montagu, 1803)		9	1				
Mollusca	140432	Sphenia binghami		W. Turton, 1822	2						
Mollusca	140480	Mytilus edulis	Juvenile	Linnaeus, 1758	8	2					
Mollusca	138751	Pododesmus patelliformis		(Linnaeus, 1761)	16						
Mollusca	141912	Dosinia lupinus		(Linnaeus, 1758)		2					
Mollusca	745846	Polititapes rhomboides		(Pennant, 1777)	3	1			1		
Mollusca	175	Onchidorididae		Gray, 1827	19						
Mollusca	1039850	Steromphala umbilicalis		(da Costa, 1778)	1						
Mollusca	55	Polyplacophora	Juvenile	Gray, 1821		3					
Bryozoa	111351	Conopeum reticulum		(Linnaeus, 1767)	P				P		
Bryozoa	111022	Amathia		Lamouroux, 1812					P		
Echinodermata	125064	Amphipholis squamata		(Delle Chiaje, 1828)		2					
Chordata	103439	Didemnidae		Giard, 1872	P						
Chordata	103719	Ascidiella scabra		(Müller, 1776)	13						
Chordata	103509	Molgula		Forbes, 1848	1						
Chordata	103882	Dendrodoa grossularia		(Van Beneden, 1846)	1						
Chordata	103538	Polycarpa		Heller, 1877	5						
Chordata	146420	Tunicata		Lamarck, 1816							2

APPENDIX 11.11

Breeding Tern Survey – Green Island

VOLUME III

APPENDICES TO ENVIRONMENTAL IMPACT ASSESSMENT REPORT

RFI Response October 2024

Proposed Operations & Maintenance Facility, Greenore Port, Co. Louth

Breeding Tern Survey – Green Island

24th August 2024

Introduction

This report was prepared in response to a Further Information (FI) request from Louth County Council and is submitted to support an application for permission for proposed Operations and Maintenance Facilities at Greenore Port, planning ref. 2460294.

It forms part of a response to Item 7 of the FI which states as follows.

"To allow a full evaluation of the potential effects of the proposed development at Greenore Port both in its construction and operational phases, on locally occurring flora, fauna and natural habitats the applicant is requested to submit an amended EIAR to include evaluation of the potential of the proposed development works having any adverse effects on the qualifying interests – Sandwich Tern, Common Tern and Light-Bellied Brent Goose for the area which pertained to the former Carlingford Lough SPA in the north of Ireland which is located in close proximity to the proposed site of these works. Also, an assessment of the possibility of the proposed works on animal or plant species of conservation importance associated with other nearby protected sites in the North of Ireland should be submitted. If any adverse effects on qualifying interests for the former Carlingford Lough SPA in the North of Ireland or other species of conservation significance associated with the North of Ireland protected sites are identified, mitigation measures to avoid such detrimental effects should in addition be included in the amended EIAR.

This report has resulted in revisions to the Biodiversity chapter of the Environmental Impact Assessment Report (EIAR) which are contained in Volume II.

Conservation Status

Green Island is a shingle bank sitting on a dipping limestone assemblage in the outer part of Carlingford lough which has historically hosted breeding terns of various species.

Figure 1 Location of Green Island

For this reason, it was included in the Special Protection Area (SPA) by the UK in 1998: "*The site qualifies under Article 4.1 of EC Directive 79/409 on the Conservation of Wild Birds by supporting internationally important breeding populations of Sandwich Tern Stema sandvicensis. The five year mean for the period 1993 to 1997 is 575 pairs which is 1.2% of international population (13.1% of the Irish population). The site also qualifies under Article 4.2 of the Directive for supporting nationally* *important breeding populations of Common Tern Stema hirundo. The five year mean for 1993 to 1997 is 339 pairs which is 12.6% of Irish population. Roseate Terns Stema dougalli i have returned to the site after an absence of six years with 2 breeding pairs recorded for 1997. In the recent past the site has also supported nationally important numbers of Arctic Tern Stema paradisaea*. (DAERA, Carlingford Lough proposed SPA , 1998)"

Green Island also qualifies as a Ramsar site, the Ramsar site being completely coincident with the SPA. The Ramsar citation states "*The site qualifies under Criterion 3c for supporting internationally important breeding populations of sandwich tern. The site also qualifies under Criterion 2a by supporting an important assemblage of vulnerable and endangered Irish Red Data Book bird species. It also is known to support a nationally important breeding populations of common, roseate and Arctic terns*" (Convention, 1998)

The area was also designated as an Area of Special Scientific Interest (ASSI) in 1996. When the UK left the European Union, and on foot of changes to UK Legislation, the SPA designation was extinguished but the ASSI designation remained. The ASSI designation is based on the flowing, again in relation to terns: "*Carlingford Lough is internationally important for its breeding Roseate Tern Sterna dougallii, holding some 4.3% ofthe European Community population. In addition three species of breeding tern are nationally significant within the site. Sandwich Tern Sterna sandvicensis, Common Tern Sterna hirundo and Arctic Tern Sterna paradisaea are regularly present although they can undergo population fluctuations. Population sizes are 59 pairs (1.6% of the Irish breeding population), 218 pairs (10.4%) and 64 pairs (2.7%) respectively.*" (NI, 1996)

In summary, one of the qualifying interests for designated sites in the north part of Carlingford Lough is breeding terns on Green Island, including roseate, arctic, common, and sandwich terns —all of the regularly breeding terns in Ireland with the exception of little terns. The designations acknowledge the regular population fluctuations at the site.

Methodology

A detailed literature survey was undertaken covering published records of terns going back to the 1970s. A review of the authors' (B. Martin) records going back to 2005 were also consulted. Consultation was made with the Royal Society for the Protection of Birds (RSPB), Matthew Tickner in January 2024 and Steve Newton from Birdwatch Ireland, as well as personnel on the car ferry during field surveys.

While the FI request was received on the 18th July 2024, the author had been surveying seals on Green Island and environs prior to this. This report includes three survey visits during June and July 2024 using the Greenore-/Greencastle car ferry as a vantage point; the car ferry passes within 200 metres of the island. Detailed views could be obtained using a telescope 60x and long lens SLR camera (400mm). It was also surveyed from Greenore shore in May and June 2024.

Results

Literature Survey

Green Island has been surveyed annually since late the 1990s and the results are reported in the NI Seabird Report published by British Trust for Ornithology and the Northern Ireland Environment Agency. RSPB has been monitoring tern breeding attempts since 1980. Numbers of breeding terns have fluctuated dramatically over the years but are marked by a steady decline: "*The RSPB has been monitoring tern breeding attempts since 1980. Prior to the intervention described in this paper, which started in 2011, Green Island was home to up to 1,200 pairs of Sandwich Terns (in 1998) and* *although fluctuating widely, their numbers remained high until 2005. The species ceased breeding in 2008. Common Terns reached a peak of 450–500 pairs between 1999 and 2003, but also ceased breeding in 2008. Relatively small numbers of Arctic Terns used the island, with a peak of 58 pairs in 2004. In the past the island has been home to an important Roseate Tern colony with a maximum of 697 pairs in 1971. However, after this date there was a steady decline, in line with UK and Irish populations generally, with 165 pairs in 1981, 25 in 1989, and finally two pairs in 1997 with none thereafter. All figures taken from Brown (2010).*"

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Numbers are reported as Apparently Occupied Nest (AON) or where there are no AONs, as single bird numbers, with confirmed fledged chicks in brackets. Results are tabulated below:

Year	Sandwich tern	Common tern	Arctic tern	Roseate tern
2015	250	305*		1
2016	0	0		0
2017	71	147 (9)	20(1)	0
2018	1	70 (5)	70(3)	0
2019	0	56(27)	50 (24)	0
2020	No data	No data	No data	No data
2021	52	No data	No data	No data
2022	0	96*		0
2023	0	0.375 chicks/AON	0.37 chicks/AON	0

*So called comic terns, where the species have not been separated

Hitherto the island supported hundreds of roseate terns in the 1990s, but these moved to rockabilly island which now supports up to 1600 pairs annually (Wolsey (2016)). The reason for the decline is likely to be a number of factors:

- the presence of large numbers of herring and great black-backed gulls, who predate eggs and fledglings
- the regular presence of an otter who predates same
- over-washing of the island in stormy conditions, exacerbated by the passage of the Seatruck at 20 knots up the lough
- disturbance by people and leisure activities
- possible rodent predation
- sea level rise due to global warming

Field Survey

Green Island was surveyed from the Greenore shore on the 25th May and 12th June 2024 as part of a seal survey. Targeted tern surveys of Green Island were made from the Greenore-Greencastle Car Ferry in 2024 on the 8th of July, 26th of July, and 5th of August and from the shore on the 30th of July.

Figure 2 Green Island 8th July 2024

Very little tern activity was noted during June, but in early July, a flock of sandwich terns was noted to settle on the island and its vicinity.

Date	Sandwich tern	Common tern	Arctic tern	Roseate tern
25th May	0	25	2	0
12th June	15	40	0	0
8th July	28*(2)	1	0	0
26th July	26(3)	2	0	0
30th July	3	4	0	0
5th August	0	0	0	0

*of which 23 apparently sitting on nests (AON).

On the 8th of July, 23 sandwich terns were observed apparently sitting on nests, several being provisioned by mate birds. No eggs or chicks were seen. By the 26th of July, no birds were sitting, and no fledglings could be seen. Members of the public were noted exploring the island via kayak, posing a possible disturbance of nest sites.

Figure 3 Sandwich terns on Green Island

Figure 4 Kayakers visiting Green Island 26th July 2024

Discussion

The interpretation is that a flock of sandwich terns, which had failed elsewhere, arrived at Green Island early July to attempt a second brood. Three herring gull nests were also noted, with one herring gull chick visible. A follow-up survey was undertaken on the 26th July when 26 adult sandwich terns were observed roosting and fishing mainly on the southern part of the island. Three fledglings were present. In two follow-up visits a few terns were seen fishing in the area of the island but again no fledglings were observed. While it is possible that some sandwich terns managed to fledge, this seems challenging and unlikely given the timescale (Sandwich terns lay 1-2 eggs which are incubated by both parents for 21-29 days. Juveniles first fly between 28-32 days after hatching and live with their parents for four months).

Some common terns were observed in June and may have attempted nesting which was not observed.

Terns typically fly to the mouth of Carlingford lough to fish, where there is a regular tidal-induced overturning of the water column bringing prey to the near the surface.

The author has surveyed Green Island for seals annually since 2015. The nesting area on the island consists of a bank of shingle sitting atop dipping limestone reefs. It has been eroding visibly over the last ten years, quite dramatically in some years, with the available area for nesting being constantly diminished. This is mainly due to winter storms overwaiting the island. In addition to this a large population of great black-backed gulls and herring gulls are regular in Carlingford lough and a few regularly breed on Green Island. It is likely that these large gulls predate tern nests and chicks. Other issues are documented in the literature (otter, rodents, sea level rise etc).

Potential impact of the proposed development on breeding terns

The tern colony on Green Island has been failing for several years and is considered to be unlikely to be viable in the long term (pers comm RSPB).

If it were viable, made possible through some remediation works on the shingle bank, two possible impacts stemming from the proposed development at Greenore Port are possible:

Construction Phase

Firstly, dredging could produce turbulence in the water column, limiting the visibility in the upper column and thereby limiting the tern's ability to see fish when fishing in the part of the lough. However, given the small scale of the dredging, the fast current and the capacity of the lough's waters to disperse this material, as confirmed in the assessments contained in the original EIAR, this effect is considered unlikely.

Operational Phase

An impact may stem from the increased passage of the 11 crew transfer vehicle boats along the shipping channel, which may cause a degree of disturbance to terns nesting on the island. This impact may be mitigated by each vessel pilot and captain being responsible for slow speeds to match environmental conditions and restrict any risk of wake as per proposed Mitigation Measure 14 in the Biodiversity chapter of the EIAR dated May 2024, which states,

"Outside of Carlingford Lough, disturbance to marine mammals during operation may occur as vessel traffic will increase. The new quay wall and pontoons will provide berths for up to 11 CTV which will access the North Irish Sea from Greenore. These vessels will be required to use existing channels on the approach to and from the port. Each vessel pilot and captain is responsible to act accordingly and slow speeds to match environmental conditions and restrict any risk of wake. Once clear of the Lough vessels will reach operational speed, which could cause disturbance and a collision risk to marine mammals. In accordance with Maritime Notice 15, a speed limit of 7knots is to be adhered to when encountering areas of mammal populations. These routes have not yet been established and disturbance and displacement will need to be considered by each ORE project through the environmental assessment undertaken for those projects."

