3FMProject

Bringing
Dublin Port
To 2040

Environmental Impact Assessment Report

Chapter 7

Biodiversity

Volume 2 Part 2

COMHLACHT CHALAFORT ÁTHA CLIATH DUBLIN PORT COMPANY

rps A TETRA TECH COMPANY

Third & Final Masterplan Project

7 BIODIVERSITY, FLORA AND FAUNA

7.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) identifies, describes and assesses in an appropriate manner, the direct and indirect significant effects of the 3FM Project on biodiversity, flora and fauna.

As noted in the EC (2013) *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment*, biological diversity or 'biodiversity' is one of the key terms in conservation, encompassing the richness of life and the diverse patterns it forms. The 1992 UN Convention on Biological Diversity defines biological diversity as '*the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'*.

Ecological Impact Assessment (EcIA) is a process of identifying, quantifying, and evaluating the potential and likely significant effects of a Project on ecological features, where ecological features are the species, habitats and biodiversity components of ecosystems that have the potential to be affected by a project. In this instance, the project is the 3FM Project and the EcIA forms part of the overall EIA to be carried out by the competent authority.

As all biodiversity comprises an enormous number of species and habitats, ecological assessment is typically divided into specialist subject areas. The biodiversity chapter of this EIAR contains a description of the terrestrial, benthic, fisheries, marine and avian biodiversity features and designated sites within a Zone of Influence (ZoI) of the 3FM Project, followed by an assessment of the potential and likely significant effects of the 3FM Project on the terrestrial, benthic, fisheries, marine and avian biodiversity features and designated sites.

This chapter contains information on different specialist subject areas of ecology and has been written by a number of authors as specified in Table 1.1 '*List of Contributors to EIAR Chapters'* in Chapter 1 of the EIAR. Avian biodiversity features are present in both the marine and terrestrial environments, and a decision was taken to present the assessment of both marine and terrestrial avian biodiversity together rather than split avian biodiversity into two sub-assessments.

The chapter has been broken down into the following sub-sections:

- **Section 7.2:** Terrestrial Biodiversity
- **Section 7.3:** Benthic Biodiversity and Fisheries
- **Section 7.4:** Marine Mammals
- **Section 7.5:** Avian Biodiversity
- **Section 7.6:** Designated Sites (other than European sites)

Each specialist sub-section sets out the methodology used, and describes the receiving environment with respect to the relevant biodiversity element within the ZoI of the 3FM Project. Potential impacts and relevant remedial and mitigation measures are discussed along with an assessment of the residual impacts.

It should also be noted that, in circumstances where Stage 1 Screening for Appropriate Assessment and a Stage 2 Appropriate Assessment are required to be undertaken by the competent authority, pursuant to Article 6(3) of the Habitats Directive (Directive 92/43/EC) and Irish implementing legislation, both an Appropriate Assessment Screening Report (AASR) and a Natura Impact Statement (NIS), have been prepared on behalf of DPC and submitted to An Bord Pleanála with the application or permission, in respect of the likely significant effects of the 3FM Project on designated European sites. To the extent relevant and appropriate, this chapter of the EIAR should be read in conjunction with the AASR and NIS and relevant supplementary documentation. Additional appendices and technical reports are cited in the text where relevant.

7.2 Terrestrial Biodiversity

This section assesses the potential impacts of the 3FM Project on terrestrial biodiversity. The methodology for data collection is presented. The receiving environment of the 3FM Project for terrestrial biodiversity is described. Impacts are predicted and mitigation measures are presented.

7.2.1 Methodology

7.2.1.1 Zone of Influence

From a terrestrial biodiversity perspective, the ZoI was defined as the footprint of the Project plus a 1km radius surrounding the Project boundary. There is no possibility of activities associated with the Project negatively influencing terrestrial habitats occurring more than 1km from the Project boundary. A change in terrestrial species behaviour is triggered by noise or visual stimuli. Species occurring within and in close proximity to the Project boundary can be negatively influenced by activities associated with the Project, but as the distance from the Project increases, the likelihood of terrestrial species being negatively affected decreases. Noise and visual stimuli that is more than 1km away from the Project boundary and that significantly affects species behaviour is unlikely to be associated with the Project. At this distance, noise or visual stimuli resulting from activities associated with the Project will not exist, being replaced by stimuli occurring much nearer to the species. On this basis, it is the view of RPS that beyond this distance, no terrestrial biodiversity receptor could be influenced by the Construction Phase or the Operational Phase of the Project.

7.2.1.2 Desktop Review

The National Biodiversity Data Centre (NBDC) collates, manages, analyses and disseminates data on Ireland's biodiversity. It is funded by the Heritage Council and the Department of Culture, Heritage and the Gaeltacht. The NBDC provides access to all validated biodiversity data through Biodiversity Maps, the on-line biodiversity data portal.

Biodiversity records and full species accounts can be viewed and scrutinised through the interactive Biodiversity Maps portal. This is a tool that can be used to help make a preliminary assessment of biodiversity issues when considering site-specific developments. The chosen search area using the NBDC search tool was customised in order to capture all terrestrial biodiversity records within 1km^2 surrounding the 3FM Project. The purpose of this task was to capture any records of protected species or species of natural heritage importance in proximity to the 3FM Project site boundary. The ZoI of the 3FM Project on terrestrial biodiversity features has been selected using a precautionary approach and project impacts beyond this zone are unlikely. Information from the NBDC was downloaded from Biodiversity Maps in May 2022 and updated in May 2024 A full list of all records can be found in Appendix 7.2.1.

7.2.1.3 Habitat Survey

Habitat surveys were initially conducted over seven separate occasions out to 150m of the red line boundary, between June 2022 and February 2023. These affected areas were surveyed again in April and May 2024. The surveys were undertaken in accordance with the Heritage Council's *Best Practice Guidance for Habitat Survey and Mapping* (Smith *et al.*, 2011). All habitats were mapped and categorised in accordance with the Heritage Council's *Guide to Habitats in Ireland* (Fossitt, 2000). A search was undertaken for protected and invasive flora species. Georeferenced aerial photographs were used as an aid to map habitats.

7.2.1.4 Protected Species

The habitat surveys included assessment of the potential presence of habitats that might support species protected by law or of natural heritage importance. This aspect of the survey was conducted with regard to best practice guidelines, in particular the National Roads Authority guidance on *Ecological surveying techniques for protected flora and fauna during the planning of National Road Schemes* (NRA, 2008).

All visible signs of mammals were recorded, and sites were visually assessed, in particular for potential breeding or resting areas of protected mammal species. Notes were taken on tracks and signs of protected species during the surveys. The suitability of habitats for protected species was also assessed using expert judgement in combination with the survey results and desktop assessment. Specific surveys were conducted for presence of bats, badgers and otters. These are described below.

Ecological Survey for Bats

An Ecological Survey for Bats was carried out from June 2022 to June 2024 to inform the EcIA. Full details of the bat survey methods, results and an interpretation of the results can be found in Appendix 7.2.2.

A Preliminary Roost Assessment (PRA) of structures/buildings within the 3FM Project site was carried out during daylight hours in September and October 2022. This PRA was updated in January, April and May 2024 to include additional areas, namely Areas K and L, as well as small numbers of existing buildings in Area O to which accessed was previously denied. A PRA of trees was carried out during daylight hours, initially between June and October 2022. Tree surveys were updated in January, April and May 2024 including existing and newly affected trees. This external inspection of structures and trees was undertaken from ground level to identify Potential Roost Features (PRFs), and to look for potential and actual bat entry/exit points, or evidence of bat roosts and signs of bat related activity in order to determine the presence or likely presence of bats.

The following structures were considered for their bat roosting potential as part of the survey:

- Poolbeg Boat Club House and associated buildings
- Turning Circle Jetty and associated Tanks
- Poolbeg Power Station Jetty
- ESB Reception Building
- Garage Style Building N of Pigeon House Road

- Kinsale Concrete Structures
- The former Bisset Engineering building
- Seatruck offices and workshop building
- Port Operations Centre & DM Mechanical & Pipe Installations
- Marine Terminals Limited & Rushfleet buildings
- Main & ancillary buildings at Hammond Lane Metal Recycling

Just one building had a score of low to moderate and as such further survey was necessary, namely dusk emergence survey. The building in question, the former Bisset Engineering building had a number of potential roost features, as well as actual evidence of bats (dropping on the exterior wall). These findings were discovered in May 2024 as access to this building and compound had previously been denied.

The other building scoring *low* is an unrelated ancillary building c. 30m north-northeast of the said Bissett building. The first dusk emergence survey was undertaken on 23rd May 2024 between 21.15 hrs to 23.30 hrs. The second was undertaken on 17th June 2024 between 21.40 hrs to 23.40 hrs.

Bat Activity Surveys consisting of dusk and dawn surveys were carried out on 23rd June 2022, 25th July 2022, 26th August 2022 and 18th May 2023. The August 2022 survey was a pre-dawn activity survey.

These activity surveys were repeated in May and June 2024: the first on 25th May 2024 between 21.27 hrs and 23.37 hrs, and the second on the 17th June 2024 between 21.55 hrs and 23.56 hrs.

The route of the bat activity survey transects are illustrated in the Bat Survey Report at Appendix 7.2.2 Terrestrial Biodiversity. The transect surveys extend from Sandymount along the active travel path, encompassing the Irishtown Nature Park to the Pigeon House Road.

Ecological Survey for Badger

Badger surveys were carried out during the habitat surveys between June 2022 and February 2023 in order to establish the presence of badger and/or foraging areas within the boundary of the proposed development, and to a distance of 50m outside of the site boundary. The development site and extended area were surveyed again in April and May 2024. The site was surveyed for the presence of badger setts and badger activity including paths, snuffle holes, latrines, badger hair and bedding material. The location of badger setts, the dimensions of sett entrances and the direction of entrance tunnels were recorded, mapped and photographed where present.

Otter Survey

Otter surveys were carried out alongside the habitat surveys between June 2022 and February 2023 as well as a dedicated otter survey carried out in April 2023 in order to establish the presence of otter and/or feeding areas within the boundary of the proposed development. The development site was surveyed again in 2024 between the months of January and May. The survey was carried out to 150m outside of the site boundary. The site was surveyed for the presence of otter holts, couches, slides, spraints and prints.

7.2.1.5 Ecological Impact Assessment

Likely significant effects of the proposed 3FM Project on terrestrial biodiversity features are assessed on the basis of the elements of the Project as set out in Chapter 5, *Project Description*. The information gathered from consultation, scoping and stakeholder feedback; the desk study and suite of targeted ecological field surveys have been used to prepare the EcIA. The EcIA was undertaken in accordance with the following guidelines which were used to derive the criteria as set out in Table 7.1 and Table 7.2.

Section 1.3.4 of the European Commission's *Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU)* (EC, 2017) provides advice and guidance on integrating biodiversity considerations into EIA generally and marine biodiversity into EIA specifically. It further refers to EC guidance on integrating climate change and biodiversity into EIA and CIEEM guidance for conducting EcIA (see below).

Section 4 of the European Commission's *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment* (EC, 2013) provides advice and guidance on integrating climate change and biodiversity into EIA.

Section 3.7.3 of the Environmental Protection Agency's *Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (2022) note under Figure 3.4 therein that "*where more specific definitions exist within a specialised factor or topic e.g. biodiversity, these should be used in preference to these generalised definitions*".

The EcIA for terrestrial biodiversity has been undertaken following the methodology set out in the Chartered Institute of Ecology and Environmental Management's *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal* and Marine (CIEEM, 2018); and with reference to Transport Infrastructure Ireland's *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (NRA, 2009); EPA (2022); and BS 42020:2013 Biodiversity: Code of practice for planning and development (BSI, 2013).

CIEEM (2018) guidelines complement EPA (2022) guidelines when describing the nature of effects on biodiversity features:

Positive or negative:	Positive and negative impacts/effects are determined according to whether the change is in accordance with nature conservation objectives and policy e.g., improves the quality of the environment or reduces the quality of the environment (*Quality of Effects*, EPA 2022);
Extent:	The spatial or geographical area over which the impact/effect may occur (*Extent and Context of Effects*, EPA 2022);
Magnitude:	'Magnitude' refers to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms (*Duration and Frequency of Effects*, EPA, 2022);
Duration:	'Duration' is defined in relation to ecological characteristics as well as human timeframes. Five years, which might seem short-term in the human context or that of other long-lived species, would span at least five generations of some invertebrate species. The duration of an activity may differ from the duration of the resulting effect caused by the activity. Effects may be described as short, medium or long-term and

	permanent or temporary. Short, medium, long-term and temporary will need to be defined in months/years (*Duration and Frequency of Effects*, EPA, 2022);
Frequency and timing:	The number of times an activity occurs will influence the resulting effect. The timing of an activity or change may result in an impact if it coincides with critical life-stages or seasons (*Duration and Frequency of Effects*, EPA, 2022), and
Reversibility:	An irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation. In some cases, the same activity can cause both reversible and irreversible effects (*Duration and Frequency of Effects*, EPA, 2022).

EcIA is based upon a source-pathway-receptor model, where the source is defined as the individual elements of the 3FM Project that have the potential to affect identified ecological features. The pathway is defined as the means or route by which a source can affect the ecological features. An ecological receptor is the feature of interest, being a species, habitat or ecologically functioning unit of natural heritage importance. Each element can exist independently, however an effect is created where there is a linkage between the source, pathway and feature.

EC (2017) advises that assessment of significance should be based on clear and unambiguous criteria. A significant effect is defined in CIEEM (2018) as –:

> *"an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features' [...] or for biodiversity in general. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national/local nature conservation policy) or more wide-ranging (enhancement of biodiversity). Effects can be considered significant at a wide range of scales from international to local";*

Table 7.1 sets out a geographic frame of reference and criteria for valuing ecological features. Table 7.2 sets out criteria for predicting magnitudes of effect. These tables have been prepared with due regard to EC, CIEEM, EPA and NRA guidelines described above.

Significant impacts are those with moderate or major effects which require avoidance, reduction or counterbalancing measures to mitigate or offset their negative effects. In this context, it should be noted that likely significant effects on designated European sites are considered separately in the Natura Impact Statement submitted with the application for permission. Beneficial effects do not require mitigation measures as their effects are positive.

Table 7.1 Geographic Frame of Reference for Value of Ecological Features

Ecological Value	*Criteria*
International	• 'European Sites' including Special Areas of Conservation (SAC), candidate Special Areas of Conservation (cSAC) & Special Protection Areas (SPA) • Resident or regularly occurring populations (assessed to be important at the international level) of the following: • Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive • Ramsar Sites • World Heritage Sites • Sites hosting significant populations of species under the Bonn Convention • Sites hosting significant populations of species under the Berne Convention
National	• Wildlife Refuge for species protected under the Wildlife Acts • Resident or regularly occurring populations (assessed to be important at the national level) of the following: • Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive • Natural Heritage Areas (NHA) or proposed (p)NHA • National Nature Reserves (NNR) • Marine Nature Reserve (MNR)
County	• Sites listed as part of the Ecological Network in the County Development Plan (CDP) • Areas subject to a Tree Preservation Order in a CDP • Resident or regularly occurring populations (assessed to be important at the County level) of the following • Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive • Species protected under the Wildlife (Northern Ireland) Order 1985 (as amended); and/or • Species listed on the relevant Red Data list • Sites containing areas of the habitat types listed in Annex I of the Habitats Directive that do not satisfy the criteria for valuation as of International or National importance • Regionally important populations of species or viable areas of semi-natural habitats or natural heritage features identified in a Biodiversity Action Plan (BAP) or County Development Plan (CDP) prepared for an administrative area • Sites containing natural habitat types with high biodiversity in a regional context and a high degree of naturalness, or populations of species that are uncommon within the County
Local (Higher)	• Locally important populations of priority species or habitats or features of natural heritage importance identified in a BAP, if this has been prepared • Key features of local value, e.g.: – sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality – Sites or features containing common or lower value habitats that maintain links and function as ecological corridors between key features of local value
Local (Lower) / Site	• Sites containing small areas of semi-natural habitats that are of limited local importance • sites containing areas of highly modified habitats • sites containing local populations of species that are common and not of conservation value • Sites that are used by protected species or species of conservation value as part of their territories but which do not contain the breeding or resting places of these species • Sites that do not maintain links or do not function as ecological corridors between key features of local value

Table 7.2 Magnitudes of Effect upon Biodiversity Features

Magnitude of Effect used in assessment	Equivalent Magnitude of Effect in EPA (2022)	Criteria
Major Negative	Profound Adverse Very Significant Adverse	• Negative Effect upon Integrity of a European site • Loss of or permanent damage to any part of a site of international or national importance • Loss of a key component or key feature of a site of regional importance • Decline in favourable conservation status (FCS) or condition (FCC) of a legally protected species at County value • Causing of an offence under European Directives or domestic transposing legislation
Moderate Negative	Significant Adverse Moderate Adverse	• Temporary impacts to key features of a site of international or national importance, but no permanent damage or loss of FCS/FCC • Permanent impacts to any part of a site of County value • Permanent loss of a key feature of local importance (higher value) where a feature is important for and supports other features of value • Causing of an offence under domestic legislation
Minor Negative	Slight Adverse	• Temporary impacts to any part of a site of County value • Temporary loss of a feature of local importance (lower or higher value) where a feature is not important for and supports other features of value
Negligible	Imperceptible	• No impacts above a *de minimis* threshold on identified biodiversity features • Beneficial and negative impacts balance such that resulting impact has no overall affect upon feature.
Minor Beneficial	Slight Beneficial	• A small but clear and measurable gain in general wildlife interest, e.g. small-scale new habitats of wildlife value created where none existed before or where the new habitats exceed in area the habitats lost.
Moderate Beneficial	Significant Beneficial Moderate Beneficial	• Larger new scale habitats (e.g. net gains > 1 ha in area) created leading to significant measurable gains helping to achieve relevant objectives of a BAP or CDP
Major Beneficial	Profound Beneficial Very Significant Beneficial	• Major gains in new habitats (net gains > 10 ha) of high significance for biodiversity helping to achieve relevant objectives of a BAP or CDP and underpinning government policy

7.2.2 Receiving Environment

7.2.2.1 Habitats

A map illustrating the site boundary of the 3FM Project and the existing habitats identified on site can be found in Figure 7.1 and Figure 7.2 at the end of this section.