No additional mitigation is deemed necessary.

No other impact is considered likely given the distance from the Port to Green Island, 1.5 km.

Conclusions

The proposed development is unlikely to have any impact on terns using Green Island for nesting, even if large scale nesting restarts on the island, and as such is unlikely to have any significant effect on the conservation objectives of the NI ASSI or NI Ramser site in Carlingford Lough.

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APPENDIX 16.1
CULTURAL HERITAGE ASSESSMENT

VOLUME III
APPENDICES TO
ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2024

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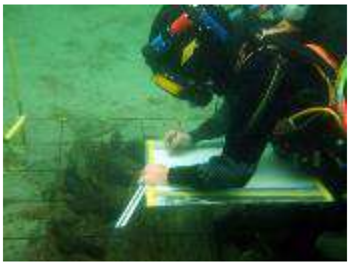
ADCO
Leading Maritime Archaeology

Cultural Heritage Assessment
Greenore O&M facility
Greenore, Co. Louth
23D0070, 23R0237

Leading Maritime Archaeology

Cultural Heritage Assessment
Greenore O&M facility
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23D0070, 23R0237

Final 27 March 2024

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Abbreviations

ADCO	The Archaeological Diving Company Ltd
CD	Chart Datum
DAHRRGA	Department of Arts, Heritage, Rural, Regional and Gaeltacht Affairs
E	Easting
EIS	Environmental Impact Statement
N	Northing
NGR	National Grid Reference
NMS	National Monuments Service
SMR	Sites and Monuments Record
UAIA	Underwater Archaeological Impact Assessment

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Executive Summary

The Archaeological Diving Company Ltd (ADCO) was appointed by McCarthy Browne consulting engineers on behalf of Greenore Port to carry out a Cultural Heritage Assessment in advance of the proposed Operations and Maintenance (O&M) facility project, at Greenore, Co. Louth. A site inspection comprising an underwater assessment and walkover inspection was completed on 24 and 25 August 2023 by a team of maritime archaeologists, operating under licences 23D0070 and 23R0237 granted by the Department of Housing, Local Government and Heritage.

The O&M facility will construct a floating pontoon at Berth 3 that will extend across to the breakwater. The quay at Berth 3 will be extended to facilitate access. Capital dredging will be required to facilitate these works. In addition, certain works will take place on land, including: the demolition of four modern structures; the construction of three new buildings to facilitate new services; general landscaping along the southern perimeter of the port to soften the boundary and provide improved parking, and the construction of a new parking area in what is a general storage adjacent to Shore Road.

Ordnance Survey mapping from the early twentieth century records an active quayside and associated railway yard that was built at Greenore between 1869 and 1873. A series of known cultural heritage assets are recorded in proximity to Greenore Port. There are three protected structures within the Greenore Port precinct. However, there are no recorded sites or features within the development footprint. Archaeological assessment and monitoring has taken place at Greenore associated with the upgrading of Berths 1 and 2.

Archaeological assessment for the present project included a sub-tidal and intertidal inspection across the marine development area, extending across an in-water area that measures some 407 m long by 157 m wide, and an archaeological walkover inspection across the port area. Site work was completed under favourable sea conditions with good underwater visibility. Full access to the survey areas was achieved.

The sub-tidal element revealed a sandy and cobble seabed surface with good penetration. Two timber braces associated with the historic breakwater were observed on the seabed. The breakwater was inspected at Low Water.

The walkover inspection recorded a series of upstanding features in addition to the three protected structures within the port area.

This report identified a total of eight additional features (ADCO 01–ADCO 08) across the port area that should be considered as retaining cultural heritage significance.

The proposed works will have impacts on the seabed (ADCO 01) by way of capital dredging and marine piling.

The development of Berth 3 will formalise the existing caisson arrangement at this location.

The proposed landside works will include the demolition of four modern structures, none of which retain cultural heritage interest: the former OpenHydro works building; part of the port's office accommodations; an ESB substation, and an unoccupied residential bungalow built before the 1970s.

The construction of the three new buildings and the general landscaping proposals will not impact on the historic landside elements identified.

It is recommended that the surviving upstanding elements of the nineteenth-century harbour area at Greenore are collated to provide a permanent record of the cultural heritage assets present. This would comprise focused research on the breakwater (ADCO 02) and the building elements recorded in this report (ADCO 04–ADCO 08). Consideration should also be given to detailed survey of the NIAH sites within the port precinct.

It is recommended that the following mitigation measures are applied as part of the construction design for the O&M facility:

- Project design to avoid impacts on the superstructure of the breakwater feature, ADCO 02, and to recover elements of the superstructure that may lie on the seabed within the dredge area.
- Project design to avoid impacts with standing heritage sites within port area, ADCO 04 and ADCO 08.
- Archaeological monitoring of the ground and seabed works associated with the Berth 3 upgrade, the dredge works and the piling activities associated with the pontoon, with the proviso to resolve fully any material of archaeological interest recovered at that point.
- Archaeological monitoring of the ground works associated with development of the port buildings area is recommended, with the proviso to resolve fully any material of archaeological interest recovered at that point.
- Consider rehabilitation of ADCO 02, ADCO 04 and ADCO 08 to celebrate the nineteenth-century origins of the Port.

A series of archaeological management measures are included.

Recommendations are subject to the approval of the National Monuments Service at the Department of Housing, Local Government and Heritage.

1.0 Introduction

The Archaeological Diving Company Ltd (ADCO) was appointed by McCarthy Browne consulting engineers on behalf of Greenore Port to carry out a Cultural Heritage Assessment in advance of the proposed Operations and Maintenance (O&M) facility project at Greenore, Co. Louth (Figure 1). Greenore Port is located in Greenore townland, Co. Louth. The location of the O&M facility is centred at ITM 722087E 810954N.

Desktop review of existing sources was followed by a site visit comprising an underwater assessment and a walkover inspection, completed on 24 and 25 August 2023 by a team of maritime archaeologists, using Surface Supplied Diving Equipment and operating under licences 23D0070 and 23R0237 granted by the Department of Housing, Local Government and Heritage. Site work was led by the licence holder and report author, Dr Niall Brady FSA, and included archaeologist/diver Rex Bangerter MA, diver/tender, Kyle McCoy, diver/tender, Shem Caulfield and dive supervisor Brian MacAllister.

The results and observations are described in the present report, and a descriptive and illustrated catalogue of the cultural heritage sites is provided in section 7.

2.0 Proposed Development

The O&M facility will construct a floating pontoon at Berth 3 that will extend across to the historic breakwater to facilitate 10 crew transfer vessel (CTV) berths and a new quay wall at Berth 3 (see Chapter 2: Development Description of the EIAR). Berth 3 is located to the south of Berth 2.

Capital dredging beyond the recent Berth 2 pocket will be required to facilitate the works.

Landside works include the demolition of four modern structures and the construction of three new buildings to facilitate new services; general landscaping along the southern perimeter of the port to soften the boundary and provide improved parking, and the construction of a new parking area in what is a general open-air storage area adjacent to Shore Road (Figure 2).

3.0 Policy context

The principal legislative, guidance and policy context that operates across the land and marine environment in Ireland is governed archaeologically by the requirements of the National Monuments Act 1930-2004, the Historic and Archaeological Heritage Bill 2023 and the Planning and Sustainable Development Acts 2000-2022, and is supported by policies governing built heritage nationally and locally. The assessment is conducted in line with the following legislative procedures and guidelines listed in Table 1.

Legislation / Policy / Guidance	Reference	Geographic Coverage
The National Monuments Act 1930-2004	Govt. of Ireland, 1930 - 2004	Ireland, Republic of
Historic and Archaeological Heritage Bill	Govt. of Ireland, 2023	Ireland, Republic of
Planning and Development Acts 2000-2022	Govt. of Ireland, 2000-2022	Ireland, Republic of
Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act	Govt. of Ireland, 1999	Ireland, Republic of
Marine Area Planning Act 2021	Govt. of Ireland, 2021	Ireland, Republic of
The Foreshore Act 1933 and 2014	Govt. of Ireland, 1933 updated 2014	Ireland, Republic of
Heritage Act, 1995	Govt. of Ireland, 1995	Ireland, Republic of
Architectural Heritage Protection Guidelines for Planning Authorities (2011)	Govt. of Ireland, 2011	Ireland, Republic of
European Convention on the Protection of the Archaeological Heritage (Valetta Convention)	EU, 1992	EU
The Convention for the Protection of the Architectural Heritage (the Grenada Convention)	EU, 1985	EU
Department of Arts, Heritage, Gaeltacht and the Islands (DAHGI) Framework and Principles for the Protection of the Archaeological Heritage	DAHGI, 1999a	Ireland, Republic of
DAHGI Policy and Guidelines on Archaeological Excavation	DAHGI, 1999b	Ireland, Republic of
International Council on Monuments and Sites (ICOMOS) guidance, non-governmental international organisation dedicated to the conservation of the world's monuments and sites – several charters and related reference texts	ICOMOS, 2011	Global

Table 1: Legislation, policy and guidance documents relevant to Cultural Heritage (including Archaeological, Industrial & Architectural).

4.0 Methodology

The present assessment is based on desktop review of existing sources (Table 2) and non-disturbance visual recording based on site inspection underwater and on land.

Data Source	Topic Focus
Historic Maps, Ordnance Survey and Admiralty Charts	Landscape and Seascape

Data Source	Topic Focus
Register of Monuments and Places (RMP), also known as the Sites and Monuments Record (SMR)	Terrestrial Archaeology
Louth CC Register of Protected Structures	Archaeology & Built Heritage
National Inventory of Architectural Heritage (NIAH)	Terrestrial Archaeology
Topographical Files, National Museum of Ireland	Terrestrial Archaeology
Historic Shipwreck Inventory maintained by the National Monuments Service (NMS) at the Department of Housing, Local Government and Heritage.	Shipwreck, recorded and known
Integrated Mapping for the Sustainable Development of Ireland's Marine Resource' (INFOMAR) project.	Shipwreck, known
Excavations database	Licensed archaeological interventions

Table 2: Principal sources to inform known Cultural Heritage (including Archaeological, Industrial & Architectural).

Site work was carried out with a view to completing an *in situ* record of any features observed to a level that would enable an archaeologist who has not seen the site to comprehend its components, layout and sequences, based on a detailed record of selected elements of the site.

The site work was completed as an underwater dive inspection within and extending beyond the development footprint for the new CTV berths; an intertidal inspection of those elements exposed at Low Water, and a walkover inspection of the wider port area, extending from Shore Road in the east to the western boundary of the port.

The in-water survey area measured 407 m long (northeast-southwest) by 157 m wide (northwest-southeast).

The underwater and intertidal elements were launched from a Dive Support Vessel and the dive work operated Surface Supplied Diving Equipment, with the archaeological diver towed across the site area to ensure maximum and complete coverage. Dive work was completed at Low Water, which resulted in shallow diving except for those elements that ran along the dredge slope created when deepening Berth 2. A metal detector was employed underwater to assist in the identification of material of significance.

The walkover inspection was conducted across the operational area of the port precinct and was limited to external consideration of buildings and structures.

Attention was paid to recording the seascape and landscape topography and any features of archaeological and cultural heritage interest. Record was made in writing and supported by photography. A handheld GPS unit was available to record the locations of any features of interest.

5.0 Receiving Environment

5.1 Historical background and cartographic sources

The port at Greenore is located on the south side of Carlingford Lough, a location well known for its rich cultural heritage close to the entrance to Carlingford Lough, and a pinch point at that entrance between Greencastle on the north shore and Greenore Point on the south. There are no recorded archaeological sites within the footprint of the development, but the wider landscape setting highlights Greenore as a location that can retain archaeological potential. The Port itself retains elements of its nineteenth-century narrative, when it was built as a new harbour with its own railhead.

The Ordnance Survey (OS) First Edition six-inch map of the 1840s shows only a small development at Greenore Point, comprising a Lighthouse and some cottages running down the eastern shore of the Point. Carlingford Lough leads inland to the important commercial centre of Newry and is challenging to navigate with many sand bars accumulating naturally along its course, which in part explains the presence of the lighthouse complex.

The decision to construct a new harbour at this location in the late 1800s was informed by a plan to engage directly with rail and ferry services to England.[1] Construction of the harbour to the north of the lighthouse was preceded by a study of the soundings taken across the Lough, with some limited dredging of the Carlingford Bar.

The new harbour was built on an area of undeveloped land with a sand/shingle shoreline. There is no indication on the historic OS map of relict shoreline features, such as fish traps, oyster beds, shipwrecks or other features of cultural heritage interest.

The Topographical Files in the National Museum of Ireland (NMI) include reference to a collection of prehistoric-period flint flakes that are provenanced to Greenore townland (reference NMI 1975:307-583). The collection includes flint scrapers, blades, bar forms, cores and awls as well as generic flakes; the sum representing a classic range of stone tools dating most probably to the Neolithic period. There is no clear indication of where they were collected from within the townland, so a specific provenance is not known, although the Sites and Monuments Record (SMR) maintained by the National Monuments Service (NMS) has identified one location as a possible source area (SMR LH0090-012), some 500 m southeast of and outside the port precinct. Inspection of the location in 2007 did not reveal any indication of lithics here.[2] The flint pieces are part of a collection made by Dr Liversage and was given to the Ulster Museum by the Queen's University Belfast, and from there to the NMI in Dublin. A note in the NMI records dated 2002 calls

[1] Canice O'Mahony, 'Iron rails and harbour walls. James Barton of Farndreg', *Journal of the County Louth Archaeological and Historical Society* 22.2 (1990), pp 134–149.
[2] Rex Bangerter, 'Underwater archaeological assessment: Phase 2 development at Greenore Port, Carlingford Lough, Co. Louth. 07D0016, 07R0067', unpublished report of the Archaeological Diving Company Ltd, 2007, p. 6.

the Greenore provenance into question, suggesting that the material may well be from Greencastle, Co. Donegal, rather than Greenore, since the rest of Liversage's material (NMI 1975:279-298) is from Donegal sites.

In terms of known archaeological sites, there are no recorded SMR (also referred to as the RMP) sites within the development area, and the closest site is that of the supposed flint scatter referred to above, located outside the port on the beach to the southeast (Figures 3–4).

There are some 43 recorded historic shipwreck events within Carlingford Lough, based on the Historic Shipwreck Inventory maintained by the NMS, but there are none associated directly with the Port. There is however a single recorded wreck associated with Greenore, and that is the vessel *Kilkeel*, which was lost in 1892 at Greenore. The event is described as a steamship that was in a derelict state when she was noted by the lighthouse keeper at Carlingford; the vessel was driven ashore but was got off. The position was not recorded.

5.2 Recorded monuments, protected structures, industrial heritage sites and other features

The existing tangible cultural heritage assets speak to the development of the port area during the nineteenth century, and in the present context are principally related to a small selection of buildings. The recorded sites and features identified in the desktop review are summarised in Table 3 and presented in Figures 3–4. Detailed descriptions are provided in section 7 of this report. Table 3 also lists a series of new observations made in the course of the present study (ADCO 01–ADCO 08).

Reference	Site type	Status	Impacts from O&M project	Rating
NIAH 13821043; RPS Lhs 009-043	Lighthouse	Standing	None	Regional
NIAH 1321044; RPS Lhs 009-044	Lighthouse Keeper's House	Standing	None	Regional
NIAH 13831026	Hotel	Largely demolished One wall length standing	None	Regional
NIAH 13831025; RPS Lhs 009-001	Water Tower	Standing	None	Regional
ADCO 01	Seabed			Not rated
ADCO 02	Breakwater	Standing	None	Not rated because not on NIAH
ADCO 03	Quay	Buried	None	Not rated because not on NIAH
ADCO 04	Engine Shed	Largely demolished One wall length standing	None	Not rated because not on NIAH

Reference	Site type	Status	Impacts from O&M project	Rating
ADCO 05	Building	Standing	None	Not rated because not on NIAH
ADCO 06	Building	Standing	None	Not rated because not on NIAH
ADCO 07	Boundary wall	Standing	None	Not rated because not on NIAH
ADCO 08	Boundary wall	Standing	None	Not rated because not on NIAH

Table 3: Cultural Heritage Assets within Greenore Port and in proximity to the O&M facility project area (including Archaeological, Industrial & Architectural).

The two earliest sites are those of Greenore Point Lighthouse and the associated Lighthouse Keeper's House, which were constructed *c.* 1830, and are entered into the National Inventory of Architectural Heritage (NIAH), references 13831043 and 13831044 respectively and are registered protected structures (RPS Lhs 009-043 and Lhs 009-044 respectively). The lighthouse was designed by George Halpin Senior, who designed many of the lighthouses along Ireland's east coast at this time.

As recorded on the OS First Edition map (*c.* 1840), the lighthouse and its accommodation were built at the most northern tip of Greenore Point. Subsequent reclamation works extended the shoreline to the north and west and facilitated the construction of the new harbour. The harbour was built between 1869 and 1873, when Greenore became a railhead for the London and North Western Railway. The harbour and the railhead were designed by railway engineer James Barton, who is also associated with the construction of the Boyne Aquaduct. The railhead included a large hotel that was integrated into the railway station, the whole unit reaching over 130 m in length (NIAH 13831026) and running parallel with the quayside. Only a short length of walling survives. A second railhead lay just south of the hotel, and its water tower survives as a protected structure that is today re-used as offices for Greenore Port, NIAH 13831025 (RPS Lhs 009-001).

The harbour comprises a quay and a detached breakwater constructed some 105 m off the quayside (Figure 3, ADCO 2, ADCO 03). Neither the quay nor the breakwater are protected structures. The breakwater, referred to in this report as ADCO 02, extends for over 280 m in length and was furnished with the 'Green Light' navigation aid. Also recorded as a 'groyne' in modern mapping, the breakwater protects the quay from northerly weather, and may originally have served to induce tidal scour along the quayside to facilitate berthing. It continues to offer protection to the quay from northerly weather but the history of its construction is not referred to in a paper describing Barton's role in building the harbour.[3] Barton is known to have conducted some dredging within Carlingford Lough to improve navigation access but the sources that might reveal whether this included dredging alongside the quay and in association with the breakwater are currently not known.

The quay has been upgraded as the port developed and currently provides two berths. While the historic quay is not a registered feature, its design by James Barton in 1869 was innovative at the time. It is labelled ADCO 03 in this report and is described in section 7. Barton, in common with Bindon Blood Stoney in Dublin, wrestled with the concept of using mass concrete to create substantial blocks that would serve as foundations for quay walls. The use of relatively small units, weighing between 3 and 4 tonnes in weight was known, but Barton was able to lay 100-ton blocks for the sub-tidal section at Greenore, extending for a distance of 800 yards (731.52 m).[4] Blood Stoney would excel further in Dublin, where he designed 350-ton blocks to create the North Wall Quay Extension that would establish a new deepwater basin; namely Alexandra Basin. Blood Stoney's work captured the imagination of the time and is remembered as an engineering marvel of the 1880s. Barton's work at Greenore a decade earlier was part of the same innovative processes that are a hallmark of the Victorian Age.

The quay has been upgraded in stages since *c.* 2000 and the old stone façade is now buried behind a combi-wall that uses driven tubular and sheet piles inserted into the seabed in front of the stone quay, with tie rods extending across the quay deck to a line of anchor piles driven through the deck. The deck level is then raised and finished with a new reinforced concrete cap.

Capital dredging has been carried out to bring the ruling depth of the berth pockets to –7.5m Chart Datum, with silt removal in 2001 and rock dredging at Berth 1 in 2015. Berth 2 was redeveloped since 2019.

Archaeological assessment and monitoring of the ground disturbance works within the port area, the quay construction works and the associated capital dredging has taken place.[5] The monitoring that was carried out during the Berth 2 works observed a small section of intact railway line associated with the former rail head, and that section was preserved as part of the industrial heritage of the port and county.

[3] O'Mahony, 'Iron rails and harbour walls, pp 145–146.
[4] Ibid.
[5] Audrey Gahan, 'Greenore Harbour, Greenore, Co. Louth. 01D056', www.excavations.ie; Martin Fitzpatrick, 'Greenore Harobur. 01E0988', www.excavations.ie; Niall Brady, 'Cultural heritage assessment, Greenore Port Berrth 2, Greenore, Co. Louth. 17D0032, 17R0051', ADCO report, 2017; Colm Flynn, 'Final archaeological monitoring report for development of a new quay at Berth 2, Greenore, Co. Louth. 19E0506', 2022.

6.0 Observations

6.1 Sub-tidal/Intertidal element, ADCO 01

The underwater archaeological inspection area is indicated on Figure 5. Vessels were being unloaded at Berths 1 and 2 at the time of the inspection; as these locations lie outside the project development area, it was not required to extend inspection to them.

The archaeological dive inspection commenced off the outer side of the breakwater and proceeded from north to south. Dive work then moved south of the breakwater and proceeded from west to east, moving northwards towards the Berth 2 dredge pocket. A final stage of diving proceeded north to south along the inside of the breakwater. In this manner, the dive inspection covered the sub-tidal element of the project area comprehensively and extended well beyond the proposed construction footprint. Underwater visibility was very good at 2 m and the sea state was calm.

The un-dredged areas of seabed were similar across the surveyed area (ADCO 01). The seabed surface is made up of a sandy bottom with rounded and sub-rounded pebble and small cobble inclusions, typically measuring less than 50 mm in diameter. The sandy surface outside the breakwater is gently rippled. Sea shells, including razor clam and native Irish oyster, are frequent, and there is a wide scatter of seaweed clumps throughout. There is good penetration of the surface sand up to *c.* 100 mm.

The nature of the seabed changes dramatically along the dredge slope, which is angled at approximately 45 degrees and the bed levels drop rapidly from a surface depth of –2.5 m to –10.5 m at the base of the dredge pocket. The soft sand matrix gives way to a dark grey-coloured silty clay (marl), with occasional boulder, mussel shell and starfish inclusions. The marl is relatively soft, with penetration depth up to 1.5 m experienced.

There was little evidence for debris rubbish on the seabed; a single metal bottle top (Vodka) was observed in the course of diving. The metal detection did not add further insight.

The seabed alongside the breakwater retains two loose timbers that measure up to 11 m in length. The timbers retain scarf joints and lie in a haphazard manner. The timbers are elements of the breakwater (ADCO 02) that have fallen from the structure and lie abandoned on the seabed.

The shoreline where it is proposed to develop Berth 3 has a gravel and shingle surface that rises above the sub-tidal area and presents a narrow expanse of intertidal foreshore. A line of concrete cubes set on to the foreshore forms the current boundary, with rock armour added behind the cubes to infill the ground area between the shore and the port area.

The un-dredged portion of the seabed has good holding capacity and is regarded as a stratum that retains archaeological potential. Capital dredging works are proposed as part of the O&M facility project, to create the berthing capacity of Berth 3 and across the pontoon area. Such works will impact on ADCO 01.

6.2 Breakwater, ADCO 02

The breakwater is a monumental construction measuring 285m in length and is treated in this report as a cultural heritage asset, ADCO 02. The breakwater has two principal elements, comprising an openwork timber superstructure and a rubble rock armour base.

The timber superstructure is formed of two lines of square-sectioned timber piles that are staggered to create a zig-zag linear formation which runs the length of the breakwater. The two lines of timber stand 2m apart for the most part but the distance expands to 5m apart at the north end. The vertical timbers are braced by a series of cross beams which form lintels at the top of the feature and also lower down where the rubble mound buries the base of the piles. The vertical piles are cut with simple scarf joins to receive the lintels, which are then fixed to the piles with iron bolts. A series of timbers also brace the vertical piles as buttresses set at 45-degree angles, and these are fixed to the piles by means of steel plates. The buttress timbers are only seen on the east-facing side of the breakwater, facing the quay.

As noted in section 6.1, two of the timber braces have fallen away and lie on the seabed off its east-facing side.

A series of steel beams fixed to the west-facing side of the breakwater at its north end appear to serve a similar bracing purpose, but they are probably a later addition as they are not continued along the length of the breakwater.

A poured concrete pier is located at the centrepoint of the breakwater's length. The pier rises almost to the same height as the timber piles. It appears to have functioned as a central anchor point.

The remains of a metal pole fitted with a circular grid lies off the north end of the breakwater on its west-facing side. This appears to have been a navigation aid that has fallen down, and may be the remnants of the Green Light fixture, or a version thereof, recorded on the historic OS map (Figure 3).