Tidal Rivers CW2

Dublin Port lies on the mouth of the River Liffey; the River Liffey originates in the Wicklow Mountains and flows for approximately 125km through the centre of Dublin City before reaching the Irish Sea at Dublin Port (Plate 7.1 and 7.2). The River Liffey at Dublin Port falls into the Tidal River CW2 habitat at Dublin Port, all areas of the River Liffey shown in habitat maps Figure 7.1 and Figure 7.2 are within the Tidal River (CW2) habitat type. The tidal nature of the River Liffey in Dublin Port greatly influences the habitats and dynamics of the area, creating a productive ecosystem that supports a rich faunal and floral biodiversity. At low tide, extensive mudflats are exposed in the estuary and adjacent areas. These mudflats provide an abundant food source for numerous bird species, including resident and overwintering wetland birds. The monitoring of wintering waterbirds by BirdWatch Ireland as part of the Dublin Bay Birds Project which is funded by DPC, has identified the most numerous species in 2022-2023 as pale-bellied brent goose, oystercatcher, dunlin, redshank, knot, bar-tailed godwit, black-headed gull and herring gull. Section 0 Benthic Biodiversity and Fisheries presents survey results that underline the intertidal and sub-tidal diversity of species and habitats in the Liffey estuary.

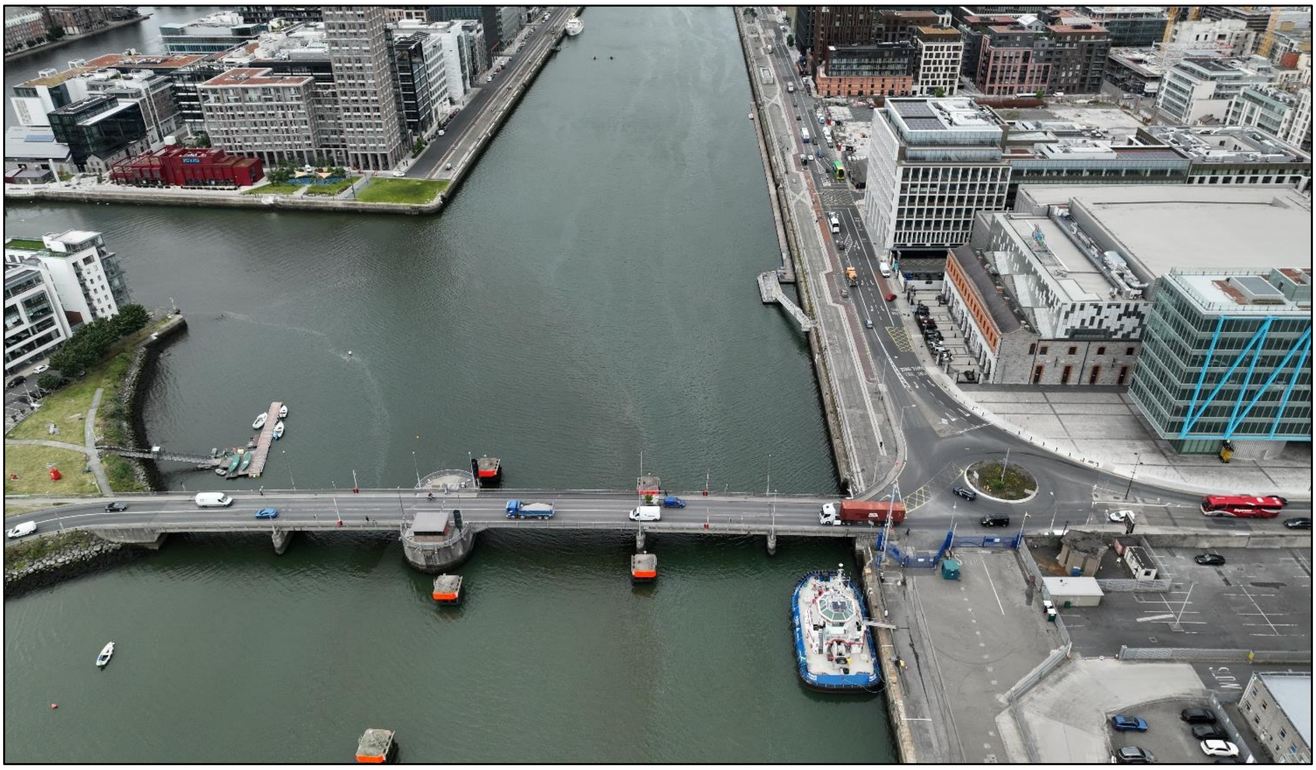

Plate 7.1 River Liffey at the Tom Clarke Bridge

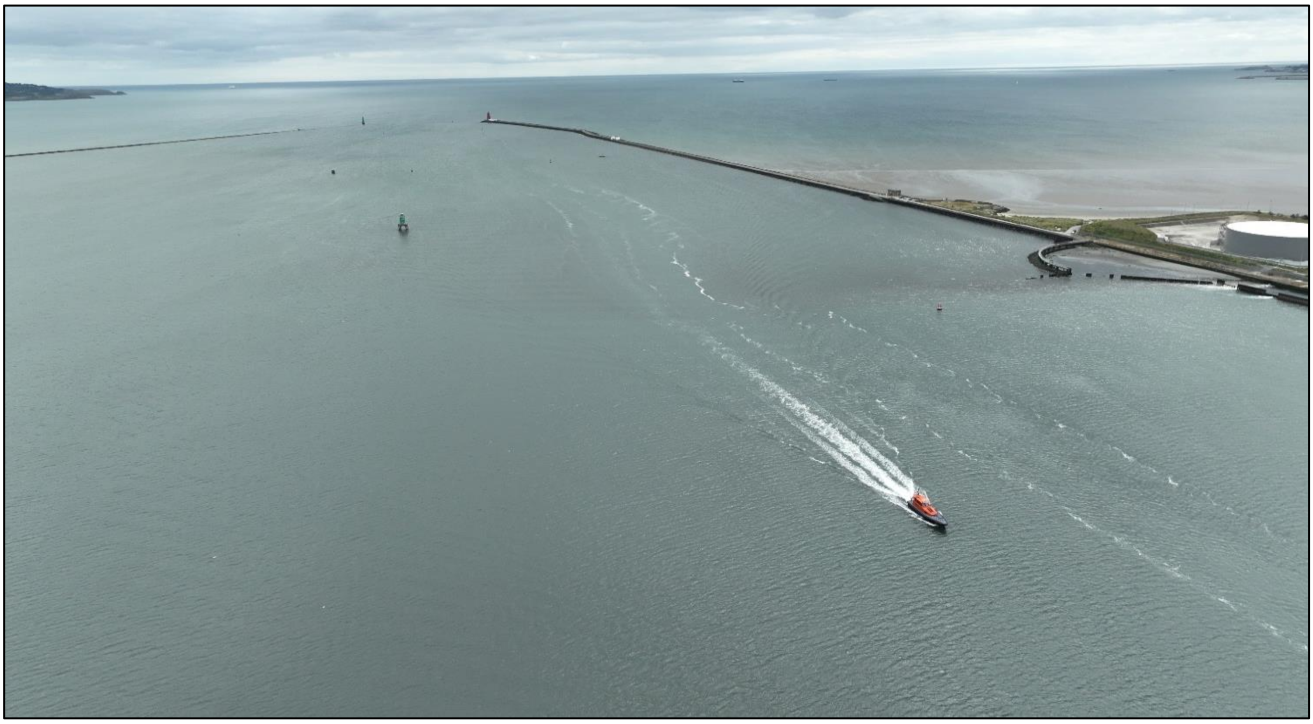

Plate 7.2 Mouth of River Liffey flowing into Dublin Bay

Amenity Grassland GA2

There are several areas of amenity grassland dispersed throughout the proposed site, largely south of the River Liffey. They typically occur in proximity the public road network, private carparking, office and auxiliary buildings. They comprise common grass and flowering herb species in variable abundances. Regular occurring herbs include common daisy *Bellis perennis*, creeping buttercup *Ranunculus repens*, white clover *Trifolium repens*, dandelion *Taraxacum officinale* agg., ribwort plantain *Plantago lanceolata*, common ragwort *Senecio jacobea* and lesser trefoil *Trifolium dubium*.

Dry Meadows and Grassy Verges GS2

Masterplan Area O

South of the Southbank Road lies a disused enclosure, approximately 1.2 ha in size (Plate 7.3 and 7.4). The area has been left unmanaged for several years. The site is more accurately a mosaic of habitats, dry meadows and grassy verges (GS2) being the dominant. The other habitats are recolonizing bare ground (ED3), scrub (WS3), spoil and bare ground (ED2), buildings and artificial surfaces. There are also damp, shallow depressions that appear to support water in winter.

The damp areas support high abundances of pointed spear-moss *Calliergonella cuspidata*, pendulous sedge *Carex pendula*. Also present are glaucous sedge *Carex flacca*, curled dock *Rumex* crispus, common cotton grass *Eriophorum angustifolium* and rushes *Juncus* spp. These areas may be brackish in nature.

Native trees and shrubs have established, mostly willow, bramble and to a lesser extent, wild cherry *Prunus avium* and common gorse *Ulex europaeus.* Bramble occurs as dense thickets as well as scattered individuals. Non-native trees and shrubs include butterfly bush *Buddleja davidii* and *Cotoneaster* spp. The scheduled nonnative species, sea buckthorn *Hippophae rhamnoides* was recorded in one location.

The grassland and bare ground support a variety of flowering herbs including red clover *Trifolium pratense*, ribwort plantain, wild carrot *Daucus carota*, fennel *Foeniculum vulgare*, teasel *Dipsacus fullonum*, common vetch *Vicia sativa*, coltsfoot *Tussilago farfara*, creeping cinquefoil *Potentilla reptans*, catsear *Hypochaeris radicata*, common ragwort, kidney vetch *Anthyllis vulneraria*, birds foot trefoil *Lotus corniculatus*, purple toadflax *Linaria purpurea*, meadow buttercup *Ranunculus repens*, fairy flax *Linum catharticum* and pale flax *Linum bienne*. Grasses include red fescue *Festuca rubra*, creeping bent *Agrostis stolonifera*, barren broom *Anisantha sterilis*. High abundances of birds foot trefoil were noted.

As well as *Cotoneaster* spp. other non-native species / garden escapes include *Cordyline*, red valerian *Centranthus ruber*, tutsan *Hypericum androsaemum*, and pampas grass *Cortaderia selloana*.

Where Area O adjoins Irishtown Nature Park there is c. 0.36 ha of linear enclosed grassland. The habitat is largely grassland with some new bare ground furthest south and recolonizing bare ground furthest north. The grassland is in a rank unmanaged condition with only intermittent flowering herbs including teasel, wild carrot, red clover, and ribwort plantain. Grasses include high abundances of red fescue and cocksfoot and intermittent tall fescue *Schedonorus arundinaceus* along damp areas supporting rush *Juncus* spp. There is some scattered bramble and willow in the open grassland and longer established willow and butterfly bush on the boundaries. This habitat is not being redeveloped and is instead being incorporated into the Irishtown Nature Park.

Plate 7.3 Drone shot of area of semi-improved grassland within Area O

Plate 7.4 Semi-improved grassland within Area O

Masterplan Area M

Area M is located north of Pigeon House Road and west of Poolbeg Power station (Plate 7.5). Like Area O it is more accurately a mosaic of habitats, primarily dry meadows and grassy verges (GS2) and scrub (WS3) with some recolonizing bare ground (ED3). The site is characterized by large bunds along the site's eastern and western boundaries followed by vegetated spoil heaps.

The scrub component includes dense continues bramble thickets and clutters areas of unmanaged willow and non-native butterfly bush. Hawthorn *Crategus monogyna* and blackthorn *Prunus spinosa* also occur. The sand and gravel substrates present support a wide variety of flowering herb species. Red valerian is abundant throughout. Common vetch, kidney vetch, birds foot trefoil and ribwort plantain are frequent or locally abundant.

Other flowering herb in lower abundances are purple toadflax *Linaria purpurea*, sea mayweed *Tripleurospermum maritimum,* narrow-leaved ragwort *Senecio inaquidens,* common ragwort, coltsfoot, mugwort *Artemisia vulgaris*, and yarrow *Achillea millefolium*, fennel, and one or more non-native fleabane *Conyza* spp. Other legumes include red clover and one or more melilot species *Melilotus* spp. Ox-eye daisy *Leucanthemum vulgare* is rare. Also present are unidentified hawkbits *Leontodon* spp. and hawkweeds *Hieracium* spp.

The central grassy area is a relative short, impoverished sward with species such as red fescue and bents *Agrostis* spp.

Non-native - garden escapes also occur including *Cotoneaster* spp. and *Cordyline*. The scheduled non-native invasive species sea buckthorn was recorded in the northeast of the site.

There remining areas of dry meadows and grass verges (GS2) (beyond the designated enclosed spaces) are linear forms along road and pedestrian paths, good examples of which occur along South Bank Road, Pigeon House Road and along the existing pedestrian path between Sean Moore Park and Irishtown Nature Park. Some are managed by periodic strimming or more regular mowing. A small number of unmanaged robust perennial herbs are constants in these areas namely alexanders *Smyrnium* olusatrum, red valerian and winter heliotrope *Petasites fragrans*, common nettle *Urtica dioica*. Where the grass is not managed these areas transition in scattered, and eventually more continuous scrub cover with rambling patches non-native traveller's joy *Clematis vitalba*. Intermittent trees such as maritime pine *Pinus pinaster* and sycamore, along with loosely scattered bramble and *Cotoneaster* spp. occur within the grassland. Some of these habitats are marred by the presence of the scheduled non-native invasive species Japanese Knotweed *Reynoutria japonica*. Non-native winter heliotrope is not a scheduled invasive species; however, it is aggressively patch forming in these areas.

The grassland just off Pigeon House Road is in rank condition with an enriched appearance. There are high abundances of cocksfoot and other common grasses. Flowering herbs comprise frequent creeping cinquefoil *Potentilla reptans*, creeping thistle, cleavers *Galium aparine*, common nettle, meadow buttercup, ribwort plantain, yarrow and crisp dock are occasional.

Along the lower pedestrian path at Sean Moore Park (seaside) alexanders, fennel, hemlock *Conium maculatum* and lucerne *Medicago sativa* ssp. *sativa*, lesser burdock *Arctium minus*, mugwort *Artemisia vulgaris*, and mallow *Malva spp.* are frequent. Sea beet *Beta vulgaris* ssp. *maritima* is occasional.

The grassland (and accompanying tree lines) along South Bank Road (Covanta side) is managed by intermittent strimming. Only common herbs and grasses were observed including cocksfoot *Dactylis glomerata*, Yorkshire Fog *Holcus lanatus*, red fescue, broadleaved dock *Rumex obtusifolius*, common ragwort, creeping buttercup, meadow buttercup, creeping thistle, and common hogweed *Heracleum sphondylium*. Three-cornered Garlic *Allium triquetrum*, a scheduled non-native invasive species was recorded at a single location.

Plate 7.5 Area of semi-improved grassland and scattered scrub within Area M

Recolonizing bare ground ED3

This habitat occurs along the approach road to DPC's Port Operations Centre. The substrate large grade quarried stone. Red valerian is the dominant species. Other species occur but in low abundances including ribwort plantain, ragworts *Senecio* spp. and broadleaved grasses like cocksfoot and false oat grass. Shrubs include intermittent butterfly bush and *Cotoneaster horizontalis*.