The base of the piles are not visible, as the base of the breakwater has a mound of granite rubble that offers rock-armoured protection to the feature. The rubble mound stands *c.* 1 m above current seabed level and extends in width just beyond the visible extent of the timberwork. There are no obvious set stones forming a wall line and the rubble mound is substantial.

The function of the breakwater and its role in the history of the port's development is not documented in the sources accessed for the present study. Whether it carried additional furniture and how it operated are currently not known. It remains, however, an integral component of the historic fabric of Greenore, and protecting it from further deterioration should be a consideration.

It is likely that the breakwater was constructed both to offer protection to the quay from adverse northerly weather, and to induce tidal scour alongside the quay, using the dynamic tidal conditions that exist at Greenore to maintain adequate depth for shipping berthed at the quay. When trying to secure the shipping channel into Dublin City across the tidal flats of the River Liffey, Dublin Corporation first constructed a timber breakwater that was detached from the city's quays and reached out into the active channel, between what is today Pigeon House Harbour and Poolbeg Lighthouse. Known simply as 'The Piles', the works were recorded in 1757 by the cartographer John Rocque as a parallel line of timber-post couplets. The Piles were subsequently replaced by a substantial stone wall that survives today as the Great South Wall. The Piles in Dublin are no longer visible but bear comparison with the breakwater in Greenore. If the comparison is valid, the breakwater in Greenore is a rare surviving example of maritime engineering in Ireland.

The superstructure element of ADCO 02 will not be impacted by the works associated with the O&M facility during design, construction, operation or decommissioning. Repair works to the rock armour base of the breakwater may however be required. Such works may include the addition of rock armour where there are gaps or localised settlement, and reconstruction or reinforcement of the toe. It is recommended that the superstructure is protected against all such impacts, direct and indirect. It is also recommended that those members of the superstructure that have fallen on to the seabed are recovered during the dredging works so that they can be available to reattach to the superstructure when appropriate. A point cloud survey has been carried out of the superstructure separately for the port. The survey will serve as a detailed baseline record of ADCO 02. The survey should be updated if necessary, to ensure that as complete a record is made prior to works commencing, above and below the waterline. This report also recommends that additional study of the structure is warranted, to enhance a permanent record of the structure in its current state. Such study should also delve more deeply into possible archives that may record the history of its construction and use.

6.3 Landside inspection, ADCO 03–ADCO 08

The protected structures of the Lighthouse and Lighthouse Keeper's House survive and lie outside the development area. However, it is clear that many of the landside elements of the nineteenth-century harbour no longer stand above ground, including the historic quay (ADCO 03). Figure 3 shows the extent of the railhead complex *c.* 1890-1900, while the annotations describe those elements that remain standing today, and a further series of ADCO numbers are assigned to provide easy reference to them.

The hotel does not stand, and only an element of the railway station wall remains intact.

While the water tower stands and is used as office space, the engine shed that abutted it is largely gone, except for a wall length that serves today to separate a parking area to the south from an operational zone to the north (ADCO 04). The wall length retains a series of architectural features, including a fractured wall end, six blocked-up window opes and one blocked-up doorway ope. A point cloud survey has been carried out separately for the port of the standing wall length. The survey serve as a detailed baseline record of ADCO 04.

ADCO 05 is a square-shaped stone building that stands to the east of the water tower.

ADCO 06 refers to elements of the building to the north of the tower that are clearly retained within current sheds.

The boundary wall that defines the curtilage of the Lighthouse and Lighthouse Keeper's House also warrants inclusion (ADCO 07).

Review of the 1890-1900 OS map shows further boundaries to the south along Shore Road and a row of buildings that no longer survive. ADCO 08 refers to the boundary wall on Shore Road that retains stretches of stone construction that would be original features, while other elements have been replaced with breeze-block walling.

Elsewhere across the operational area of the port, there is little evidence of former structure standing, with the space occupied either by modern sheds and silos or as open surface (Plates 1–4).

The four standing structures that are proposed to be demolished as part of the development comprise the former OpenHydro works building; part of the port's office accommodations; an ESB substation, and an unoccupied residential bungalow built before the 1970s (Figure 2, see also descriptions in EIAR Chapter 2). None of these four structures retain cultural heritage interest but consideration should be given to monitoring their demolition in the event that buried horizons are observed in the foundation levels of same.

6.4 Conclusions

Greenore Harbour is historically an important construction of the late 1800s, as one of few new-build harbours in Ireland at that time. Its construction was developed under the watchful eye of renowned railway engineer James Barton.

The surveyed area was inspected comprehensively above and below the waterline.

Much of the historic fabric of Greenore Harbour is now lost to view. This report identifies those elements that are still visible above ground in addition to the three protected structures, and assigns a series of ADCO numbers (ADCO 01–ADCO 08) for ease of reference and as the basis for considering the compilation of an inventory of cultural heritage assets within the port area that will help to ensure against further erosion of these assets.

7.0 Catalogue of cultural heritage assets

The catalogue is based on the known cultural heritage sites recorded within Greenore Port. The entries are drawn from the National Monuments Service's Sites and Monuments Record (SMR), the National Inventory of Architectural Heritage (NIAH) and Louth County Council's Register of Protected Structures (RPS).

Supplemental information is provided where appropriate from fieldwork carried out to inform the O&M facility project. Unless otherwise stated, photographs are sourced from ADCO's field inspections.

The catalogue provides the official site registration reference; site name; site type; positioning data based on ITM Easting and Northing taken from the online NMS portal and using the OS 25-inch map (1890-1900) as the basis (https://heritagedata.maps.arcgis.com/); Site Description; Proximity to the O&M facility project area; Likely impacts, and Recommended mitigation arising from the O&M facility project. Where sites are included that have no official site reference number, they are given a project specific number; namely, ADCO #.

Reference	Site Name	Site Type	ITM Easting	ITM Northing
NIAH 13821043; RPS Lhs 009-043	Greenore Point Lighthouse	Lighthouse	722354	811016
Description	Formerly known as Haulbowline Lighthouse. Freestanding two-stage lighthouse, built 1830, now disused. Circular-plan, tapered profile. Flat roof with domed light positioned centrally on top, surrounded by walkway with wrought-iron railing, weather vane to light. Painted ashlar stone walling, projecting plinth, corbelled brackets supporting roof. Square-headed window openings, painted stone sills, painted timber eight-over-eight sliding sash windows. Square-headed door opening, painted timber vertically-sheeted door. Interior with granite and concrete floor, smooth rendered walling, circular granite staircase, cast-iron balustrading, fluted columns, original lamp missing. Set in grounds shared with lighthouse keeper's house to north-east, bounded by random rubble stone wall, painted to east, granite coping, square gate piers with pyramidal caps to east; located to south of Greenore Point. Appraised as a fine lighthouse that forms an important group with the associated former lighthouse keeper's house. Built by George Halpin Snr, it stands as a reminder of the maritime industry which shaped the development of Greenore. Though now disused, it retains its original form and character together with important salient features such as its lantern and other original materials.			
Image/s	 View looking east to Lighthouse and Lighthouse Keeper's House			
Proximity to development	Within Greenore Port but outside O&M facility project area			
Likely Impacts	None			
Recommended Mitigation	Detailed archaeological survey to ensure a permanent record is made			

Reference	Site Name	Site Type	ITM Easting	ITM Northing
NIAH 13821044; RPS Lhs 009-044	Lighthouse Keeper's House	House	722364	811003
Description	Detached three-bay single-storey with attic former lighthouse keeper's house, built c. 1830, now disused. Rectangular-plan, porch with lean-to roof projecting from north and south elevations, lean-to flanking bay to east. Double-pile pitched slate roof, clay ridge tiles, granite verge coping, granite chimneystacks with stone strings and red brick top stages, cast-iron gutters on drive-in brackets, circular cast-iron downpipes. Painted smooth rendered walling, painted stone plinth. Square-headed window openings, stone sills, painted timber two-over-two, six-over-six and eight-over-eight sliding sash windows. Square-headed door openings, painted timber vertically-sheeted doors, cast-iron door furniture. Set in grounds shared with lighthouse to south-west, bounded by random rubble stone wall, painted to east, granite coping, square gate piers with pyramidal caps to east; located to south of Greenore Point. Appraised as a well-composed house, forming an interesting maritime complex with its associated lighthouse, retains its original form and fabric throughout. The striking chimneystacks, an unexpected feature on this small-scale structure, are of high-quality stonework and add further appeal to the structure.			
Image/s	 View looking east to Lighthouse and Lighthouse Keeper's House			
Proximity to development	Within Greenore Port but outside O&M facility project area			
Likely Impacts	None			
Recommended Mitigation	Detailed archaeological survey to ensure a permanent record is made			

Reference	Site Name	Site Type	ITM Easting	ITM Northing
NIAH 13831026; RPS Lhs 009-043	Greenore Railway Station	Railway Station and Hotel	722266	811045
Description	Formerly described in the NIAH as a detached fourteen-bay two-storey with attic brick former railway station and hotel, built *c*. 1875, attic level later addition. Located to south of quay with harbour-related structures to south and Greenore Point to north-east.			

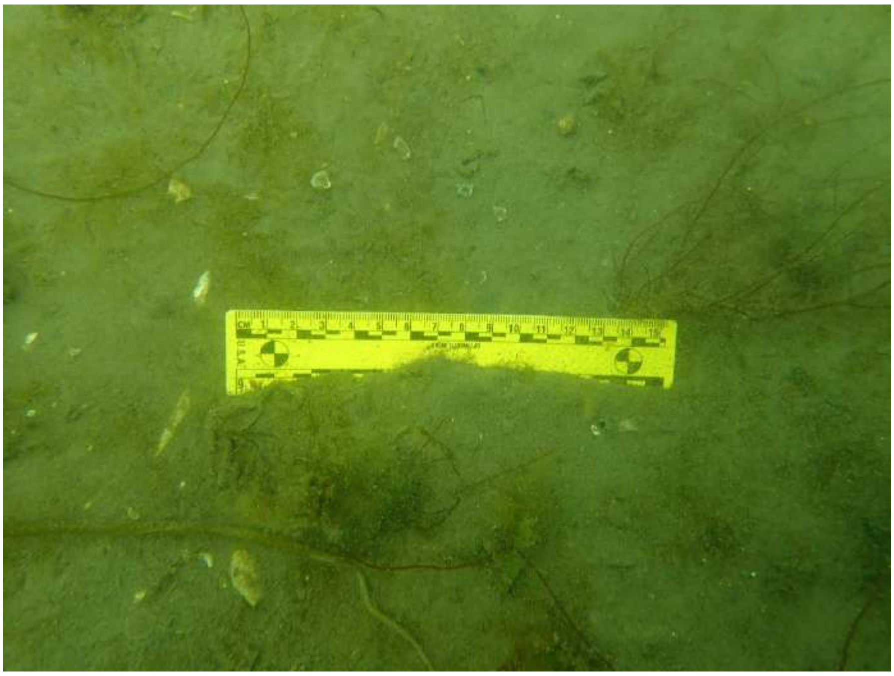
	The building is demolished today but for a short length of walling that remains standing.
Image/s	 Historic photograph of the Hotel at Greenore, looking northwest. Source: National Library of Ireland, James Green, 1990-91.  Length of walling retained of former hotel and railway station today, looking southeast.
	 Point Cloud survey showing north-facing façade completed separately for the port.

	 Point Cloud survey showing south-facing façade completed separately for the port.
Proximity to development	Within Greenore Port but outside O&M facility project area
Likely Impacts	None
Recommended Mitigation	Retain as protected structure

Reference	**Site Name**	**Site Type**	**ITM Easting**	**ITM Northing**
NIAH 13831025; RPS Lhs 009-001	Greenore Railway Station	Water Tower	722284	810905
Description	Attached three-stage stone water tower, built *c.* 1840, ground floor converted to office lobby with office buildings attached to east and west. Square-plan, steel tank on yellow brick corbel course. Squared roughly coursed rubble stone walling to bottom stage, red brick walling to upper stages; cut limestone plinth coping, yellow brick quoins, ashlar limestone and yellow brick string courses. Blind oculus to bottom stage, yellow brick surround; blind paired round-headed openings to second stage, block-and-start yellow brick jambs, round-arched brick archivolt. Round-headed door opening, block-and-start yellow brick jambs, round-headed rubbed brick archivolt, painted timber door with glazed panels. Two-storey random rubble store to north *c.* 1840. Appraised as a finely-built water tower is symbolic of the high quality craftsmanship employed in Victorian engineering projects. The variety of materials used in its construction enliven this functional building allowing it to make an attractive as well as historical contribution to maritime landscape of Greenore. Though part of the structure has been converted to office use, it continues to retain its original function as a water tower.			

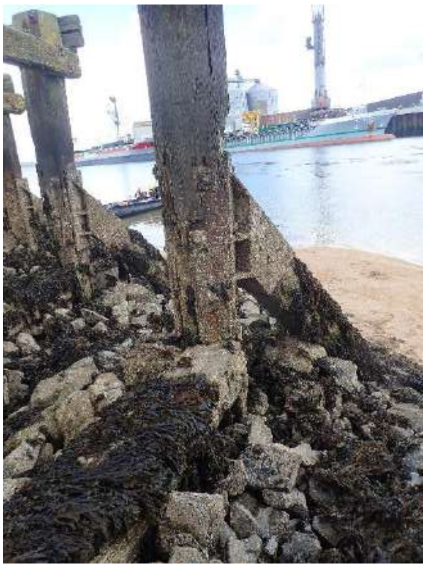
Image/s	 View looking northwest from car park at water tower.
Proximity to development	Within Greenore Port but outside O&M facility project area
Likely Impacts	None
Recommended Mitigation	Detailed archaeological survey to ensure a permanent record is made.

Reference	**Site Name**	**Site Type**	**ITM Easting**	**ITM Northing**
ADCO 01	Seabed	Seabed	722091	810948
Description `	The un-dredged seabed surface is made up of a sandy bottom with rounded and sub-rounded pebble and small cobble inclusions, typically measuring less than 50 mm in diameter. The sandy surface outside the breakwater is gently rippled. Sea shells, including razor clam and native Irish oyster, are frequent, and there is a wide scatter of seaweed clumps throughout. There is good penetration of the surface sand up to *c.* 100 mm. The nature of the seabed changes dramatically along the dredge slope, which is angled at approximately 45 degrees and the bed levels drop rapidly from a surface depth of –2.5 m to –10.5 m at the base of the dredge pocket. The soft sand matrix gives way to a dark grey-coloured marl or clay, with occasional boulder, mussel shell and starfish inclusions. The marl is relatively soft, with penetration up to 1.5 m experienced. There was little evidence for debris rubbish on the seabed. The seabed alongside the breakwater retains two loose timbers that measure up to 11 m in length. The timbers retain scarf joints and lie in a haphazard manner. The timbers are elements of the breakwater (ADCO 02) that have fallen from the structure and lie abandoned on the seabed. The shoreline where it is proposed to develop Berth 3 has a gravel and shingle surface that rises above the sub-tidal area and presents a narrow			

	expanse of intertidal foreshore. A line of concrete cubes set on to the foreshore forms the current boundary, with rock armour added behind the cubes to infill the ground area between the shore and the port area. The un-dredged portion of the seabed has good holding capacity and is regarded as a stratum that retains archaeological potential. Capital dredging works are proposed as part of the O&M facility project, to create the berthing capacity of Berth 3 and across the pontoon area. Such works will impact on ADCO 01.
Image/s	 Seabed image.  Seabed image.

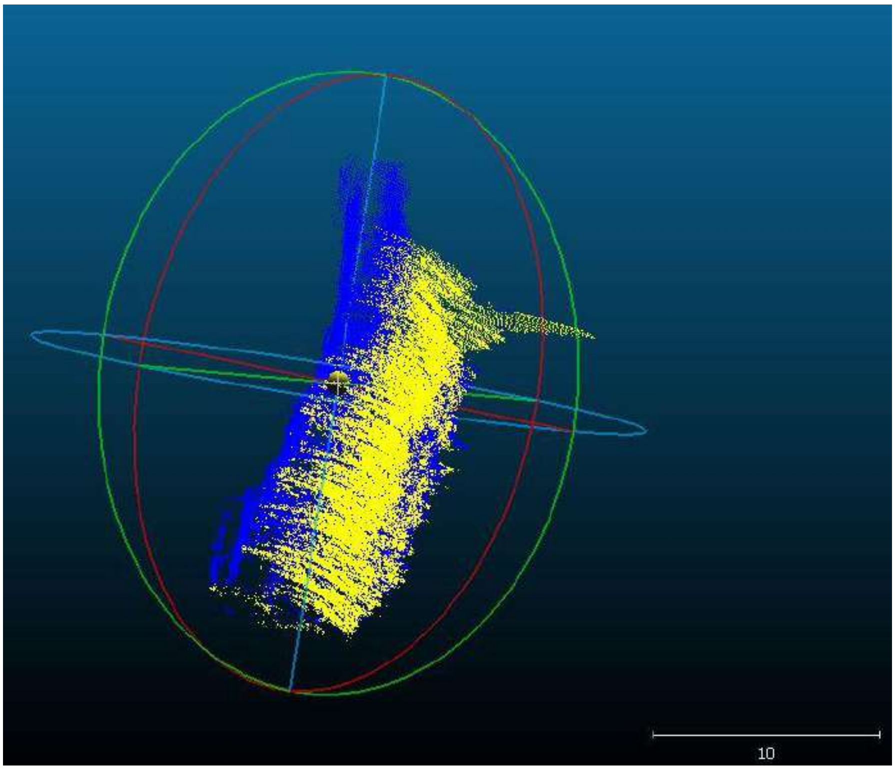
	 Foreshore image where it is intended to extend Berth 3.
Proximity to development	Within O&M facility project area
Likely Impacts	Capital dredging, marine piling
Recommended Mitigation	Archaeological monitoring of seabed impacts

Reference	**Site Name**	**Site Type**	**ITM Easting**	**ITM Northing**
ADCO 02	Breakwater	Breakwater	722086	811024
Description	The breakwater has two principal elements, comprising an openwork timber superstructure and a rubble rock armour base. The timber superstructure is formed of two lines of square-sectioned timber piles that are staggered to create a zig-zag linear formation which runs the length of the breakwater. The two lines of timber are braced by a series of cross beams which form lintels at the top of the feature and also lower down where the rubble mound buries the base of the piles. The vertical piles are cut with simple scarf joins to receive the lintels, which are then fixed to the piles with iron bolts. A series of timbers also brace the vertical piles as buttresses set at 45-degree angles, and these are fixed to the piles by means of steel plates. The buttress timbers are only seen on the east-facing side of the breakwater, facing the quay. Two of the timber braces have fallen away and lie on the seabed off its east-facing side. A series of steel beams fixed to the west-facing side of the breakwater at its north end appear to serve a similar bracing purpose but they are probably a later addition as they are not continued along the length of the breakwater. A poured concrete pier is located at the centrepoint of the breakwater's length. The pier rises almost to the same height as the timber piles. It appears to have functioned as a central anchor point. The remains of a metal pole fitted with a circular grid lies off the north end of the breakwater on its west-facing side. This appears to have been a navigation aid that has fallen down, and may be the remnants of the Green Light fixture, or a version thereof, recorded on the historic OS map (Figure 3). The base of the piles are not visible as the base of the breakwater has a mound of granite rubble that offers rock-armoured protection to the feature. The rubble mound measures *c.* 1 m high above current seabed level and extends in width just beyond the visible extent of the timberwork above. There			

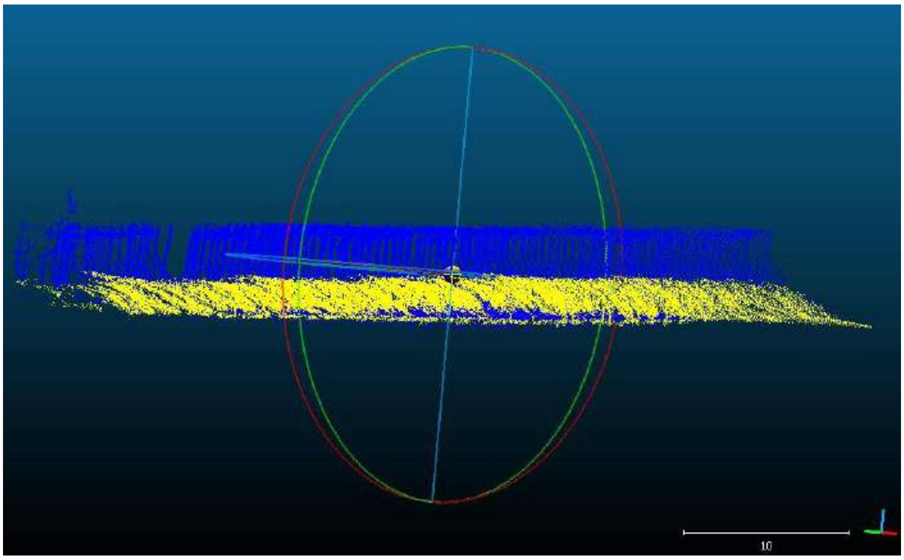
<table>
<tr><td></td><td colspan="2">are no obvious set stones forming a wall line and the rubble mound is substantial.
A point cloud survey completed separately for the port has recorded the primary elements of the breakwater, stopping short of surveying the seabed on the west-facing side. Based on the point cloud, the breakwater measures 285m long and is not entirely straight but retains a slight bend; the piles are exposed to a height of 6m at the north end, and 3m at the south end. The rock armour base reaches 4m wide consistently along its length.</td></tr>
<tr><td rowspan="3">Image/s</td><td>
View looking north along east-facing side.</td><td>
View looking north along west-facing side.</td></tr>
<tr><td>
View looking north through breakwater.</td><td>
View looking east at timber buttressing.</td></tr>
<tr><td>
View looking at central pier.</td><td>
View looking at central pier.</td></tr>
</table>


View of collapsed navigation aid.


View of secondary steel bracing.



Detail from point cloud showing Bird's Eye perspective looking north along breakwater length. Blue elements are the standing piles; yellow elements is the rock armour foundation.



Detail from point cloud showing isometric view along breakwater from south to north.

	Detail from point cloud showing close-up isometric view detail looking north along breakwater.
Proximity to development	Within Greenore Port directly adjacent to O&M facility project area
Likely Impacts	Repair works to rock armour base of the breakwater feature may be required. Works may include addition of rock armour where there are gaps or localised settlement, and reconstruction or reinforcement of the toe.
Recommended Mitigation	Avoid all impacts to the superstructure during design, construction, operation and decommissioning. Dredging design in vicinity will need to ensure that the breakwater is not undermined. Dredging should seek to retrieve fallen timbers from the superstructure. Consider rehabilitation of breakwater to celebrate the nineteenth-century origins of the Port.

Reference	**Site Name**	**Site Type**	**ITM Easting**	**ITM Northing**
ADCO 03	Quay	Quay	718129	734913
Description	The stone-built quay was well-constructed, made up of cut stone blocks, laid in courses where the stones mask the formal courses by being of different sizes. At regular intervals, there are pairs of projecting jamb stones to capture and secure in place vertical timber fenders. The base of the quay wall was covered in silt and cobble for the most part, but the most southerly section featured a glacis embrasure built at its base to act as a rock armoured defence against erosion. The feature was curved in plan view and served to deflect scour from the base of the quay wall. The sub-tidal element was covered in a loose shingle and cobble when inspected in 2017. The only feature observed was a line of vertically-set timber uprights that formed a line of shuttering located some 10 m out from the quay wall. It is understood that the timberwork would have served as part of the quay's construction. The timbers were set edge-to-edge and many featured eroded tops, where the top surface is sheared off at an acute angle, perhaps from previous cutting action. The stone quay is now buried under the modern combi wall that was constructed on Berths 1 and 2.			

Image/s

Historic photograph of Greenore quayside looking north, showing the railhead. Source: National Library of Ireland, Robert French, 1841-1917.

View along the façade of the stone-built quay in 2017, showing the cut stone blocks and the projecting jamb stones in the upper level spaced at regular intervals to secure the vertically-set timbers used as fenders. The uppermost layer of concrete was a later addition to support that quayside cranes in use.

View looking down from quayside at the embrasure feature built in front of the stone quay at its southern end, to act as an armoured protection.