Treeline WL2 and (linear) Scrub WS1

These features occur along South Bank Road and Pigeon House Road (Plate 7.6). The scrub habitat is predominantly self-sown butterfly bush. The treelines vary between uniform rows of sycamore *Acer pseudoplantanus* or Norway Maple *Acer platanoides* to more irregular assemblages of mix species including sycamore, white poplar *Populus alba*, alder *Alnus* spp., pine *Pinus* spp., wild cherry *Prunus avium*, and cypress *Cupressus* spp. These are sometimes mixed with non-native shrubs such as ake-ake *Olearia traversii* and varieties *Elaeagnus* and *Escallonia*. Given the shaded conditions due to the prevalence of as well as non-native evergreen shrubs. Flowering herbs are scarce except for occasional wood avens *Geum urbanum*, largely a consequence of deep shade given the high abundances of common ivy *Hedera helix* and non-native evergreen shrubs. The sunlit edges can be good for flowering herbs that are typical of bare substrate across Dublin Port, notably red valerian, ragworts, alexanders, and yellow brassicas Brassicaceae spp.

Linear scrub (on a c. 400m long beam) occurs alongside Area O (southern boundary). It is an overgrown patchwork of bramble, willow, butterfly bush, and common gorse on a. Some open patches occur with coarse grassland and winter heliotrope covering. Also present on the beam are linear stands of scheduled Japanese Knotweed. There is one lone area of scheduled sea buckthorn where this habitat meets Irishtown Nature Park.

Plate 7.6 Treeline along Pigeon House Road

Immature Woodland (WS2)

This is a small linear area of planted immature woodland measuring c. 0.11ha. It occurs along the southern boundary of the Covanta waste to energy site alongside amenity grassland and adjacent carparking. The species include pine Pinus spp., Norway Maple, and birch *Betula* spp.

Building and Artificial Surface BL3

This is the dominant habitat across the proposed development site, particularly north of the River Liffey comprising a complex of port buildings, structures and associated hardstanding (Plate 7.7). South of the River Liffey this habitat extends throughout the port estate from the East Link Toll Bridge to the Great South Wall. There are scatterings of self-sown flowering on wherever there is available substrate. These are frequently annuals, for example pineappleweed *Matricaria discoidea* and willowherbs *Epilobium* spp. or more ubiquitous perennials such as red valerian and ragworts *Senecio* spp.

Plate 7.7 Typical hard standing within the development area

7.2.2.2 Invasive Plant Species

Japanese knotweed, sea-buckthorn and three-cornered garlic were recorded within the boundary of the Project. These species are listed as non-native species subject to restrictions to prevent their dispersal, establishment or spread under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011. The Japanese knotweed within the 3FM Project site is currently managed via herbicide treatment to prevent further spread in accordance with Dublin Port Japanese Knotweed Treatment Record (Enviroco Ltd 2023). The location of these species is illustrated in Figure 7.3 at the end of this section.

7.2.2.3 Flora Protection Order (FPO) & Rare Plants

The NBDC records highlighted two records of plant species listed under the Flora Protection Order (2022) within the (customised polygon) 1 km buffer search area namely, the many-seasoned thread-moss *Bryum intermedium* and Warne's Thread-moss *Bryum warneum*.

No species (including many-seasoned thread-moss and Warne's Thread-moss) listed on the Flora Protection Order (2022) were recorded across the 3FM Project site during habitat surveys.

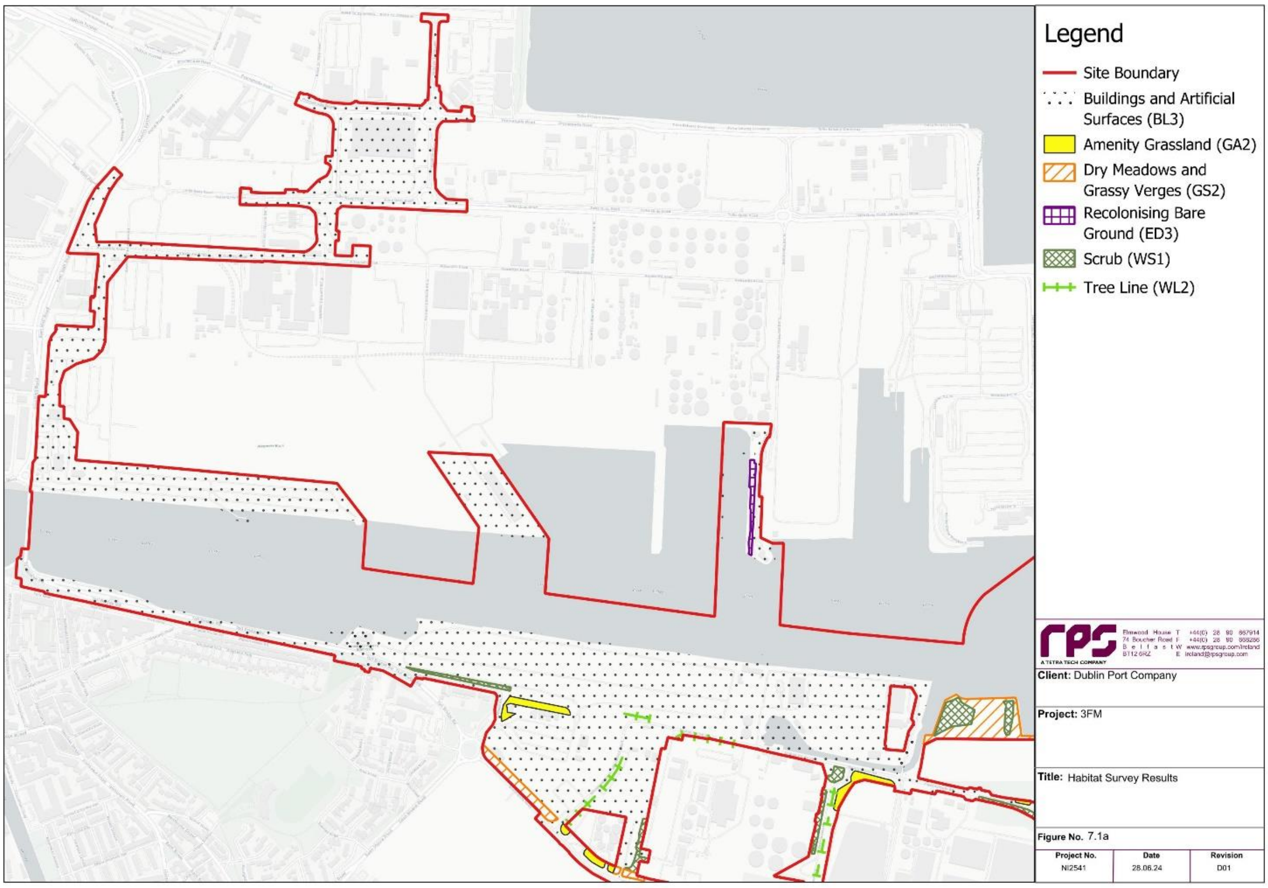

Figure 7.1 Habitat Map

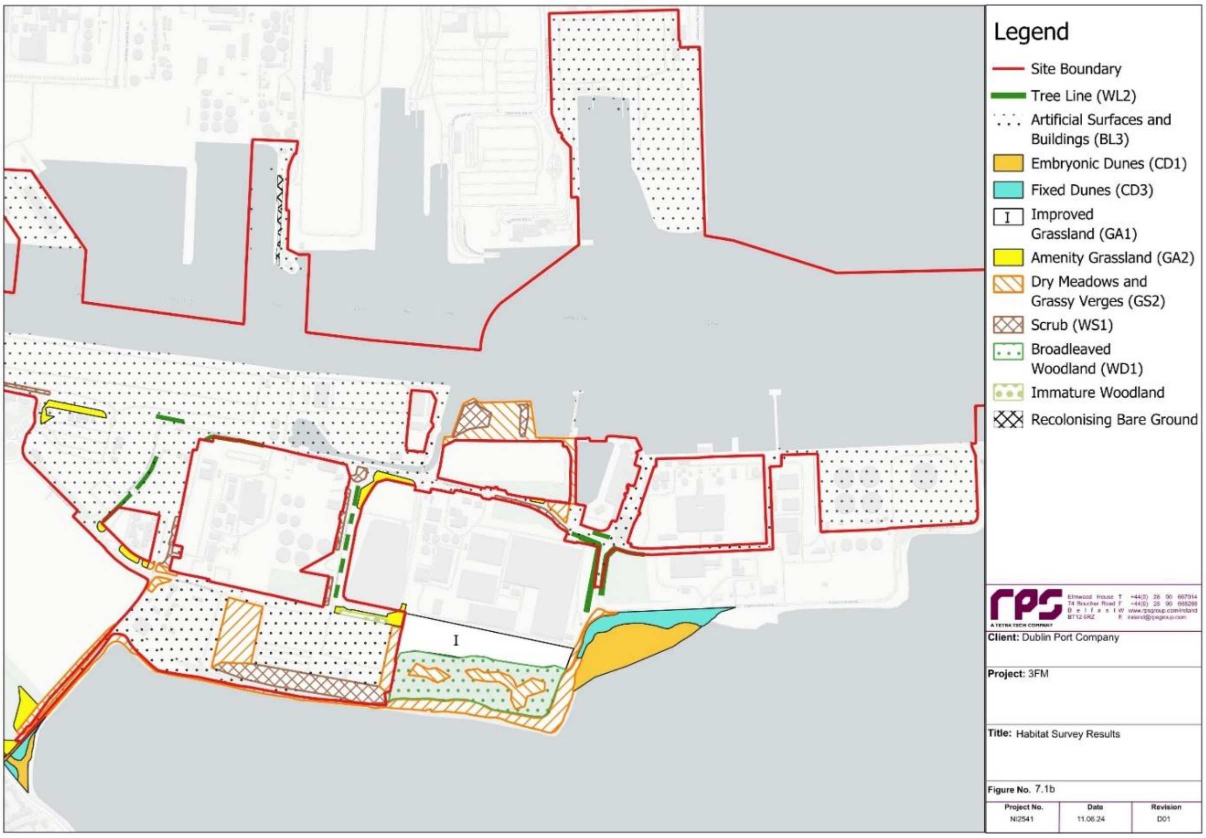

Figure 7.2 Habitat Map

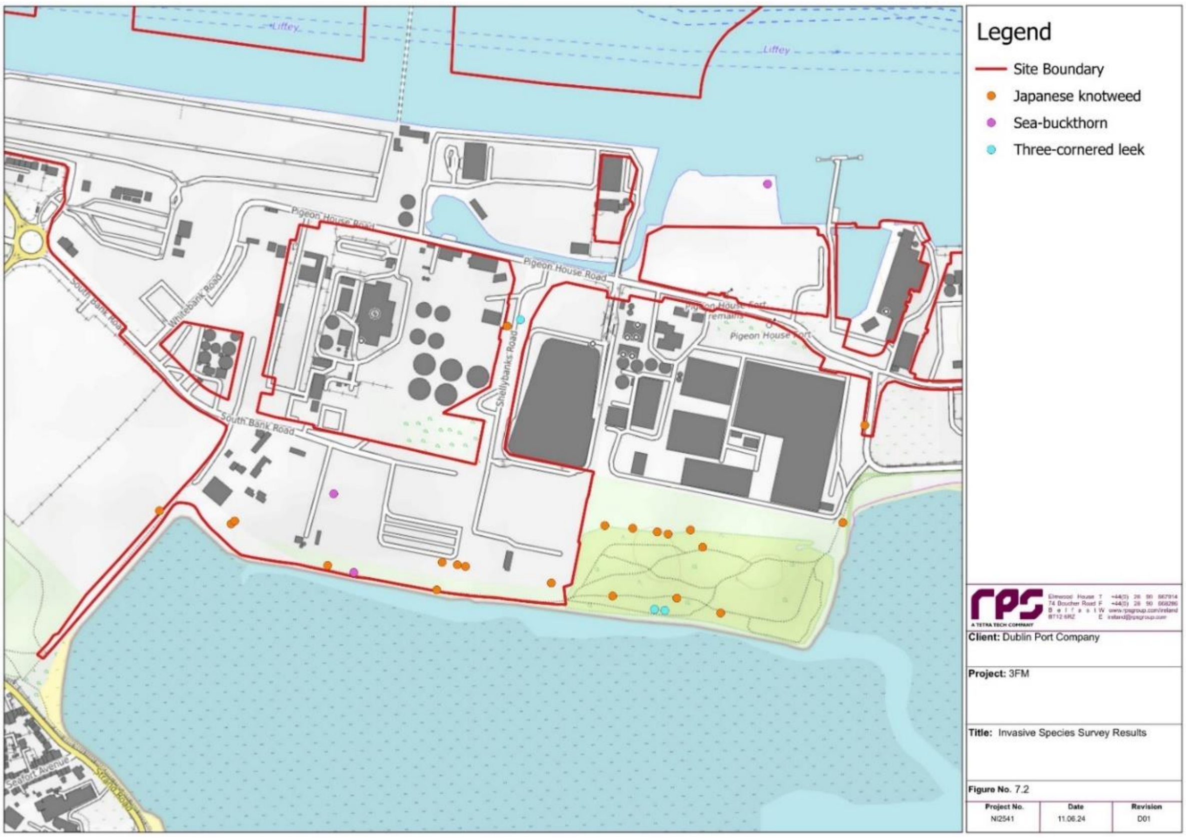

Figure 7.3 Invasive Non-Native Species Map

7.2.2.4 Protected Species

Bats

The NBDC records search identified three historical records of bats within the (customised polygon) 1km^2 search area. The records are all greater than 20 years old and consist of brown long-eared bat *Plecotus auritus* and Daubenton's bat *Myotis daubentonii*.

A search of Bat Conservation Ireland records highlighted 898 historical records of bats within 5km of the site boundary. The records range from 1999 to 2022, including seven historical bat roost locations. Records returned include the following species: *Pipistrellus* sp., common pipistrelle *Pipistrellus pipistrellus*; soprano pipistrelle *Pipistrellus pygmaeus*; brown long-eared bat *Plecotus auritus*; Leisler's bat *Nyctalus leisleri*, whiskered bat *Myotis mystacinus*, Natterer's bat *Myotis nattereri* and Daubenton's bat *Myotis daubentonii*.

Bat surveys associated with other planning applications within Dublin Port were also scanned for information on bats in the general area. A record of a common pipistrelle roost on private property was identified, located at Pigeon House Road, Ringsend. Several ad-hoc records of common pipistrelle and Leisler's bat *Nyctalus leisleri* were identified in surveys located around the Irishtown Nature Park within the 3FM Project site boundary. Other locations near the site had more numerous bat records. These included records of common pipistrelle, Leisler's bat and *Myotis* spp. (2020) in areas around Sean Moore Park located approximately 300m southwest of the site boundary; records of common pipistrelle, soprano pipistrelle and Leisler's bat (2020) at Ringsend Park and surrounding areas approximately 100m west of the project site; and common pipistrelle (2020) recorded at Shelley Banks Road.

The 3FM Project site consists mainly of hardstanding with some scattered areas of semi-improved grassland leading into immature broadleaved woodland at Irishtown Nature Park which could be used by a small number of foraging bats. Foraging opportunities within 250m of the site consist of mainly urban habitat and gardens with some parkland including Seamore Park and Ringsend Park. The River Liffey and the River Dodder provide a suitable commuting route linking the site to the wider landscape. Elm Park Golf Club, Herbert Park, UCD and tributaries of the Liffey in the wider landscape provide suitable foraging habitat for bats.

A total of 23 structures or buildings were subject to PRA to identify potential entry and exit points and determine potential the roost suitability for bat species. Just two buildings (S8 and S23 scoring *low* to *medium*, and *low* respectively) were subject to further survey namely dusk emergence surveys. All other structures or buildings had a *negligible* score.

No conformed bat roosts were recorded at S8 and S23 during dusk emergence surveys. Full details of the PRA for each structure, and the emergence surveys at buildings S8 and S23 can be found in Appendix 7.2.2.

Bat activity surveys, including those as recently as May and June 2024 confirmed the presence of three species foraging within the site boundary: Leisler's bat, common pipistrelle and soprano pipistrelle. Unconfirmed soprano or common pipistrelle were assigned to the group, pipistrelle sp. (50kH). The coastal path and the Irishtown Nature Park showed the highest activity levels of foraging and commuting bats during the survey.

Badger

The NBDC records search highlighted one historical record of badger *Meles meles* from 2013 within the (customised polygon) 1km^2 search area. The presence of badger was confirmed outside of the site boundary and an artificial badger sett was recorded during the course of the habitat survey. A map illustrating the location of badger setts and field signs can be found below in Figure 7.4.

Artificial Badger Sett

There is a newly created artificial main badger sett >3 m from the site boundary (Plate 7.8). The sett is located within the Irishtown Nature Park, on a cleared woodland bank. The sett is securely fenced off and so no access to the sett was possible to access activity levels. Five artificial tunnelled entrances were observed. The artificial sett was created as part of Permitted 'Enabling Works' Development in relation to planning application Ref.PWSDZ3270/19, due to the removal of a main badger sett at the former Irish Glass Bottle Plant at Ringsend approximately 25 m from the site boundary.

This artificial sett was re-visited in on 9th May 2024 as part of the wider badger survey. There was no evidence of badgers using the entrances into and out of the enclosure. Vegetation had grown up and around these entrances. Two are pictured in Plate 7.9 below. There was no evidence of activity within the enclosure (flattened vegetation, foraging, etc.). There was no recorded evidence of badger in the wider development site during habitat surveys in April and May 2024.

Plate 7.1 Artificial sett and secured fencing

Plate 7.2 Two of the discussed entrances into the artificial sett enclosure

Figure 7.4 Badger Survey Results

Otter

The NBDC records search highlighted six historical records of otter *Lutra lutra* from 2016 within the (customised polygon) 1km^2 search area. Otter Surveys carried out by Triturus Environmental Ltd for Dublin City Council's Dublin City Otter Survey, '*An Action of the Dublin City Biodiversity Action Plan 2015-2020'*, showed the port and surrounding coastal habitats to have ranked near the bottom of areas surveyed for otter signs/activity. The survey highlighted the location of three holts (two active, one inactive), located in largely inaccessible areas of habitat on the northside of Dublin Port. Two of these holts are located approximately 60m from the 3FM Project site boundary in Masterplan Area C (see Figure 1-1). Also recorded was a single spraint on the great south wall just beyond the 3FM Project site boundary.

The 3FM Project otter surveys were carried out alongside the habitat surveys between June 2022 and February 2023, as well as a dedicated otter survey carried out in April 2023. An updated otter survey was undertaken in 2024, including efforts to ascertain the status of the holts identified in the (2019) Dublin City Otter survey in Area C. Initial attempts to locate these 2019 holts were unsuccessful due to the absence of safe access. The 2019 holt locations were in steep rock armour with entangled steel and other masonry. Two locations suspected to be holts were monitored from a distance. However, initial attempts to capture otter footage were unsuccessful. The only mammal footage was that of fox *Vulpes vulpes*.

Safe access was eventually made in on 24th April 2024. One holt had an active appearance evidenced by the presence of spraints at the entrance as shown in Plate 7.10 and 7.11 below. A camera trap was erected on the 09th May 2024 for a period of 23 days to determine if this was a holt of the highest significance, namely a breeding or natal holt.

Otter was recorded on just one occasion (a single adult) on the night of the 11th May 2024 in one 10sec recording (Plate 7.12). As such, this is not a natal holt and is sufficiently distanced (>30m) from the development boundary.

A map illustrating the location of these holts is shown below in Figure 7.5.

Plate 7.3 The active otter holt with spraints at the entrance.

Plate 7.4 The camera trap fixed on the active holt (9 May – 3 June 2024).

Plate 7.5 Screenshot of the only otter footage, a single male at 01.31 AM on 11 May 2024.

Marsh Fritillary

The NBDC records search highlighted no records of marsh fritillary butterfly *Euphydryas aurinia* within the (customised polygon) 1km^2 search area. No sightings or signs of marsh fritillary were recorded during the survey visits.

Common Frog

The NBDC records search highlighted 10 historical records of common frog *Rana temporaria* from 2020 within the (customised polygon) 1km^2 search area. No sightings or signs of common frog were recorded during the survey visits.

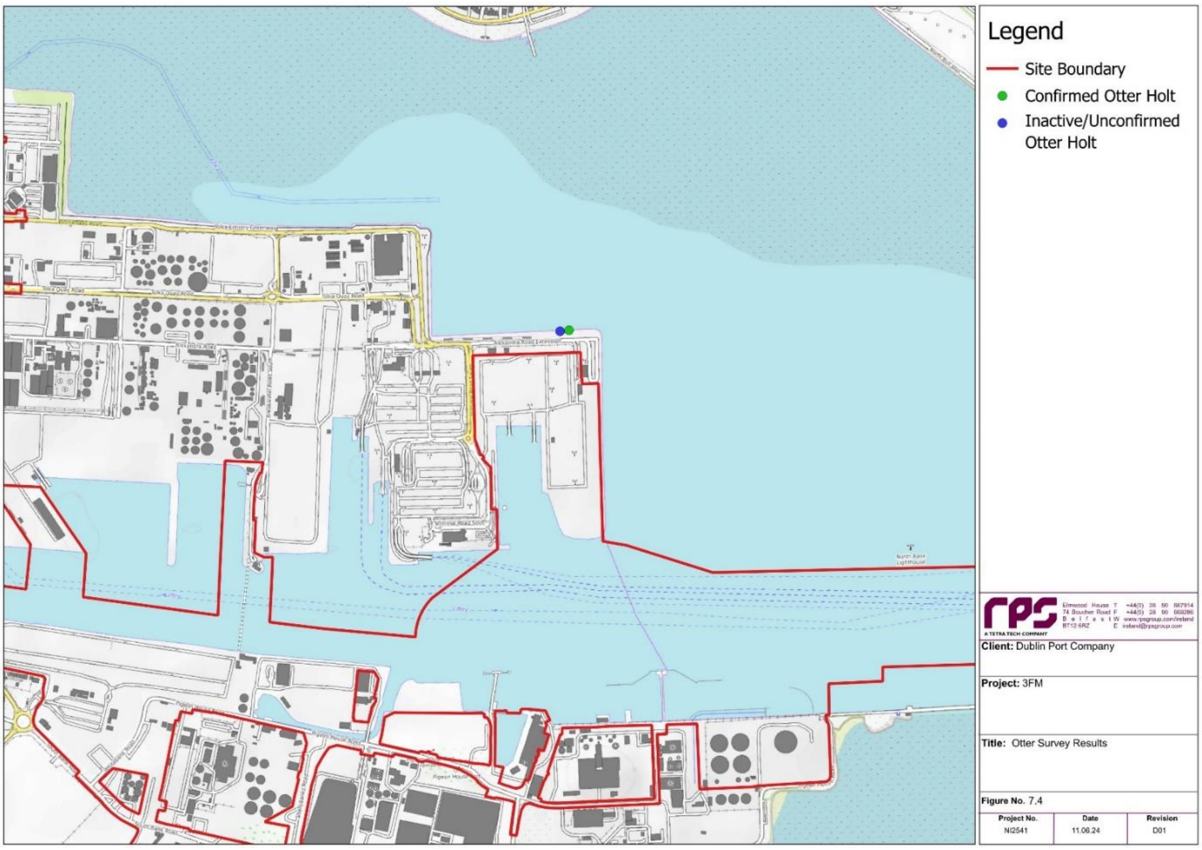

Figure 7.5 Otter Survey Results

7.2.3 Impact Assessment

As outlined above, the EcIA for terrestrial biodiversity has been undertaken following the guidance and methodology set out in CIEEM (2018); EC (2017); EPA (2022); EC (2013); BSI (2013) and NRA (2009); Table 7.1 sets out a geographic frame of reference and criteria for valuing ecological features. Table 7.2 sets out criteria for predicting magnitudes of effect. These tables have been prepared with due regard to EC, CIEEM, EPA and NRA guidelines.

The predicted magnitude of potential effects on biodiversity features is based on the criteria set out in Table 7.2 and determines whether or not impacts are significant in the absence of mitigation.

Significant impacts are moderate or major effects which require avoidance, reduction or counterbalancing measures to mitigate or offset their negative effects. Beneficial effects do not require mitigation measures as their effects are welcomed.

7.2.3.1 Potential Effects at Construction Phase

Habitats

The following habitat features will be affected by the development:

- Approximately 1.2 ha of mosaic habitat (largely dry meadows and grassy verges with recolonising bare ground) within Area O will be permanently lost. This feature is considered to be of Local (Lower) value.

- Approximately 0.4 ha of mosaic habitat (dry meadows and grassy verges with recolonising bare ground, and scrub) within Area M will be permanently lost in order to facilitate the new turning circle. This feature is considered to be of Local (Lower) value.
- Approximately 208 m of treelines will be lost at various locations for the purposes of road upgrading and newly built roads. These features are considered to be of Local (Lower) value.
- Up to c 1.0 ha of scrub at various locations will be lost for the purposes of road upgrading, newly built roads and landscaping (new retaining wall and tree planting along the southern boundary of Area O). These features are considered to be of Local (Lower) value.
- Road upgrading and newly built roads will result in the small losses of habitats of Local (Lower) value. These are amenity grassland, (species poor) dry meadows and meadows and grassy verges, and immature woodland. For example, c. 100m² of immature woodland south of the Waste to Energy Plant will be lost for the purposes of a new access road.

In accordance with Table 7.2, permanent loss of those features of Local (Lower) ecological value is predicted to result in a minor negative magnitude of effect, as their loss does not result in any significant environmental impact. In accordance with the methodology set out in Section 7.2.1.5, these impacts do not require avoidance, reduction or counterbalancing measures to be implemented.

Protected Flora

No species listed on the Floral Protection Order (2015) were recorded within the development site. There are consequently no potential impacts, significant or otherwise on protected floral species as a result of the construction or operation of the 3FM Project.

Invasive Species

During the construction phase Japanese knotweed, sea buckthorn and three-cornered garlic located within the site boundary of the Project has potential to spread within and outside of the site in the absence of mitigation during ground works.

Bats

Two buildings (scoring *low – medium* and *low*) were subject to further survey (dusk emergence surveys). Neither building was found to support roosting bats. All other structures had negligible bat roost suitability. As such, the proposed project will have no impact on roosting bats.

Common pipistrelle, soprano pipistrelle, a *Pipistrelle* sp. (50kH), and Leisler's bat were recorded during activity surveys. Small numbers of these bats, notably common pipistrelle, showed some association with the linear scrub, grassland and scattered tree corridor alongside the coastal path connecting Sean Moore Park with the proposed Port Park and Wildflower Meadow. As part of the 3FM Project, the coastal path between Sean Moore Park and the proposed new Port Park and Wildflower Meadow will comprise new lighting, and some minor habitat loss to enhance access from the said path into the new Port Park. No existing trees are scheduled for removal at this location. The existing vegetation on the Pembroke Cove side of the path will be untouched. As such, there will be a continuity of scrub, rough grassland and scattered trees along which the existing bats can commute and forage.

Commuting and foraging common pipistrelle (and soprano pipistrelle) bats are shown to be tolerant of nighttime artificial lighting (ILP, 2023). However, unsuitable / obtrusive lighting could discourage foraging and/or commuting activity, certainly in the immediate vicinity of the coastal path where lux levels are highest. Such changes could result in a significant negative effect - moderate negative, in the absence of mitigation.

Otter

The site boundary within Area C is within 61m of two otter holts at the same location, one of which is currently active. These holts are sufficiently distanced and screened from the proposed works and as such, no mitigation is proposed.

Badger

An artificial badger sett enclosure is <3m from the site boundary. The nearest sett entrance is c. 8m from the site boundary. The tunnels appear to travel in an eastern direction away from the edge of the site boundary.

Where Area O adjoins Irishtown Nature Park there is c. 0.36ha of linear enclosed grassland. This will become a brent geese *Branta bernicla* landing and feeding site, and an extension of the existing c. 2.6ha geese field that sits immediately north of Irishtown Nature Park.

Furthermore, this new landing and feeding strip will be buffered by the provision of an additional c. 0.47ha of adjoining lands within Area O. This hardstanding area will be converted into grassland and planted with trees along its western boundary. These additional lands are illustrated in Landscape Drawings nos. 33-P-001G and 33-P-004.1C.

This extension will provide create a distance in excess of 50m between the artificial badger sett and the new Area O Ro-Ro Terminal.

Increased activity during the construction (fence removal, landscaping etc.) may cause increased disturbance to badgers using the artificial sett. As such mitigation is proposed.

7.2.3.2 Potential Cumulative Effects

Chapter 5 of the EIAR describes other related projects in proximity to the proposed 3FM Project, in the surrounding Dublin Port estate and further afield.

No likely significant effects on terrestrial biodiversity features are predicted as a result of the construction or operation of any of the projects listed in Chapter 5 of the EIAR, and no remedial or mitigation measures are required to reduce the magnitude of the effects predicted in the relevant assessments (where documented) of those other projects.

As there are no likely significant impacts predicted on any terrestrial biodiversity feature as a result of the 3FM Project alone, and no likely significant effects on terrestrial biodiversity features predicted as a result of the construction or operation of any of the projects listed in Chapter 5 of the EIAR, there is no pathway for additional or additive effects resulting in synergistic impacts above a magnitude already predicted in this assessment.

Cumulatively, there will be no cumulative terrestrial biodiversity impacts between the 3FM Project, and the other projects considered in Chapter 5 of the EIAR.

7.2.4 Remedial & Mitigation Measures

As outlined in Section 7.2.2.1 7.2.3.1, potential impacts on habitats are considered to be of a minor negative impact. As such, no significant effects are likely for habitats and bats and do not require avoidance, reduction or counterbalancing measures to be implemented.

Nonetheless, counterbalancing measures are proposed, principally the following:

- Irishtown Nature Park is to be extended west incorporating an additional c. 0.85 ha of grassland, principally for brent geese but with the potential to support other fauna including invertebrates.
- 0.88 ha of new meadow will be created adjoining the new Area O Ro-Ro Terminal to the west comprising sown wildflower and grass seed mix with mown paths to be maintained as per design.

Invasive Species

There is potential for the spread of invasive non-native species within the site and outside the site in the absence of mitigation measures. A Contamination Zone will be set up around invasive non-native species located within the site boundary. The Contamination Zone will extend 7m laterally from visible plant growth and warning signs will be erected to ensure there is no access within the Contamination Zone during initial site preparation works or the main construction contract.

Badger

There is potential that the project may cause a significant impact to badger, a protected species, without the use of appropriate mitigation measures. An Ecological Exclusion Zone (EEZ) will be set up to ensure no disturbance to the artificial badger sett at Irishtown Nature Park prior to commencement of pre-site clearance and construction works. Temporary hi-visibility fencing will be erected 25 m from the sett. No vehicles, storage or stockpiling of materials will be allowed within the EEZ.

This disturbance will be temporary. When the works are complete, and the new grassland habitat is vacated, there will be benefits for badger i.e., the provision of wider protective grassland buffering, as well as screening (boundary tree planting alongside the new Area O – Ro-Ro Terminal).

Bats

New lighting along the upgraded path connecting Sean Moore Park and the new Port Park & Wildflower Meadow will be in accordance with the Institution of Lighting Professionals (ILP) Guidance Notes for the Reduction of Obtrusive Light (ILP, 2021) and Bats and Artificial Lighting in the UK (ILP, 2023).

Within the new Port Park, lighting is proposed around the sports pitch. Lighting is designed here to minimise light spill by using LED floodlights that have a very low upward light output ratio and will also be fitted with back reflectors to cut off the low throwback to reduce light pollution to areas adjacent the pitch.

All luminaires should lack UV elements when manufactured. Metal halide, compact fluorescent sources should not be used. LED luminaires should be used where possible due to their sharp cut-off, lower intensity, good colour rendition and dimming capability. Column heights will minimise light spill and glare visibility. Luminaires will be mounted horizontally, with no light output above 90° and/or no upward tilt (ILP, 2023).

The species present (notably common pipistrelle) are predicted to remain active along this corridor avoiding only the highest lux levels beneath the light columns. Following the provision of suitable lighting, the impact overall is considered to be negligible.

Measurable gains

The provision of new tree planting and wildflower meadow at the new Port Park overall has the potential to result in a minor beneficial effect on local bat populations.

Also noted is the provision of a new linear coastal park c. 25m wide that will border the Sean Moore Park – Port Park corridor as part of the Glass Bottle Site development. This will broaden the vegetated corridor on the landward side of the new pathway.

7.2.5 Residual Impacts

7.2.5.1 Flora & Habitats

There are no significant residual impacts predicted on terrestrial flora and habitat features as a result of the construction and operation of the 3FM Project.

7.2.5.2 Protected Species

There are no significant residual impacts predicted on terrestrial protected species as a result of the construction and operation of the 3FM Project.

7.3 Benthic Biodiversity and Fisheries

This section provides an overview of the potential benthos and fisheries impacts arising during the construction and operation phases of the 3FM Project on the surrounding marine environment.

7.3.1 Methodology

7.3.1.1 Benthic Faunal Surveys

Subtidal Sampling – Dublin Harbour

A total of 18 sub-tidal grab samples were collected from the River Liffey from the Tom Clarke Bridge to the Poolbeg generating station. All samples were collected on 15th December 2022 and were sampled using a 0.1m^2 stainless steel Van-Veen Grab for benthic faunal analysis. Due to the coarse nature of the seabed, no sample was collected from site B_10. To supplement the infaunal information collected in grab samples, drop-down video footage was collected at 19 locations within the same survey area. Video data was collected on 20th October 2022. All sampling stations were positioned using a Garmin eTrex GPS. A list of the stations sampled and their ITM positions is presented in Table 7.3 and

Table 7.4 and displayed on a map in Figure 7.6.

Table 7.3 Positions of sub-tidal grab sampling stations (B_01 to B_19). All positions are in Irish Transverse Mercator.

Station	Easting	Northing
B_01	718082	734293
B_02	718046	734349
B_03	718317	734232
B_04	718601	734187
B_05	718708	734140
B_06	718936	734108
B_07	719170	734077
B_08	719465	734040
B_09	719806	734001
B_10	No Sample	No Sample
B_11	720239	734014
B_12	720536	733952
B_13	720654	733946
B_14	720940	733961
B_15	720938	733958
B_16	720063	734003
B_17	720056	733978
B_18	720124	734010
B_19	720178	733977

Table 7.4 Positions of sub-tidal video sampling stations (BV_01 to BV_19). All positions are in Irish Transverse Mercator.