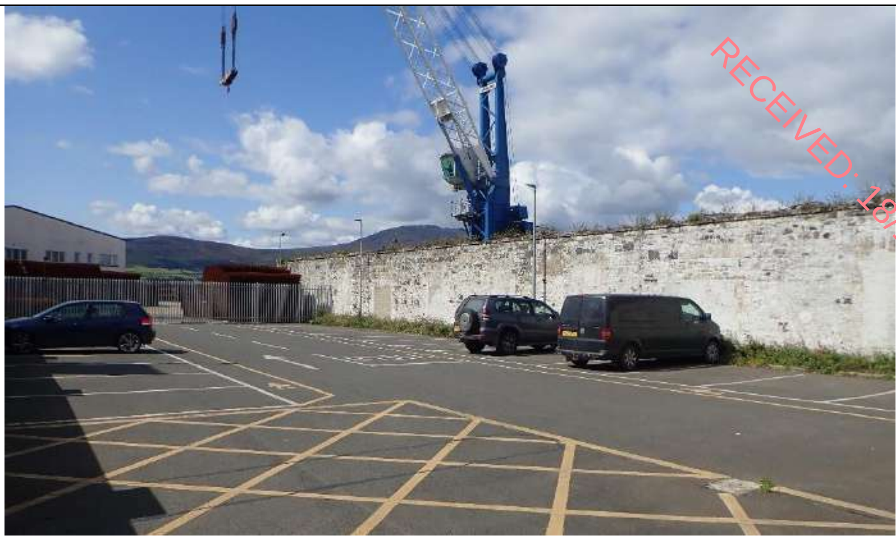
	 View showing example of the eroded tips of timbers associated with the timber shuttering observed at the south end of Berth 2.
Proximity to development	Within Greenore Port but outside O&M facility project area
Likely Impacts	None
Recommended Mitigation	None

Reference	**Site Name**	**Site Type**	**ITM Easting**	**ITM Northing**
ADCO 04	Engine Shed	Wall	722213	810881
Description	Wall length representing the southern long wall of the former Engine Shed recorded on the OS 1890-1900 historic map. The wall retains a series of architectural features, including a fractured wall end, six blocked-up window opes and one blocked-up doorway ope. It currently serves as a boundary between the operational area of the port to the north and Port car parking to the south.			

Image/s	 Engine Shed wall, east end, view from north.  Engine Shed wall, central area, view from north.

Engine Shed wall, view looking east.

Engine Shed wall, west end showing wall end-wall fracture, view from north.

	 Engine Shed wall view from south.
	 Point cloud survey of north-facing façade (interior) completed separately for the port.
	 Point cloud survey of south-facing façade (exterior) completed separately for the port.
Proximity to development	Within O&M facility project area
Likely Impacts	None
Recommended Mitigation	Avoid all impacts during design, construction, operation and decommissioning. Consider rehabilitation of wall to celebrate the nineteenth-century origins of the Port.

Reference	**Site Name**	**Site Type**	**ITM Easting**	**ITM Northing**
ADCO 05	Building	Building	722268	810919
Description	Square-planned stone building, two storeys in height, windowless on north, west and south sides, entrance door on north through rounded arch, lesser side entrance on west. Roughly cut stone laid in courses with quoins formed using yellow brick. Roof area accommodates a tank, either concrete or steel, painted blue. South façade supports Greenore Port sign and is otherwise covered in ivy. A lean-to shack was formerly appended to the north wall. The building is part of the railway complex associated with NIAH 13831025; RPS Lhs 009-001 and probably held a second water tower.			

Image/s	 View from south.  View from north.
Proximity to development	Within Greenore Port but outside O&M facility project area
Likely Impacts	None
Recommended Mitigation	Detailed archaeological survey to ensure a permanent record is made.

Reference	**Site Name**	**Site Type**	**ITM Easting**	**ITM Northing**
ADCO 06	Building wall	Wall	722239	810912
Description	Stone wall at rear of complex that houses NIAH 13831025; RPS Lhs 009-001. The wall is the north-facing long wall of a gabled building whose gable end is sheathed in concrete render and whose roof is a simple corrugated metal. Modern concrete building abuts west end and is aligned north-south. The wall is currently absorbed as part of sheds but should be regarded as part of the former railway complex abutting			

	and east of the Engine Shed (ADCO 04). On the OS 1890-1900 map, railway lines ran in front (north) of the building, where today there is a brown-coloured metal shed.
Image/s	 View from west.

	 Detail showing visible section of stone wall (highlighted by red arrow) outside the shed complex.
Proximity to development	Within Greenore Port but outside O&M facility project area
Likely Impacts	None
Recommended Mitigation	Detailed archaeological survey to ensure a permanent record is made.

Reference	**Site Name**	**Site Type**	**ITM Easting**	**ITM Northing**
ADCO 07	Lighthouse boundary wall	Wall	722350	810982
Description	Low wall constructed with roughly shaped limestone blocks laid in courses and surmounted with granite paving that forms an elegant lintel. The southern section stands *c.* 800 mm above current ground level within Port area, while the northern			

	section is taller (*c.* 1.3m) and facilitated a series of lean-to sheds against the wall within the Lighthouse curtilage.
Image/s	 View looking north.  View looking southeast.
Proximity to development	Within Greenore Port but outside O&M facility project area
Likely Impacts	None
Recommended Mitigation	Detailed archaeological survey to ensure a permanent record is made.

Reference	**Site Name**	**Site Type**	**ITM Easting**	**ITM Northing**
ADCO 08	Shore Road boundary wall	Wall	722372	810969

Description	Low wall constructed with roughly shaped limestone blocks laid in courses and standing *c.* 1.1 m high above ground level within Port area, and surmounted with a mortared crown of limestone. Later additions in concrete add greater height. The historic OS 25-inch map (1890-1900) shows a range of buildings standing against but outside (east) the wall, and at least one sill from those buildings was noted in the surviving wall. The wall may originally have extended over 50 in length. The southern section today has been rebuilt using concrete breeze blocks.
Image/s	 View from west.  View looking north.

	 View looking south and showing sill of former building extruded on wall.  View from east at boundary wall from Shore Road.
Proximity to development	Within Greenore Port but outside O&M facility project area
Likely Impacts	None
Recommended Mitigation	Detailed archaeological survey to ensure a permanent record is made. Avoid all impacts during design, construction, operation and decommissioning. Consider rehabilitation of wall to celebrate the nineteenth-century origins of the Port.

8.0 Impact assessment

Impact/effect categories devised by the Environmental Protection Agency (EPA) for archaeological matters are categorised as having a direct impact, an indirect impact or as having no predicted impact. Each impact is qualified both in terms of magnitude of impacts (high, medium, low) and in terms of significance of impacts by being considered (profound, significant, moderate, slight or imperceptible). The duration of impacts is also assessed in terms of a scale ranging from temporary to permanent.[6] The impacts assessed for the O&M facility project are summarised in Table 4.

Reference	Site type	Status	Impacts from O&M project	Impact Magnitude	Impact Significance[7]
NIAH 13821043; RPS Lhs 009-043	Lighthouse	Standing	None	n/a	n/a
NIAH 1321044; RPS Lhs 009-044	Lighthouse Keeper's House	Standing	None	n/a	n/a
NIAH 13831026	Hotel	Largely demolished One wall length standing	None	n/a	n/a
NIAH 13831025; RPS Lhs 009-001	Water Tower	Standing	None	n/a	n/a
ADCO 01	Seabed	Un-dredged	Dredging Piling	High	Direct, Negative, Profound, Permanent
ADCO 02	Breakwater	Standing	Repair works to rock armour	Medium	Direct, Positive, Moderate, Permanent
ADCO 03	Quay	Buried	None	n/a	n/a
ADCO 04	Engine Shed	Largely demolished One wall length standing	None	n/a	n/a
ADCO 05	Building	Standing	None	n/a	n/a
ADCO 06	Building	Standing	None	n/a	n/a
ADCO 07	Boundary wall	Standing	None	n/a	n/a
ADCO 08	Boundary wall	Standing	None	n/a	n/a

Table 4: Impact assessment on Cultural Heritage Assets and locations within the Greenore Port and the O&M facility project area (including Archaeological, Industrial & Architectural).
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The majority of the cultural heritage assets listed in Table 4 will not be impacted by works associated with the O&M facility. However, the proposed works will have impacts on the seabed

[6] EPA 'Guidelines for Information to be Contained in EIAR' 2022, 'Guidelines on the information to be contained in Environmental Impact Statements', 2002; 'Advice notes on Current Practice (in preparation of Environmental Impact Statements), 2003 and Revised Draft 2015, EPA; and Guidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes, 2006, National Roads Authority.
[7] Following impact/effect categories devised by the EPA; see note 6 above.

(ADCO 01) by way of capital dredging and marine piling. Such works will require archaeological mitigation.

While the breakwater (ADCO 02) superstructure will not be impacted, repair works to the rock armour base of the breakwater may be required. Such works may include the addition of rock armour where there are gaps or localised settlement, and reconstruction or reinforcement of the toe. Such impacts will be considered direct and positive impacts insofar as they will help to further stabilise the structure. They should be limited in scope and consequently may be deemed to by moderate in scale and will be permanent in nature. Archaeological mitigation will be required.

The demolition of the four modern standing structures identified on Figure 2 (namely, the former OpenHydro works building; part of the port's office accommodations; an ESB substation, and an unoccupied residential bungalow built before the 1970s) represent direct impacts. Archaeological mitigation will be required to monitor the exposure of foundation levels.

Construction of new compound buildings, car park and the landscaping proposed along the southern perimeter of the Port area have the potential to expose previously unrecorded archaeological levels and will require archaeological mitigation.

9.0 Recommendations

Table 5 summarises the mitigation measures recommended.

Reference	Site type	Status	Impacts from O&M project	Pre-construction Phase measures	Construction Phase measures
NIAH 13821043; RPS Lhs 009-043	Lighthouse	Standing	None	Detailed archaeological survey	None
NIAH 1321044; RPS Lhs 009-044	Lighthouse Keeper's House	Standing	None	Detailed archaeological survey	None
NIAH 13831026	Hotel	Largely demolished One wall length standing	None	Detailed archaeological survey	None
NIAH 13831025; RPS Lhs 009-001	Water Tower	Standing	None	Detailed archaeological survey	None
ADCO 01	Seabed	Un-dredged	Dredging Piling	None	Archaeological monitoring and resolution Retrieval of structural elements from ADCO 02 that lie on seabed

Reference	Site type	Status	Impacts from O&M project	Pre-construction Phase measures	Construction Phase measures
ADCO 02	Breakwater	Standing	None	Detailed archaeological survey	Avoid impact to superstructure Amend survey data if required Archaeological monitoring and resolution Consider rehabilitation
ADCO 03	Quay	Buried	None	None	None
ADCO 04	Engine Shed	Largely demolished One wall length standing	None	None	Avoid impacts Archaeological monitoring and resolution Consider rehabilitation
ADCO 05	Building	Standing	None	Detailed archaeological survey	None
ADCO 06	Building	Standing	None	Detailed archaeological survey	None
ADCO 07	Boundary wall	Standing	None	Detailed archaeological survey	None
ADCO 08	Boundary wall	Standing	None	Detailed archaeological survey	Avoid impacts Archaeological monitoring and resolution Consider rehabilitation

Table 5: Mitigation measures on Cultural Heritage Assets and locations within the Greenore Port and the O&M facility project area (including Archaeological, Industrial & Architectural).

9.1 Pre-construction recommendations

It is recommended that the surviving upstanding elements of the nineteenth-century harbour area at Greenore which have not been surveyed in detail are surveyed archaeologically in detail, to provide a permanent record of the cultural heritage assets. This approach would be considered a Heritage Gain initiative, to safeguard the surviving cultural heritage elements and record of the historic port.

Surveys already exist for NIAH 13831026 (Hotel), ADCO 02 (breakwater) and ADCO 04 (Engine Shed). Those surveys should be amended to include additional detail if necessary.

Detailed archaeological survey is recommended for the the NIAH sites within the port precinct (NIAH 13821043, Lighthouse; NIAH 1321044, Lighthouse Keeper's House, and NIAH 1381026, Water tower). Such survey work should also be carried out on ADCO 05 (building); ADCO 06 (building); ADCO 7 (boundary wall), and ADCO 08 (boundary wall).

Such archaeological survey would be carried out using laser-scanning or similar current high-end survey, to create point-cloud data sets from which measured plan, elevation and section drawings can be generated.

9.2 Construction phase recommendations

As part of the construction stage works, the following mitigation measures are recommended:

- Project design to avoid impacts on the superstructure of the breakwater feature, ADCO 02. Consideration needs to be given to the proposed dredging in this area to ensure that the dredging does not undermine the base of the breakwater.
- Project design to ensure that impacts are avoided on all other cultural heritage assets identified in this report.
- Archaeological monitoring of the ground and seabed works associated with the Berth 3 upgrade, the dredge works and the piling activities associated with the pontoon, with the proviso to resolve fully any material of archaeological interest recovered at that point.
- Archaeological monitoring of the ground works associated with demolition and construction works on the landside elements is recommended, with the proviso to resolve fully any material of archaeological interest recovered at that point.