Station	Easting	Northing
BV_01	718068	734347
BV_02	718064	734281
BV_03	718376	734205
BV_04	718583	734205
BV_05	718698	734157
BV_06	718985	734127
BV_07	719211	734089
BV_08	719489	734062
BV_09	719808	734005
BV_10	720222	734208
BV_11	720242	733999
BV_12	720514	733923
BV_13	720649	733961
BV_14	720832	733959
BV_15	720953	733941
BV_16	720078	734004
BV_17	720085	733974
BV_18	720125	734022
BV_19	720140	733960

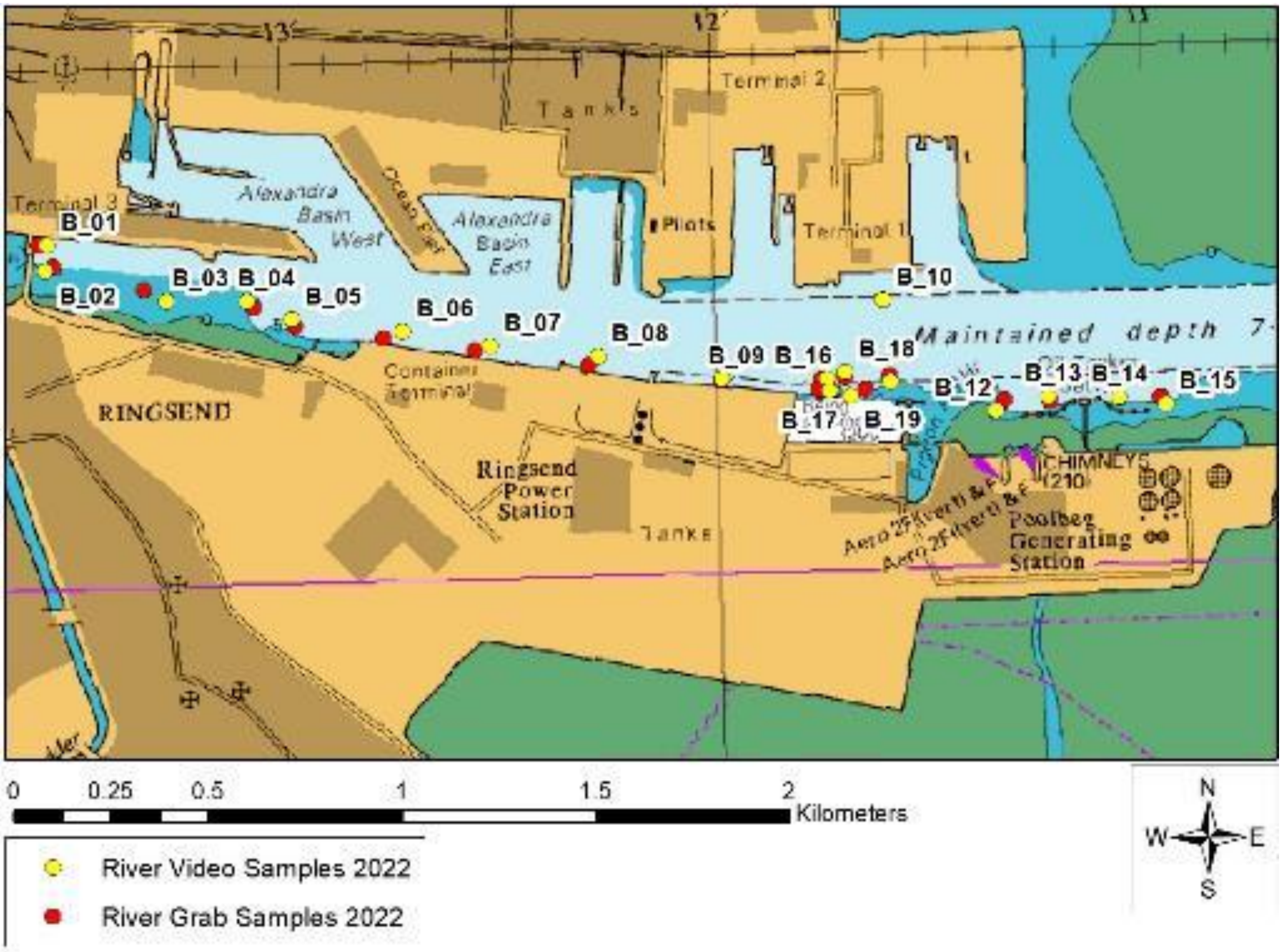

Figure 7.6 Map showing the positions of video and sub-tidal grab samples (Red Circles) and video only sample locations (Yellow Circles) taken within the inner Liffey Channel.

At each sampling station:

- 1 x 0.1m^2 Van-Veen grab taken for benthic faunal analysis. [18 Sites]
- 1 x 0.1m^2 Van-Veen grab from which a small amount of sediment was retained for Particle Size Analysis and Loss on Ignition Analysis. [18 Sites]
- Drop-down video imagery collected [19 Sites]

Subtidal Sampling – Burford Bank Disposal Site

A total of 22 sub-tidal grab samples were collected from the dredge spoil disposal site at the Burford Bank. Sampling locations were revisited from surveys undertaken at the same location in 2016 and 2018 to assess changes during this period and assist in assessing potential impacts associated with the proposed development. Single grabs were collected at 7 sampling locations, and three replicates were collected at a further five locations (S_03, S_07, S_10, S_11 and S_12). All samples were collected on the 20th July 2022 using a 0.1m^2 stainless steel Van-Veen grab. In addition, drop-down video was collected at 29 locations within the survey area. Video data was collected on 25th August 2022. All sampling stations were positioned using a Garmin eTrex GPS. A list of the stations sampled and their ITM positions is presented in Table 7.5 and Table 7.6 and displayed on a map in

Figure 7.7 and 7.8.

Table 7.5 Positions of sub-tidal grab sampling stations (S_01 to S_12). All positions are in Irish Transverse Mercator.

Station	Easting	Northing
S_01	730371	733989
S_02	730115	733435
S_03A	730740	733603
S_03B	730876	733629
S_03C	730749	733594
S_04	728924	732463
S_05	731360	732555
S_06	730245	731432
S_07A	730616	731340
S_07B	730662	731313
S_07C	730519	731283
S_08	731193	730842
S_09	730318	733035
S_10A	729871	732459
S_10B	729862	732563
S_10C	729873	732490
S_11A	730522	732521
S_11B	730527	732289
S_11C	730568	732319
S_12A	730457	731676
S_12B	730578	731716
S_12C	730497	731603

Table 7.6 Positions of sub-tidal video sampling stations (V_01 to V_31). All positions are in Irish Transverse Mercator.

Station	In		Out	
	Easting	Northing	Easting	Northing
V_01	727050	733821	727016	733793
V_02	727840	733706	727884	733584
V_03	727810	734916	727740	734917
V_04	729054	733928	729028	733884
V_05	729785	734654	729763	734599
V_06	730423	735292	730438	735260
V_07	728166	733743	728167	733740
V_09	730464	734029	730453	733982
V_10	731750	733977	731775	733851
V_11	730079	733118	729963	733031
V_12	730893	733088	730874	733016
V_13	732441	733101	732448	733069
V_14	727116	732631	727042	732601
V_15	728944	732495	728900	732448
V_16	730317	732593	730286	732534
V_18	731328	732556	731330	732523
V_19	733007	732589	733038	732491
V_20	730083	732007	730024	731979
V_21	730877	732026	730778	731985
V_22	728671	731542	728609	731507
V_23	732298	731748	732313	731677
V_24	729180	731010	729192	730994
V_25	730643	730990	730643	730989
V_26	732030	730930	732024	730902
V_27	728308	730142	728257	730116
V_28	729841	730304	729779	730292
V_29	731254	730315	731207	730316
V_30	733209	729943	733216	729914
V_31	730688	729509	730650	729515

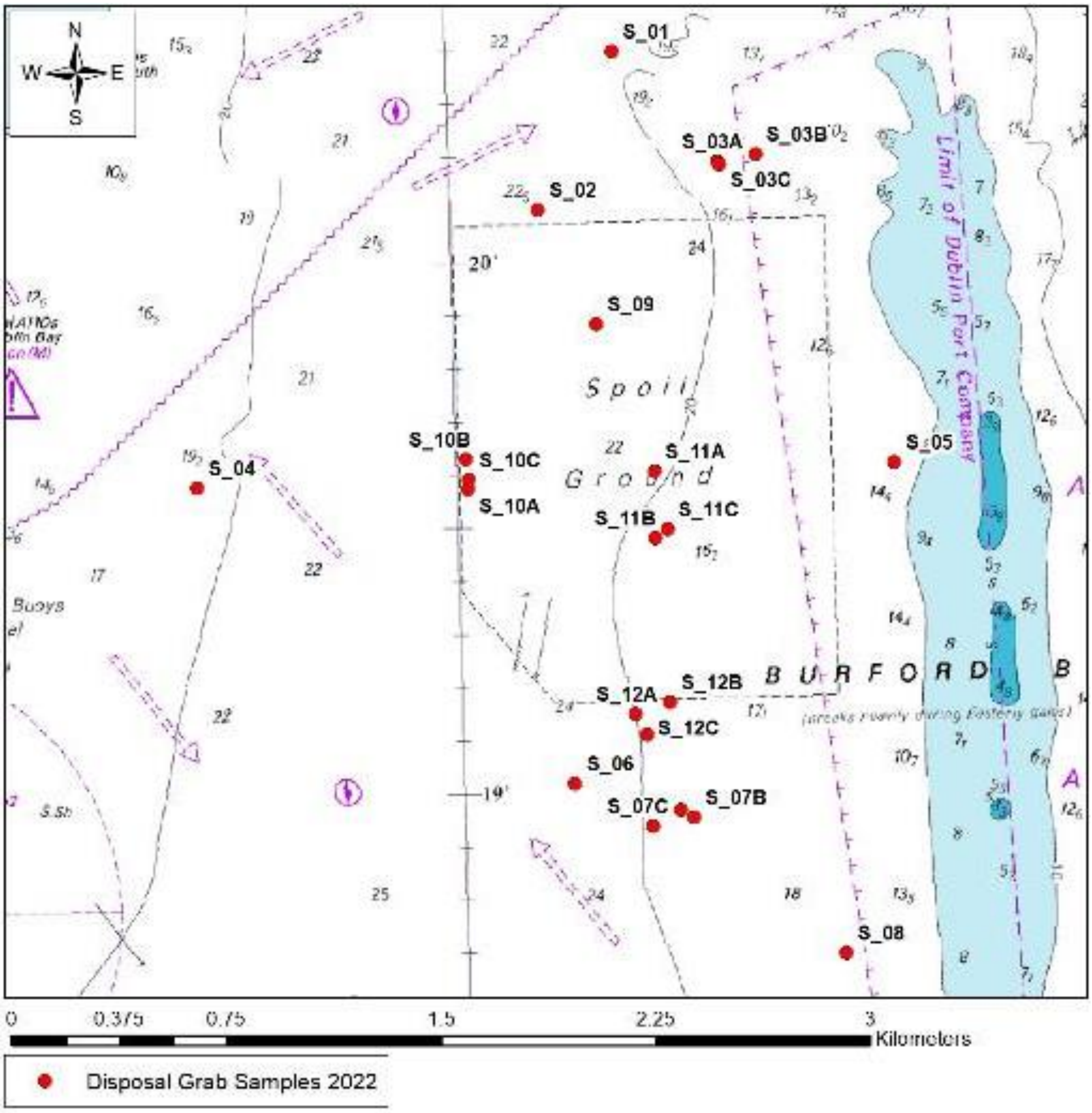

Figure 7.7 Map showing the positions of the sub-tidal grab samples (red dots) collected from the Burford Bank disposal site in Dublin Bay

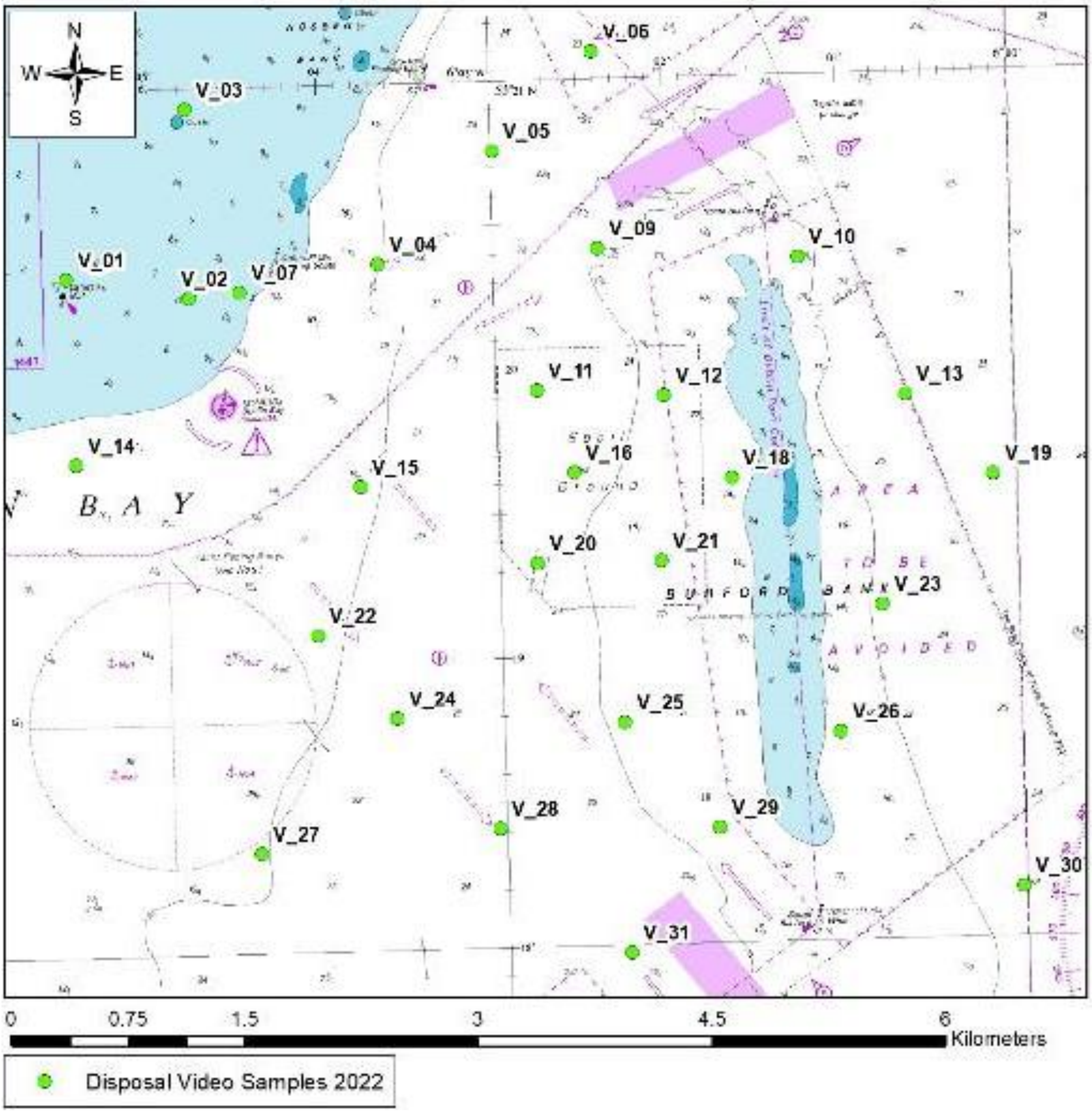

Figure 7.8 Map showing the positions of the drop-down video sites (green dots) collected from the Burford Bank disposal site in Dublin Bay.

Samples collected from the Burford Bank disposal site included:

- 1 x 0.1m^2 Van-Veen grab taken for benthic faunal analysis. [22 Sites]
- 1 x 0.1m^2 Van-Veen grab from which a small amount of sediment was retained for Particle Size Analysis and Loss on Ignition Analysis. [22 Sites]
- Drop-down video imagery collected [29 Sites]

7.3.1.2 Intertidal Survey

The 3FM Project will entail alterations to or removal of sections of the hard intertidal along the south side of the Liffey Estuary from Tom Clarke Bridge in the west to just east of the treated sewage discharge from Ringsend Wastewater Treatment Plant near the start of the Great South Wall walkway, a straight line distance of approximately 3km and about 3.5km if Pigeon House harbour is included. In terms of habitat allocation these can be roughly divided as 38% rock armour/ rock rubble intertidal, 45% sheet pile wall and 17% stone wall. This entire shore has been manmade over the centuries and decades.

In virtually all cases the shore is very narrow ranging from vertical quays or steep rock revetments. In addition, several pontoons and jetties, some earmarked for removal as part of the project, offer additional hard substrate, mainly tubular steel piles, for colonisation by epilithic algae and invertebrate fauna. Finally, floats supporting the walkways of the Poolbeg Yacht Club marina provide additional substrate for floral and faunal colonisation.

In order to better define the intertidal hard benthos habitats, in particular those earmarked for removal or alteration as part of the project, two field visits were undertaken during low spring tides; the first from the land on 6th June 2023, when the low water at the Dublin North Wall was 0.77m CD and again on 8th July 2023 when the shore was approached by boat and low water level was 0.55m CD at Dublin North Wall. On both dates, walk-over surveys were undertaken at a range of locations to assess the dominant habitats and species present. At low water of spring tides there are also small areas of soft sediment exposed at low water and general observations were made in these locations wherever encountered.

7.3.1.3 Fisheries

Dublin Harbour

Baseline data on the migratory (anadromous and catadromous) species. i.e. salmon, lamprey and eel, was obtained from a combination of a literature review of the relevant publications on salmon and eel in the publications section of the IFI website. In addition, actual elver trap counts at the Islandbridge elver trap, which also included detailed data on river lamprey movements into the Liffey since 2018, was obtained from the Marine Institute. Finer background details on the salmon counter data for both the Leixlip and Islandbridge data were obtained in consultation with research staff in the Marine Institute, IFI and ESB fisheries and with IFI staff from the Eastern Region. Data on the resident estuarine/marine species in the Lower Liffey Estuary were obtained from the WFD fish publications on transition waters surveys for the River Liffey (Kelly *et al.,* 2009, 2011 and Wightman *et al.,* 2022 – in press), as well as beam trawls surveys undertaken within the port area in 2013, 2018 and 2020 (RPS 2014, ASU 2019, ASU 2020). Data on recreational angling within the 3FM Project study area and wider Dublin Bay was obtained from IFI and other online resources, combined with consultation with IFI personnel.

Burford Bank Disposal Site

Trawling was undertaken on 21st July 2022, in order to assess the main demersal/benthic fish and epibenthic invertebrates in and around the dump site. A total of eight trawls (A-H) were collected, with locations presented

Figure 7.9. Trawls A & B were north of the site, C immediately west of the dump site, D, E and F within the dump site and G and H just south of the dump site. These latter trawl lines were the same as those chosen when trawling surveys on the dump site took place in September 2018. Trawls were collected using a 2m scientific beam trawl with a mesh size of 11mm. Trawls were hauled at a speed of 2 knots resulting in trawls of about 500m – 750m in length. Once on board, the trawl contents were placed into a container and photographed prior to processing. Fish species were separated and counted and measured to the nearest millimetre and every attempt was made to return them alive to the water after processing. Colonial invertebrates (such as hydroids,

bryozoans etc.) were marked present or absent, while others were either bulk weighed or individually counted. One very large catch of brittle stars (Trawl D) was photographed and returned to the water after the fish and as many of the other invertebrates present that could be extracted from the catch. Invertebrates were identified in the field, where possible. Specimens which were difficult to identify to species or genus while on board were identified to a higher taxonomic level, usually family. Due to conditions arising on the day, Trawl H was not attempted.

Table 7.7 Positions of shallow water trawl locations in 2022.

Station	Depth (m)	In		Out	
		Latitude	Longitude	Latitude	Longitude
Trawl A	22	53°19.951' N	6°03.416W	53°20.825' N	6°02.716W
Trawl B	24	53°20.706' N	6°02.172W	53°19.938' N	6°02.302W
Trawl C	21	53°19.371' N	6°03.416W	53°19.935' N	6°03.413W
Trawl D	22	53°19.993' N	6°02.914W	53°19.290' N	6°02.880W
Trawl E	18	53°19.328' N	6°02.272W	53°20.061' N	6°02.239W
Trawl F	18	53°20.190' N	6°01.904W	53°19.293' N	6°02.036W
Trawl G	24	53°18.558' N	6°02.631W	53°19.197' N	6°02.569W
Trawl H	19	53°19.258' N	6°02.127W	53°18.500' N	6°02.194W

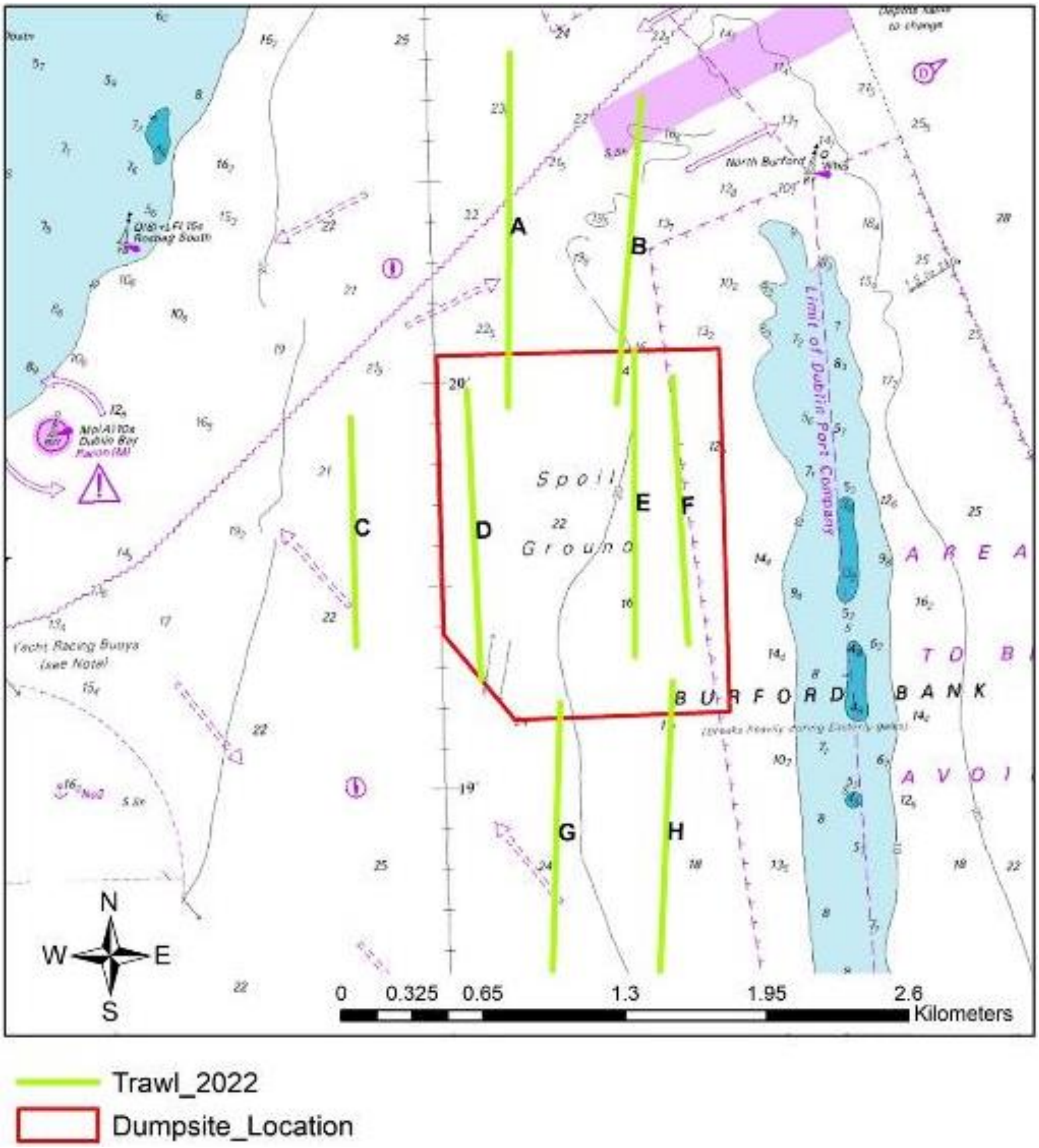

Figure 7.9 Map showing locations of benthic trawls –September 2018 and July 2022.

7.3.1.4 Sample Processing

Faunal Processing

Grab samples were sieved through a 1mm mesh sieve onboard the survey vessel and immediately preserved in 4% buffered formalin. Back in the laboratory samples were sorted by eye using a binocular microscope and the extracted fauna then identified to the lowest taxonomic level possible using standard keys to north-west European fauna. This work was undertaken by specialist taxonomists from Thomson Environmental Consultants using NE Atlantic Marine Biological Analytical Quality Control (NMBAQC) protocols.

A number of biotic indices were calculated from the species/abundance matrix from the grab sample faunal data. These indices included Simpson's Dominance Index (where values range from low dominance [0] to high dominance [1]), Shannon-Wiener Diversity Index (values ranging from low diversity [0] to high diversity [4]) and Pielou's Evenness Index (values ranging from low evenness (dominated by a few species) [0] to high evenness (a more even spread of species) [1]).

The drop-down video data from surveyed sites was recorded as MPEG4 format files directly to a portable DV recorder. At each station a single recording was taken with the video camera lowered to above the seafloor. Video Images were assessed for visible benthic fauna and habitat type by specialists from Aquatic Services Unit.

Granulometric Analysis

Granulometric analysis was carried out on oven dried-sediment samples from each station using the protocols described by Holme & McIntyre (1984). The sediment was passed through a series of nested brass test sieves with the aid of a mechanical shaker. The brass sieves chosen were 2mm, 1mm, 500µm, 250µm, 125µm and 63µm. The sediments were then classified into three principal fractions: i.e., % Gravel (>2mm), % Sand (<2.0mm >63µm) and % Silt-Clay (<63µm). More detailed analysis of the >63 µm fraction was undertaken using the Gradistat package (Blott & Pye, 2001).

Organic Matter Analysis

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

7.3.1.5 Impact Assessment

The assessment of the potential impacts of the 3FM Project, including the descriptions of impact quality, significance, extent and duration follow the most recent EPA Guidelines (EPA, 2022).

7.3.2 Receiving Environment

7.3.2.1 Benthic Assessment - Dublin Port Sites

Granulometric Analysis

Results from the particle size assessment indicates the dominance of muddy sites within the survey area of Dublin Harbour. Areas proximate to where vessels turn adjacent to the basins, as well as an area of potential scour from increased water flow near the Tom Clarke Bridge are dominated by cobble and gravel. The remaining sites along the southern bank of Dublin Harbour are dominated by muds and sandy muds, with a single site at the furthest downstream location dominated by coarser muddy sands (Table 7.8, Figure 7.10 & Figure 7.11). This is reflected in the Loss on Ignition values recorded in the area, with higher organic content present in the inner sites (Table 7.8)

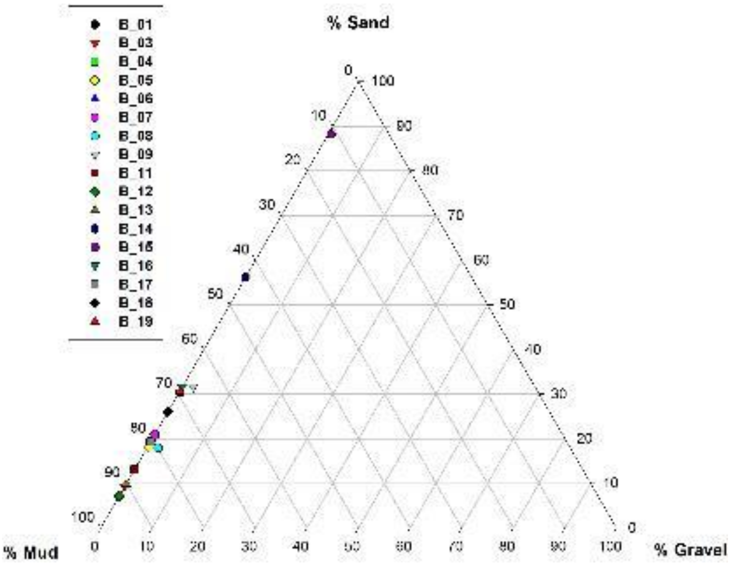

Figure 7.10 Ternary Plot of granulometric results from sites B_01 to B_19 in the River Liffey Channel.

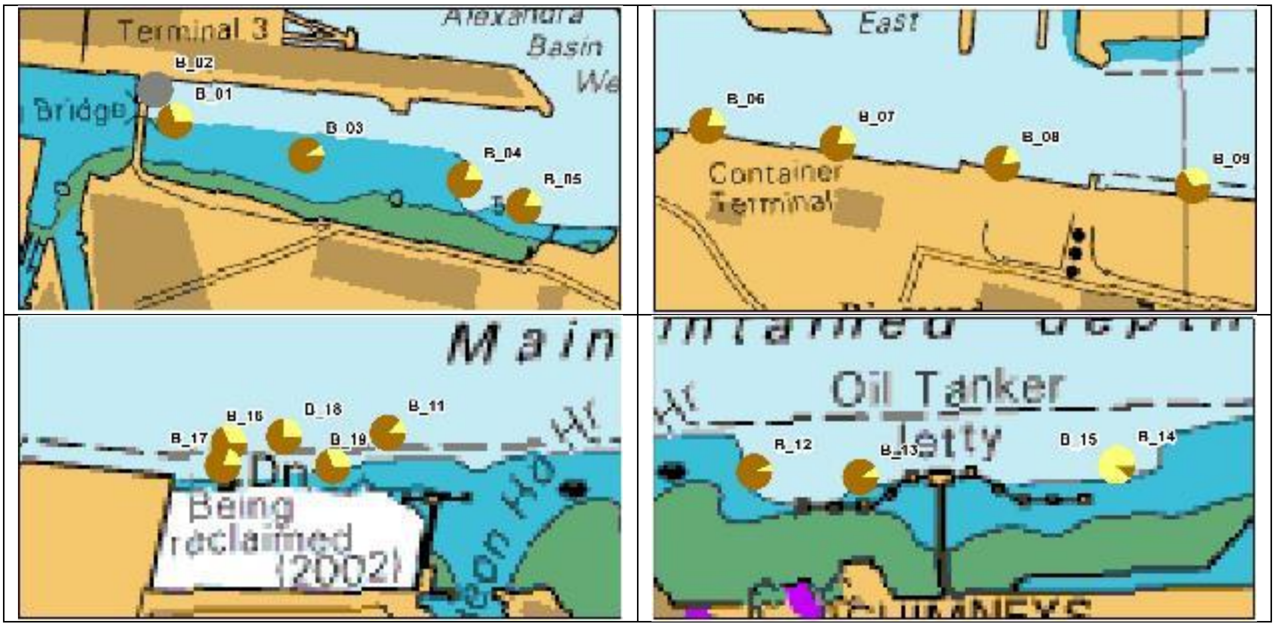

Figure 7.11Distribution of PSA within the survey area. (Grey – gravel; Yellow – sand; Brown – mud)

Table 7.8 Granulometric and Loss on Ignition results from samples taken within the survey area of Dublin Harbour.

	B01	B02	B03	B04	B05
% Gravel	0.24%	100%	0.00%	0.00%	0.16%
% Sand	30.22%	0%	9.22%	19.36%	18.11%
% Mud	69.54%	0%	90.78%	80.64%	81.72%
% LOI	6.01%	N/R	7.81%	6.69%	6.41%
Textural Group	Slightly Gravelly Sandy Mud	Gravel	Mud	Sandy Mud	Slightly Gravelly Sandy Mud

	B06	B07	B08	B09	B11
% Gravel	0.00%	0.00%	2.18%	2.13%	0.00%
% Sand	19.96%	20.89%	17.90%	31.61%	13.09%
% Mud	80.04%	79.11%	79.92%	66.26%	86.91%
% LOI	6.82%	5.79%	5.36%	5.25%	6.84%
Textural Group	Sandy Mud	Sandy Mud	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud	Sandy Mud

	B12	B13	B14	B15	B16
% Gravel	0.00%	0.00%	0.00%	0.60%	0.00%
% Sand	7.08%	9.82%	56.15%	88.18%	31.50%
% Mud	92.92%	90.18%	43.85%	11.22%	68.50%
% LOI	8.02%	6.59%	6.6%	1.29%	5.57%
Textural Group	Mud	Mud	Muddy Sand	lly Muddy Sand	Sandy Mud

	B17	B18	B19
% Gravel	0.00%	0.00%	0.00%
% Sand	19.24%	26.07%	30.65%
% Mud	80.76%	73.93%	69.35%
% LOI	5.13%	6.96%	4.36%
Textural Group	Sandy Mud	Sandy Mud	Sandy Mud

Infaunal Assessment

A total of 66 individual taxa, of which 56 taxa were countable (Appendix 7.3.1a), were recorded in 0.1m^2 infaunal grab samples collected from the River Liffey sites, Dublin Harbour (Table 7.9).

Table 7.9 Diversity indices derived from the infaunal grab data from Dublin Harbour.