9.3 Management recommendations

A Construction Environmental Management Plan (CEMP) will be finalised and will include detail in respect of every aspect of the works in order to minimise potential impacts and maximise potential benefits associated with the works.

The following archaeological monitoring and management measures will be undertaken:

- Retaining a project archaeologist/s. An archaeologist experienced in maritime archaeology will be retained by Greenore Port for the duration of the relevant works.
- Retaining a heritage architect. A heritage architect experienced in industrial and maritime architectural heritage will be retained by Greenore Port, to advise specifically in relation to works associated with ADCO 02 and, in conjunction with the project archaeologists, to advise on rehabilitating the assemblage of cultural heritage features to celebrate the nineteenth-century origins of the Port.
- Archaeological licences will be required to conduct the on-site archaeological works. Licence applications require the inclusion of detailed method statements that outline the rationale for the works, and the means by which the works will be resolved. Licence

applications take a minimum of four weeks to process through the DHLGH, and advance planning is required to ensure that the necessary permits are in place before site works commence. It is anticipated that the following licence types will be required: Excavation, to cover monitoring and investigations works; Detection, to cover the use of metal-detectors; and Dive Survey, to cover the possibility of having to conduct underwater inspections. Since 2017, Excavation licence applications must be accompanied by a letter from the client on their letterhead that follows a prescribed format to confirm that sufficient funds and other facilities are available to the archaeologist to complete the archaeological excavation, post-excavation, and preliminary and final reports (including specialist reports). It is confirmed that Dublin Port Company has confirmed that sufficient funds and other facilities as required will be made available to the project archaeologist to complete all reports required.

- An Archaeology Management Plan will be prepared by the archaeologist to prepare the protocols that ensure proper management and response to archaeological monitoring, recording and resolution that will be required in the course of the project.
- Archaeological monitoring will be carried out by suitably qualified and experienced maritime archaeological personnel licensed by the DHLGH. Archaeological monitoring is conducted during all terrestrial, inter-tidal/foreshore and seabed disturbances associated with the development. The monitoring will be undertaken in a safe working environment that will facilitate archaeological observation and the retrieval of objects that may be observed and that require consideration during the course of the works. The monitoring will include a finds retrieval strategy that is in compliance with the requirements of the National Museum of Ireland.
- The time scale for the construction phase will be made available to the archaeologist, with information on where and when ground disturbances will take place.
- Discovery of archaeological material. In the event of archaeologically significant features or material being uncovered during the construction phase, machine work will cease in the immediate area to allow the archaeologist/s to inspect any such material.
- Archaeological material. Once the presence of archaeologically significant material is established, full archaeological recording of such material will be recommended. If it is not possible for the construction works to avoid the material, full excavation will be recommended. The extent and duration of excavation will be a matter for discussion between the client and the licensing authorities.
- Archaeological team. It is recommended that the core of a suitable archaeological team be on standby to deal with any such rescue excavation. This would be complimented in the event of a full excavation.
- Archaeological dive team. It is recommended that an archaeological dive team is retained on standby for the duration of any in-water disturbance works on the basis of a twenty-

four or forty-eight hour call-out response schedule, to deal with any archaeologically significant/potential material that is identified in the course of the seabed disturbance activities. The dive team and all in-water work will conform to the Port's safety protocols for Diving at Work.

- A site office and facilities will be provided by the Dublin Port Company on site for use by archaeologists.
- Secure wet storage facilities will be provided on site by the Dublin Port Company to facilitate the temporary storage of artefacts that may be recorded during the course of the site work.
- Buoying/fencing of any such areas of discovery will be necessary if discovered and during excavation.
- Machinery traffic during construction will be restricted to avoid any identified archaeological site/s and their environs.
- Spoil will not be dumped on any of the selected sites or their environs.
- All site work will be conducted in strict compliance and accord with Dublin Port Company's Health and Safety requirements.
- Post-construction project report and archive. It is a condition of archaeological licensing that a detailed project report is lodged with the DHLGH within 12 months of completion of site works. The reports will be particular to each licence granted. The reports should be to publication standard and should include a full account, suitably illustrated, of all archaeological features, finds and stratigraphy, along with a discussion and specialist reports. Artefacts recovered during the works need to meet the requirements of the National Museum of Ireland in terms of recording, conservation and storage.

PLEASE NOTE: The above observations and conclusions are based on the archaeological information and information for the Greenore Port O&M facility project provided. Should any alteration occur, further assessment would be required.

Recommendations are subject to the approval of the National Monuments Service at the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.

10.0 Acknowledgements

ADCO acknowledges the assistance of Richard Browne, and Niall McCarthy and his staff at Greenore Port for facilitating site access. Site work was conducted by Niall Brady, Rex Bangerter, Kyle McCoy, Brian MacAllister and Liam O'Shea. The report was prepared by Brady, the figures by Bangerter.

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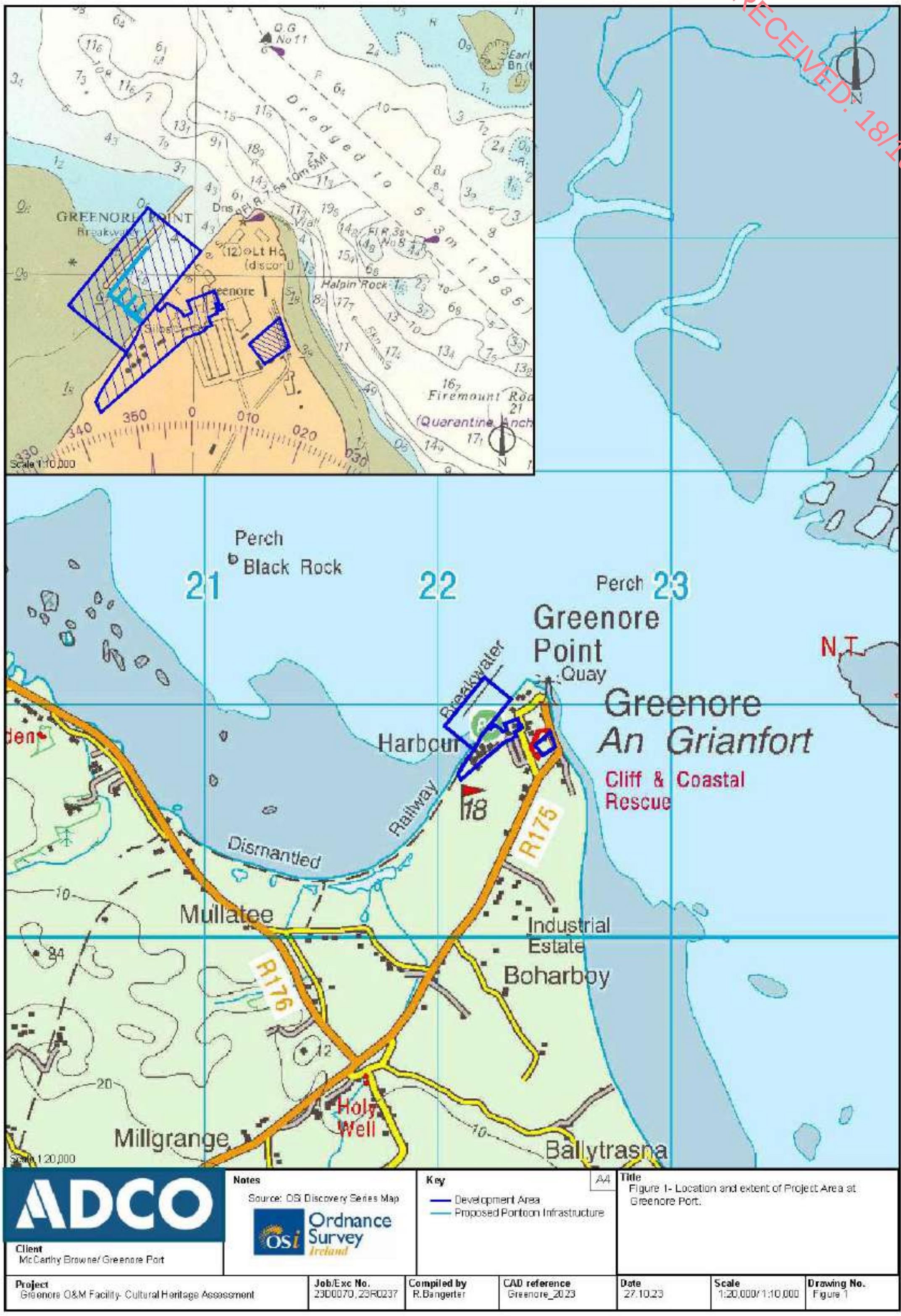