	B01	B02	B03	B04	B05	B06	B07	B08	B09
No. of Species	10	22	5	5	6	6	27	4	6
No. of Individuals	52	51	15	15	26	76	159	47	24
Shannon-Wiener	1.47	2.76	1.4	1.2	1.68	0.934	2.49	0.44	1.19
Pielou's Evenness	0.639	0.894	0.867	0.749	0.94	0.521	0.757	0.317	0.665
Simpson's Dominance	0.359	0.0827	0.298	0.404	0.204	0.539	0.143	0.804	0.41

	B11	B12	B13	B14	B15	B16	B17	B18	B19
No. of Species	2	3	2	1	7	7	10	3	11
No. of Individuals	31	46	32	8	61	123	186	58	312
Shannon-Wiener	0.143	0.446	0.139	0	0.761	0.65	1.39	0.337	1.33
Pielou's Evenness	0.206	0.406	0.201	****	0.391	0.334	0.602	0.307	0.554
Simpson's Dominance	0.938	0.768	0.939	1	0.66	0.734	0.355	0.84	0.39

Analysis of the data shows the presence of two discrete faunal assemblages across the Dublin Harbour survey area, with a single outlier (B_02) present in an area of coarser sediment located immediately adjacent to the central channel of the Tom Clarke Bridge (

Figure 7.12 and Figure 7.13). The distribution of these groups follows a distinct spatial pattern, with sites B_03, B_04 and B_05 located along the southern bank immediately adjacent to the Tom Clarke Bridge, and the remaining sites located within the soft sediment areas within the channel and along the berths on the southern bank of Dublin Harbour.

Table 7.10 Results from multivariate analysis of the fauna identified in each faunal group identified in the survey area.

GROUP 1: (Average Similarity: 57.08)
Tubificoides pseudogaster agg
Polydora cornuta
Abra alba
Capitella capitata
Tharyx spp.
GROUP 2: (Average Similarity: 58.58)
Capitella capitata
Malacoceros fulginosis

The species identified in the present survey (Table 7.10) are typical of sheltered, estuarine subtidal communities, with all species identified common in Irish coastal waters. The dominant fauna across the survey is the polychaete worm, *Capitella capitata*, which is a highly opportunistic species associated with stressed and organically enriched environments.

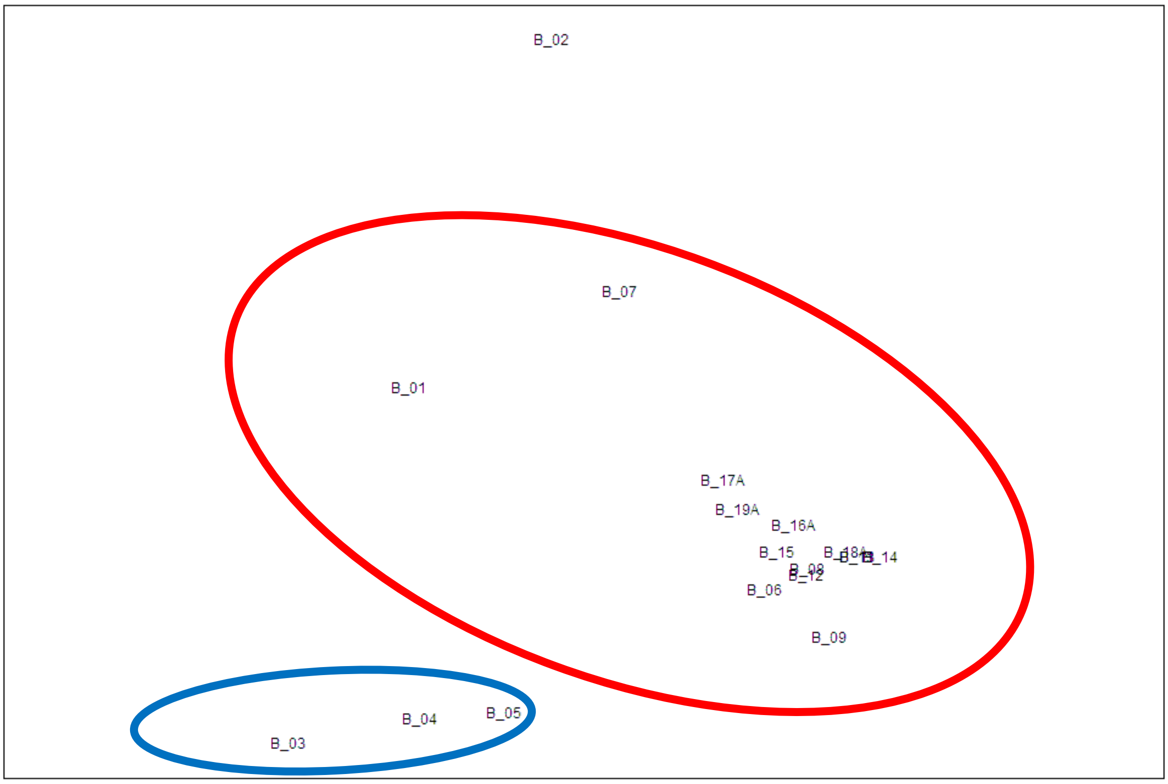

Figure 7.12 MDS Plot of Dublin Harbour fauna (Stress = 0.09). Group 1 are coloured blue, Group 2 are coloured Red.

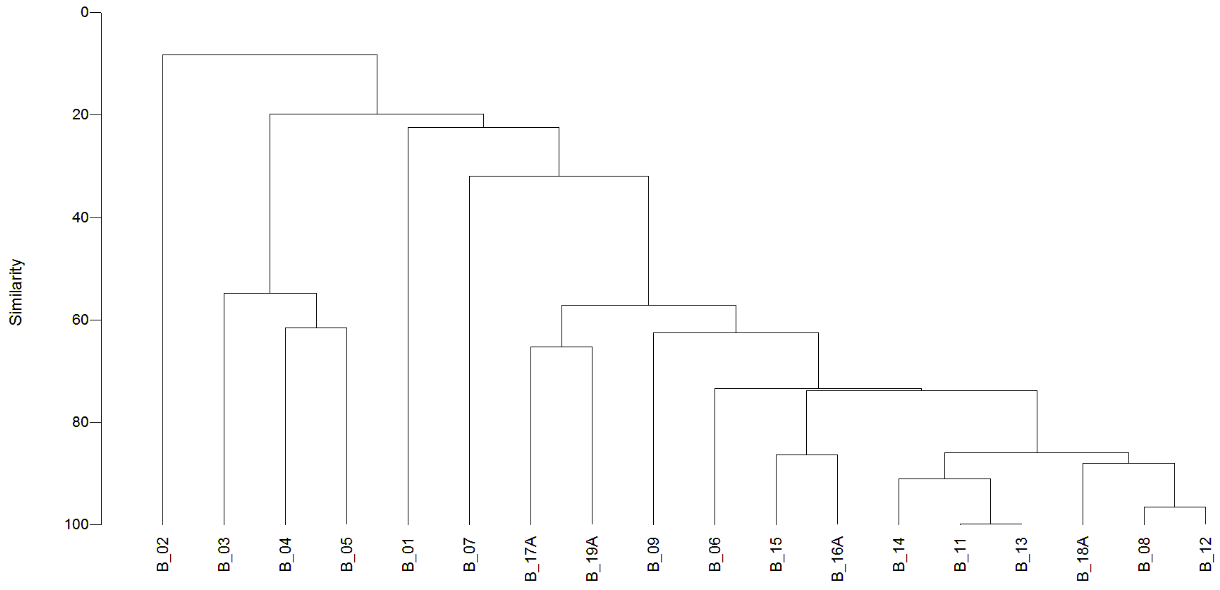

Figure 7.13 Cluster dendogram indicating the distribution of sites based on faunal distribution within the survey area of Dublin Harbour.

Video Assessment

Results from the video survey undertaken in October 2023 confirm the results obtained from the grab samples, with muddy sediments dominating the southern bank of Dublin Harbour. Coarser sediment of gravels and cobble are present in the main channel in areas where there is increased water flow (such as B_01) and areas which are used as vessel turning areas within the port (B_10).

Due to technical issues on site as a result of cable failure at these sites, no video was recorded at B_01, B_02 and B_07. At each location, the benthos at the site was recorded as mud with debris at B_01 and Mud at sites B_02 and B_07.

The inner port sites at B_03, B_04 and B_05 consisted of muds with anoxia present just beneath the sediment surface. Occasional green crabs (*Carcinus maenas*) were noted in video footage across the site (e.g., at B_04) and diatoms were present on the mud surface shallow water sites at B_03 and B_04 (

Figure 7.14). The benthos immediately adjacent to the loading berths 41 - 47 showed a similar habitat, with anoxic muds and occasional algal debris present across the area (

Figure 7.15). Four sites were sampled immediately adjacent to the boundary of the proposed Turning Circle. Benthos at sites B_16, B_17 and B_19 was similar to that identified previously, dominated by muds, with diatoms present on the surface of the substrate in the shallower sites and occasional green crab noted in the video. Mullet feeding tracks on the mud surface were identified at B_19. More coarse material was identified at site B_18, but the site was still dominated by muds and sandy muds (Figure 7.16). The turning circle adjacent to Berth 50 consists of coarse gravels and cobble (B_10), reflecting the disturbed nature of the seabed at this location, being regularly subjected to disturbance from the vessels propellors during manoeuvring activities in the port. The remaining sites, (B11-B15) all contain soft muds and sandy muds, with diatoms present on the sediment surface in the shallower sites (Figure 7.17 & Figure 7.18).

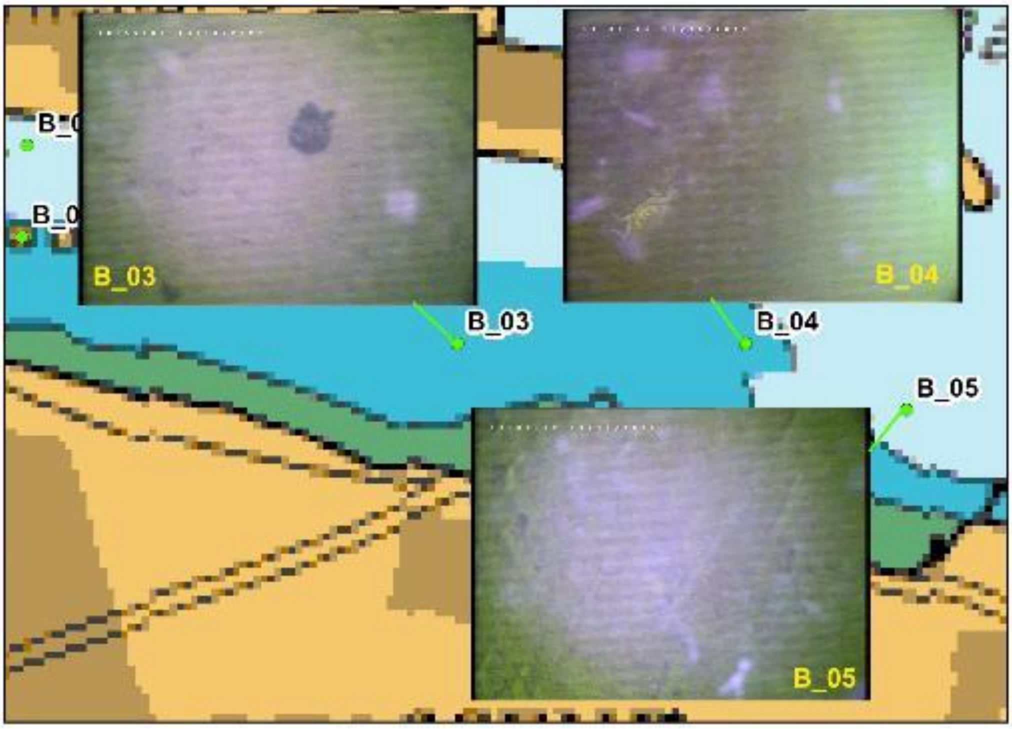

Figure 7.14 Representative imagery captured from the video taken along the inner extent of the survey area. Visibility was reduced with increased floc present in the water column. Sediment consists primarily of muds with anoxia present just below the sediment surface.

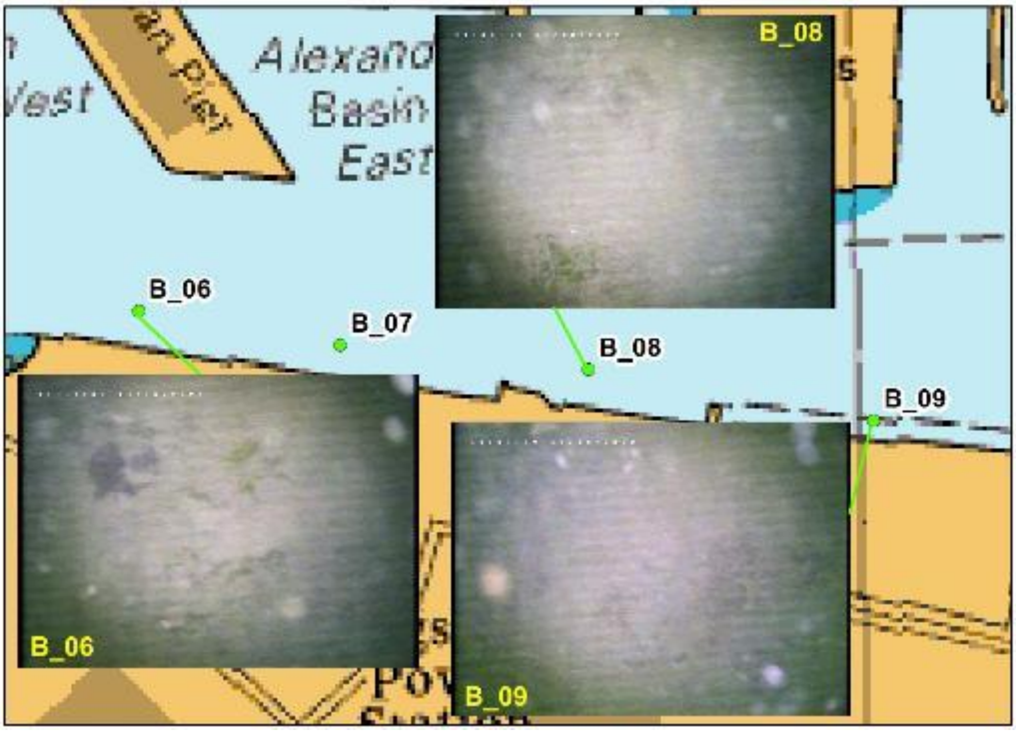

Figure 7.15 Representative imagery captured from the video taken along the southern bank of the port area immediately adjacent to berths 41 – 47.

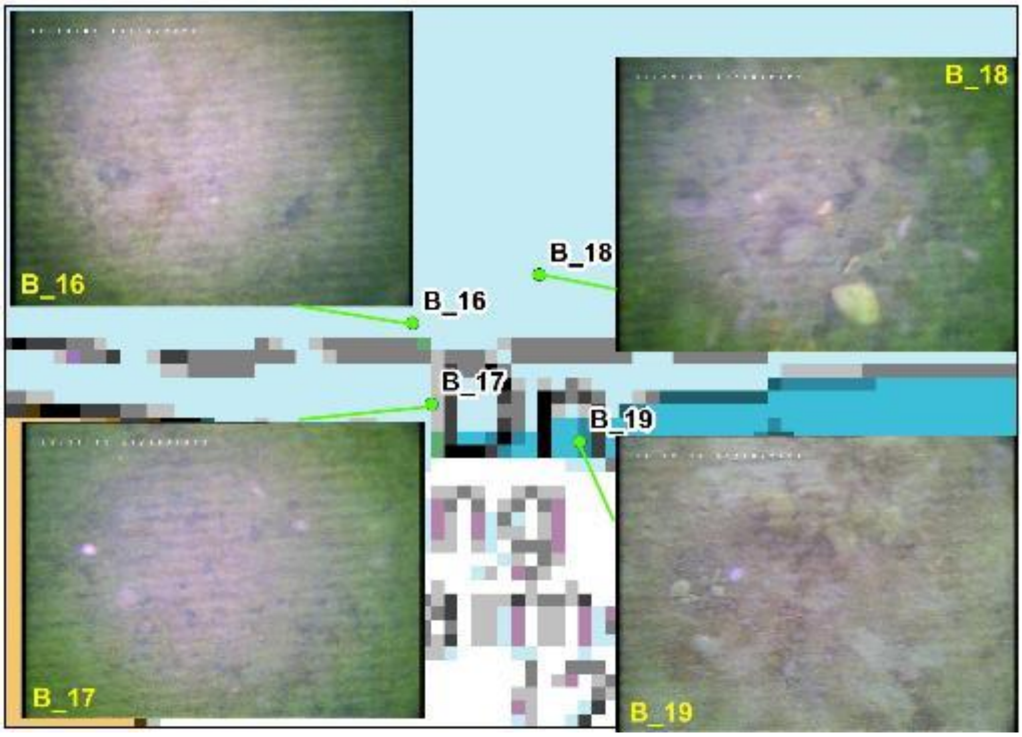

Figure 7.16 Imagery captured from video data collected around the sites in close location to the proposed Turning Circle. Sediment at the site consisted of muds and sandy muds, with coarser gravels present in parts of B_18, however this is not reflected in grainsize from the site. Mullet feeding tracks were identified on the diatom growth at site B_19.