Figure 1: Location of project area at Greenore Port

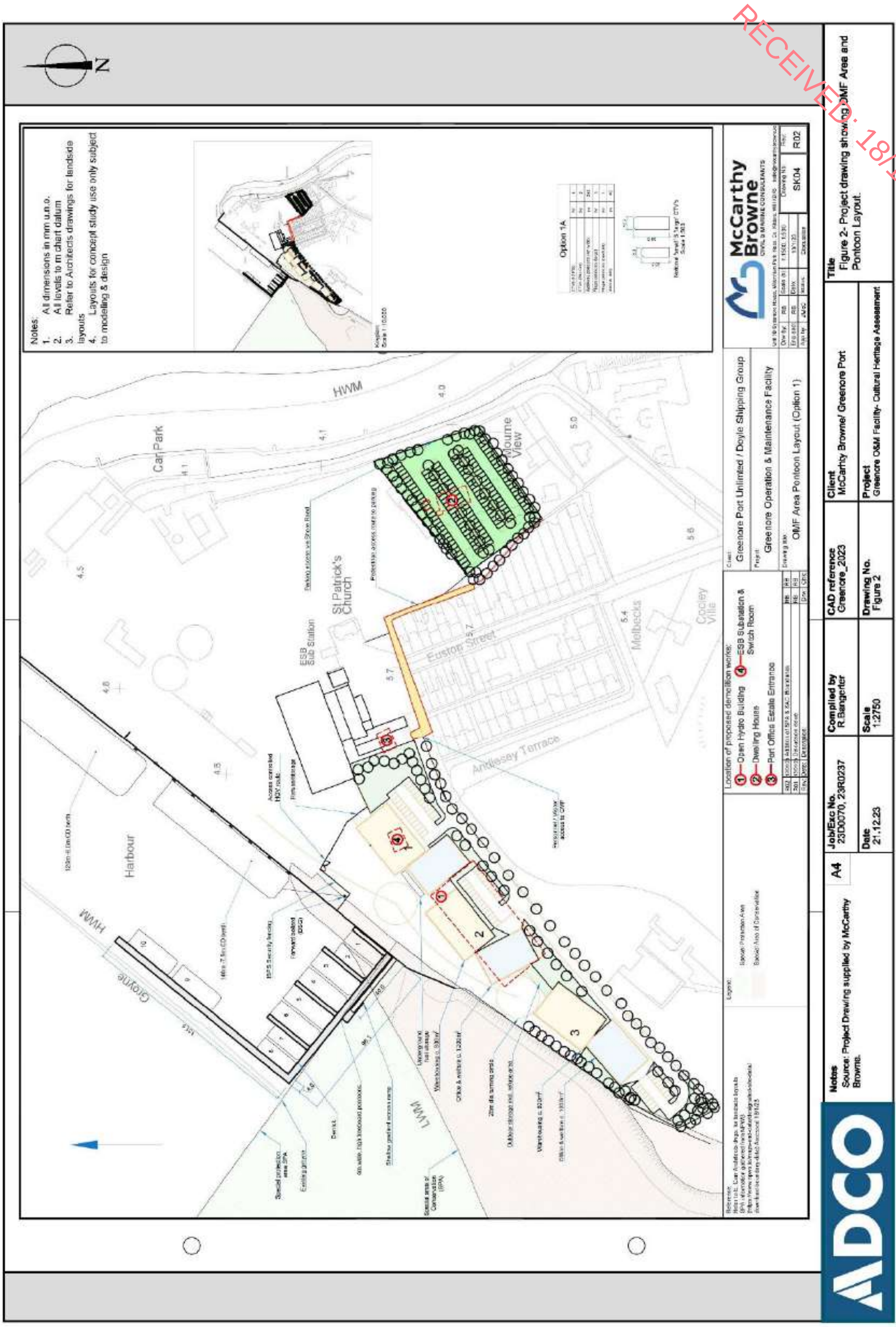

Figure 2: Project drawing showing OMF Area and Pontoon Layout

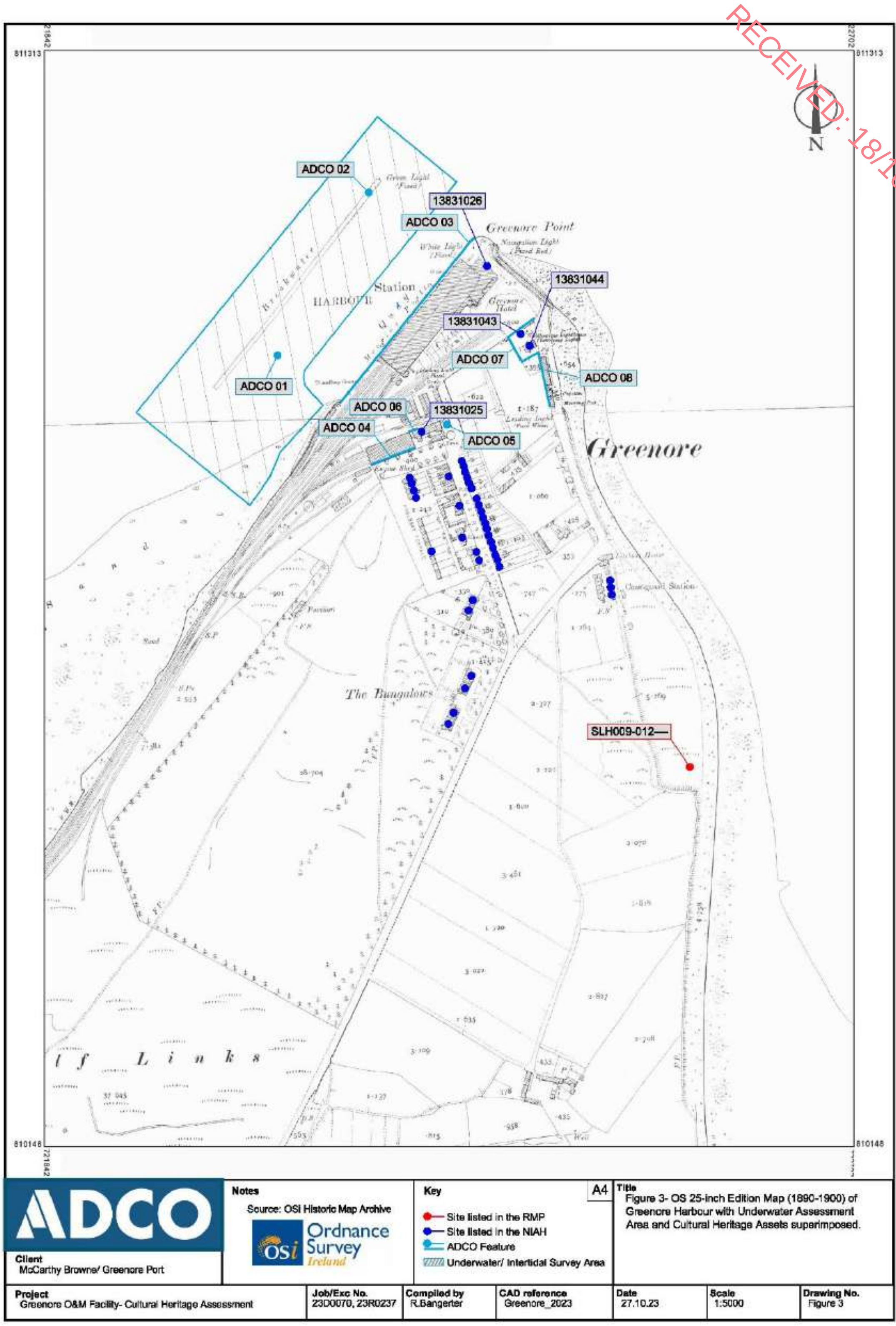

Figure 3: OS 25-inch map (1890-1900) showing Greenore Harbour with Underwater Assessment Area and Cultural Heritage Assets superimposed

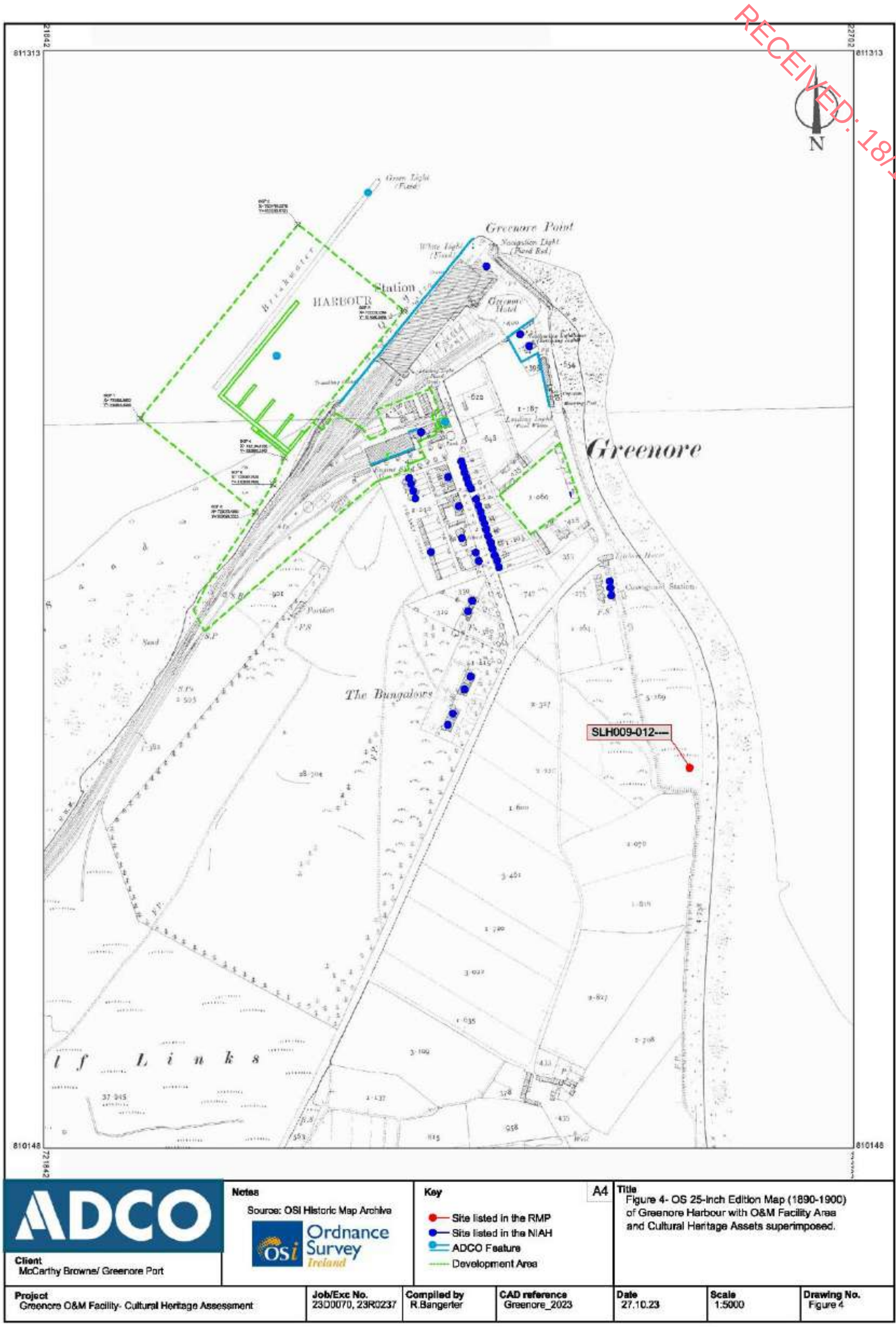

Figure 4: OS 25-inch Edition Map (1890-1900) of Greenore Harbour with O&M Facility Area and Cultural Heritage Assets superimposed

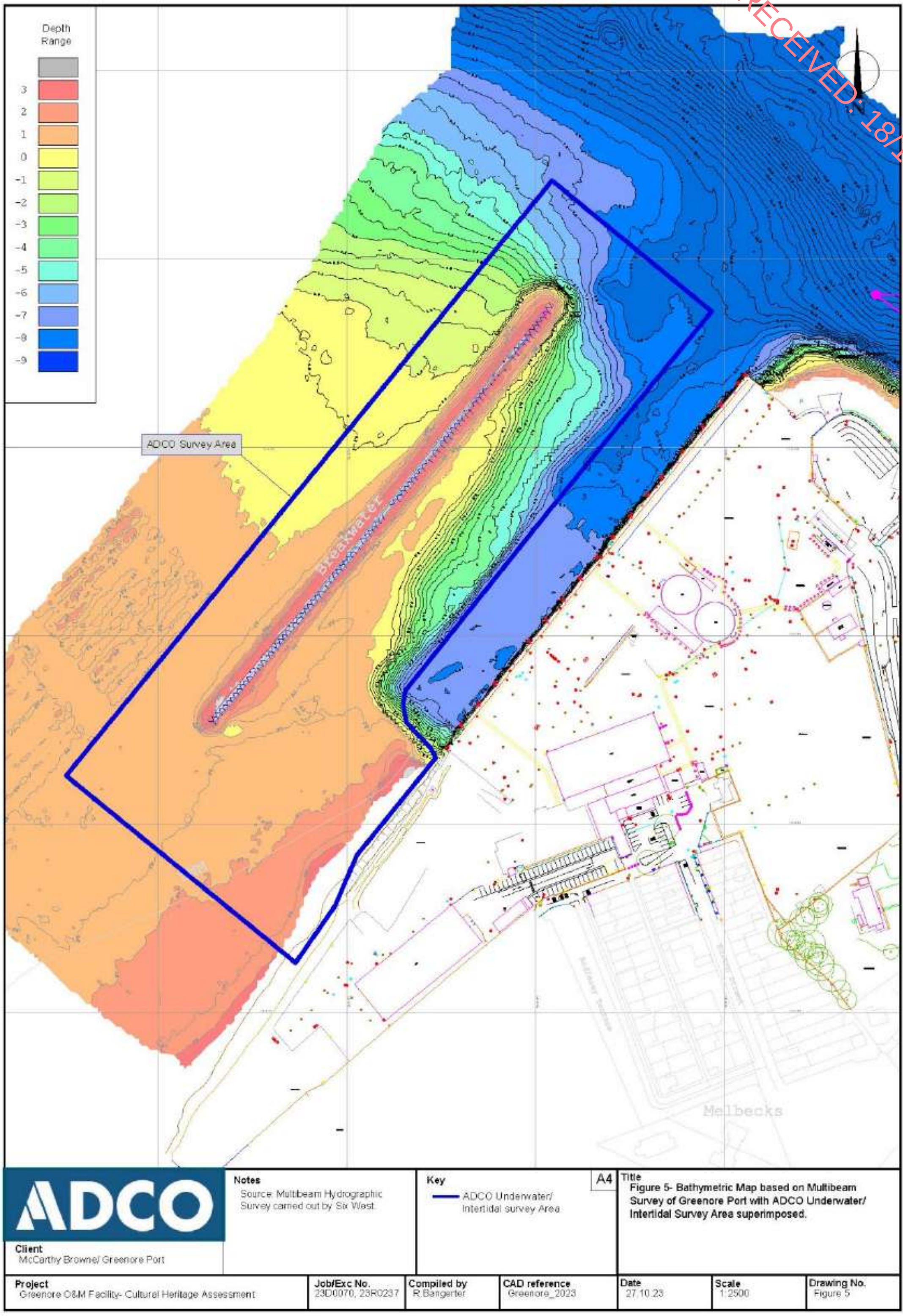

Figure 5: Bathymetric map based on multibeam survey of Greenore Port with overlay showing ADCO underwater and intertidal survey area

Plate 1: Area to east of Port offices where it is proposed to provide a parking area, in what is currently open-air storage.

Plate 2: Southern end of new parking area east of port offices, showing nature of breeze-block boundary wall.

Plate 3: Operational area west of the Engine Shed (ADCO 04) site.

Plate 4: Operational area further west of the Engine Shed (ADCO 04) site.