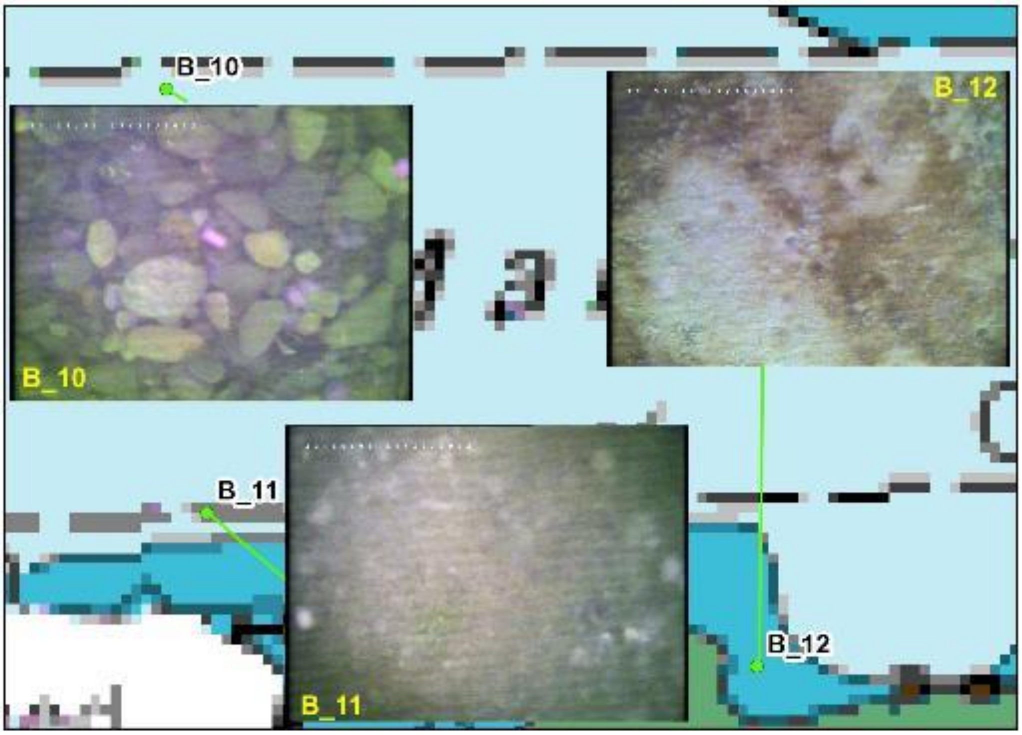

Figure 7.17 Imagery captured from video data collected near Pigeon House Harbour and the vessel turning area adjacent to Berth 50. Sites along the southern bank of the port are dominated by muds, with gravels and cobble dominating the turning area in the channel.

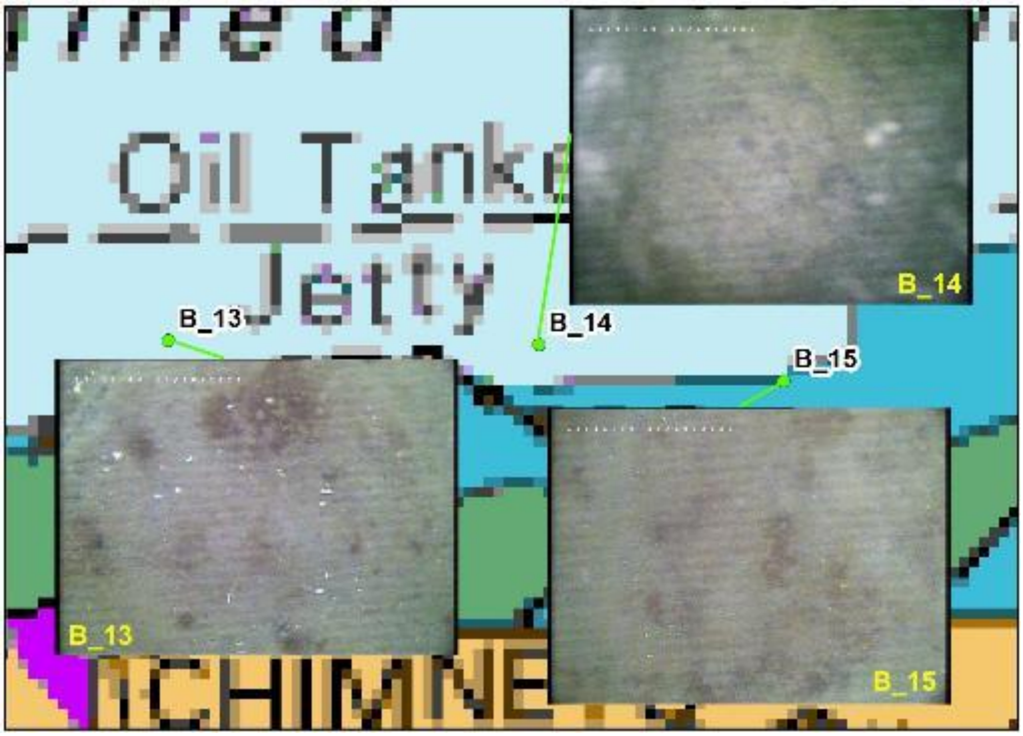

Figure 7.18 Imagery captured from video data collected from sites adjacent to the Poolbeg generating station. The sites at this location are dominated by sandy muds.

Intertidal Survey

Rock Armour Revetments and Rocky intertidal

A rock armour revetment, measuring approximately 720m in length, runs east along the southern shore of the Liffey from Tom Clarke Bridge to the Poolbeg Yacht Club slipway (Figure 19 a and b). This is a narrow, steep sided structure leading down to a narrow band of primarily soft sediment intertidal which is only exposed at low water of spring tides. The revetment consists of limestone boulders, with smaller angular cobble interspersed between the larger elements. The supralittoral is dominated by a few terrestrial plant species typical of such habitats including buddleia, wall valerian, and pellitory-of-the-wall. Below this, is a narrow strip of mainly bare boulder with scattered patches of yellow lichens (*Xanthoria* sp. and *Caloplaca* sp.) followed down-shore by a narrow band where the green algae, *Ulva* sp. and *Prasiola stipitata* dominate; the latter probably due to nitrogen inputs from roosting gulls. Below this is the main brown seaweed dominated intertidal, with a narrow band of *Fucus spiralis* uppermost and the rest of the middle and lower shore dominated by *Ascophyllum nodosum* with pockets of *Fucus ceranoides*. The lower shore boulders and cobbles are dominated by *Fucus serratus*. The upper shore has a scattered understorey of *Catanella cespitosa* and *Gelidium pusillum*, while the bulk of the shore has an understorey of *Rhodochorton purpureum* (Figure 7.19c). The lower shore has scattered clumps of the red alga *Chondrus cris*pus (Figure 7.19e), forming a more extensive turf on scattered large cobble on the extreme lower shore. A foliose red alga (believed to be *Pyropia leucosticta*) was present in the lower shore/shallow subtidal among scattered clumps of *Fucus serratus*. Mobile fauna were scarce except for many amphipods, occasional juvenile green crabs and scattered low densities of the barnacle *Austrominius modestu*s. This shore community is typical of sheltered rocky intertidal shores but with somewhat reduced diversity probably due to a lack of microhabitats such as rock pools, overhangs and crevices typical of natural shores, in addition to the influence of freshwater inputs from the Liffey, the latter attested to by the presence of *Fucus ceranoides* (Figure 7.19c).

The base of the revetment gives way to a narrow, flat strip of mixed sediment dominated by a mix of gravel and sand nearest the revetment base, merging into soft sandy mud closer to or just below the tideline (Figure 7.19f).

Using EUNIS Habitat Classification and the JNCC Marine Habitat Classification systems, the main habitat present in along this shore is: *Fucoids on variable salinity Atlantic littoral rock* [EUNIS:MA125] / *Fucoids in Variable Salinity* [JNCC:LR.LLR.FVS], with pockets of others such as: Prasiola stipitata *on nitrate-enriched supralittoral or littoral fringe rock* [EUNIS:MA1212 ; JNCC:LR.FLR.Lic.Pra].

Intertidal Area by Proposed Turning Circle

A large vessel turning circle of 325m diameter is proposed to be dredged between Berths 49A/49 on the northern side of the channel and the shore near the sludge jetty on the southern side. Due to its large sweep, the turning circle will impinge on the sludge jetty and the north eastern corner of a piece of reclaimed ground immediately west of the sludge jetty. The latter is fringed by a rock armour revetment and its eastern face forms a shallow embayment where it joins the Pigeon House Harbour Wall to the south near the landward end of the sludge jetty (Figure 20a and b). As part of the creation of the turning circle, the sludge jetty, which is approximately 110m long and suspended on more than 80 piles, will be removed. In addition, the north eastern corner of the rock armour revetment immediately west of the jetty will be removed. An arc-shaped section of sheet pile and tubular combi-wall will be constructed to form the boundary of the Turning Circle on its western and southern edge which will result in the infilling of the embayment in that area (see Figure 7.20a).

This embayment includes a range of habitats, including an area on the mid to lower intertidal containing mixed sediment dominated by scattered large cobble, gravel, sand and muddy sand, backed to the west and north west by a manmade rocky shore comprising rock armour of mixed small boulder and large cobble, which is heavily coated in fucoid algae over most of its area, and to the south by a vertical stone sea wall. The lower shore mixed sediment was covered by a patchy mosaic of *Fucus serratus* interspersed with *Ulva intestinalis* and *Ulva lactuca* (Figure 7.20a). Scattered large cobbles were dominated by barnacles, mainly *Semibalanus balanoides*, with lesser numbers of *Austrominius modestus* and occasional limpets (*Patella vulgata*) (Figure 7.20c). Other red algae present here included *Palmaria palmata*, *Chondrus crispus* and *Mastocarpus stellatus*. In areas where sand or muddy sand dominated there were occasional dense patches of sand mason (*Lanice conchilega*) polychaete worms (Figure 7.20b).

The rocky intertidal, consisted of an upper shore narrow band of *Fucus spiralis* and a wider band immediately below it dominated by [1]*Fucus macroguiryi* (Figure 7.20e), a middle shore dominated by a mix of *Fucus vesiculosus* and occasional *Ascophyllum*, and *F. serratus* dominating the lower shore (Figure 7.20d). Mid-upper shore understorey species included patches of *Rhodochorton purpureum* and *Ulva* sp. Lower shore red algae were dominated by *Chondrus crispus* and occasional *Mastocarpus stellatus* (Figure 7.20f).

Littorinids and other snails were common including *Littorina littorea*, *L. obtusata/mariae, Steromphala umbilicalis* and occasional dog whelks (*Nucella lapillus*). Attached species included barnacles (S*. balanoides and A.*

1 Known until recently as Fucus guiryi *modestus*), limpets (*P. vulgata*), small patches of encrusting bryozoans and spirorbid and serpulid tube-forming worms. Juvenile green crab were frequently found beneath cobbles. Overall, this is typical of a semi-exposed shore with a mix of rocky and mixed sediment substrates in full or near full salinity. Using EUNIS Habitat Classification and the JNCC Marine Habitat Classification systems, the main habitats present in this are: '*Barnacles and fucoids on moderately exposed shores*' [EUNIS:MA124 ; JNCC:LR.MLR.BF], '*Fucoids on sheltered marine shores*' [EUNIS:MA123C ; JNCC:LR.LLR.F] and patches of 'Lanice conchilega *in littoral sand*' [EUNIS:MA 5255 ; JNCC:LS.LSa.MuSa.Lan].

Figure 7.19(a) = view of the revetment looking east from the southern end of Tom Clarke Bridge. (b) = close up of the revetment showing near bare rock armour above, fucoid seaweed dominated armour below and a narrow band between dominated by green algae including *Ulva* sp. and *Prasiola stipitata*. (c) = brown seaweed pulled aside to show *Rhodochorton purpureum* on the rocks beneath. (d) = *Fucus ceranoides*. (e) = two clumps of *Chondrus crispus* on a lower shore boulder. (f) = western end of the revetment with Tom Clarke Bridge behind showing the low spring tide muddy expanse off the base of the revetment.

Figure 7.20(a) = the embayment which will be impinged on by the southern end of the new vessel turning circle, looking east toward the southern end of the sludge jetty, with the Pigeon House Harbour Wall on the right (south), and a mixed sediment foreground and a fucoid and barnacle middle and right background. (b) = patch of the sand mason worm (*Lanice conchilega*). (c) = a large cobble dominated by barnacles and occasional limpets. (d) = close up of the fucoid-dominated rock armour revetment, part of which will be removed to allow for the turning circle (view to the south). (e) = *Fucus spiralis* and *F. macroguiryi* on the upper section of the rocky revetment. (f) = the red alga *Mastocarpus stellatus* with *Fucus serratus* toward the base of the revetment.

Area N Intertidal Habitats

Virtually the entire 710m section of shore, which Area N will be built in front of, comprises all vertical stone seawall (Figure 7.21a) or, toward the eastern end, a sheet pile wall. The only exceptions to this are two small adjoining sections of hard intertidal comprised mainly of massive boulders, situated immediately east of the ESB Oil Jetty, and at either side of the pumphouses for the cooling water intakes for the ESB Poolbeg generating station site (Figure 7.21b). The combined area of these two areas is just under 0.1ha, with a combined length of 124m and a maximum width of 19m (Figure 7.21b). This is a short, steep shore where the boulders are dominated by a dense cover of brown fucoids, especially *Ascophyllum* (Figure 7.21c) which attests to its sheltered location. The extreme lower shore drops into deeper water and the boulders here are covered with a layer of fine silty sand interspersed with a sparse cover of fine red algae (Figure 7.21d). *Fucus serratus* dominated the lower shore with small amounts of the kelp *Saccharina latissima* (Figure 7.22a) at extreme low water. Toward the lower shore also, sponges (*Halichondria* sp. and *Hymeniacidon* sp.), encrusting bryozoans, and barnacles, including *Balanus crenatus*, were common (Figure 7.22b). *Ascophylum* and *Fucus serratus* along the lower shore had a variety of attached bryozoa, hydroids and spirorbid worms. Farther up the shore, dog whelks (*N. lapillus*) and flat periwinkles (*L. obtusata*/*mariae*) were common in the main *Ascophyllum* zone. The top of the shore is backed by the Great South Wall, with a narrow zone, at the top, of fine green algae (*Ulva* sp.) and occasional *Porphyra* sp. followed immediately below by a narrow band of *Fucus spiralis* and *F. macroguiryi*, (Figure 7.22c). The main mid zone comprised *Ascophyllum* with an understorey in places of *Ulva lactuca, Cladophora rupestris*, *Porphyra* sp., and fine reds such as *Ceramium* sp*.* Below the base of the wall the massive boulder shore is also dominated by *Ascophyllum*, with bare rock dominated by barnacles (*Semibalanus balanoides*) and scattered limpets (*Patella vulgata*). In terms of diversity, the lower to extreme lower shore was the most diverse, both in terms of algae and attached fauna. The very large boulders, constituting the bulk of the shore, offered little in the way of microhabitats. Another feature of this section of the shore was the pumphouse structure which is situated on a platform supported by piles open to the tide (Figure 7.22c). The boulders and large angular cobble beneath this platform were heavily shaded, with no algal cover as a result. A mosaic of sponges, barnacles and encrusting bryozoans dominated the substrate (

Figure 7.22d). This shore can be classified under the JNCC Marine Habitat Classification system as: Fucoids on sheltered marine shores - LR.LLR.F.

The piles supporting the Poolbeg oil jetty, which is earmarked for demolition as part of the construction of Area N, were largely devoid of algae except for occasional *Ulva lactuca* and *Porphyra* sp., with scattered fine reds present below the water line at low spring tide. The surface between high and low water mark was dominated by encrusting fauna including, barnacles, hydroids, sponges, colonial botrylloid sea squirts and encrusting bryozoans. There were no mussels (*Mytilus edulis*) or sea anemones noted on the piles (Figure 7.22e), although some may be present below low water of spring tides.

At the eastern end of the proposed Area N terminal there is an intertidal crescent of muddy sand (Figure 7.22f) immediately adjacent to the treated sewage effluent discharge point from the Ringsend Wastewater Treatment Plant. As a result of this high organic matter input this soft sediment intertidal area is dominated by a very high density of small opportunistic worms, primarily oligochaetes and polychaetes such as *Capitella capitata*. A narrow arc shaped platform raised on concrete piers and bedded on a low concrete base with scattered large angular cobbles along its base juts out from the Great South Wall at this location. This hard substrate was covered with barnacles and scattered limpets while juvenile green crabs and edible periwinkles (*Littorina littorea)* were common among the large cobbles and small boulders in the area. The substrate was almost devoid of algae except for scattered *Fucus ceranoides*, probably occurring due to the influence of the large volume of treated effluent being constantly discharged at a rate of 6m^3/sec immediately to the west of this area. Overall, this section of shore has a very low diversity of habitats and species.

Figure 7.21(a) = the western end of the Great South Wall looking east toward the Poolbeg pumphouse and Oil Jetty. The southern boundary of the proposed new Area N Terminal will be kept 10m and 6m out from the Great South Wall which means that it will finish to the left of the fucoid covered 'slipway' shown in Figure 7.23(a). (b) = a Google Earth aerial photo showing the two small areas of intertidal hard substrate just west of the jetty – (blue arrows). (c) = the top of the Great South Wall in the first of these boulder intertidal areas showing fine greens on top and *Fucus spiralis* below. (d) = general view of the shore toward the west showing the *Ascophyllum* covered boulders in the foreground and the shaded corner beneath the concrete platform on piles in the left background.

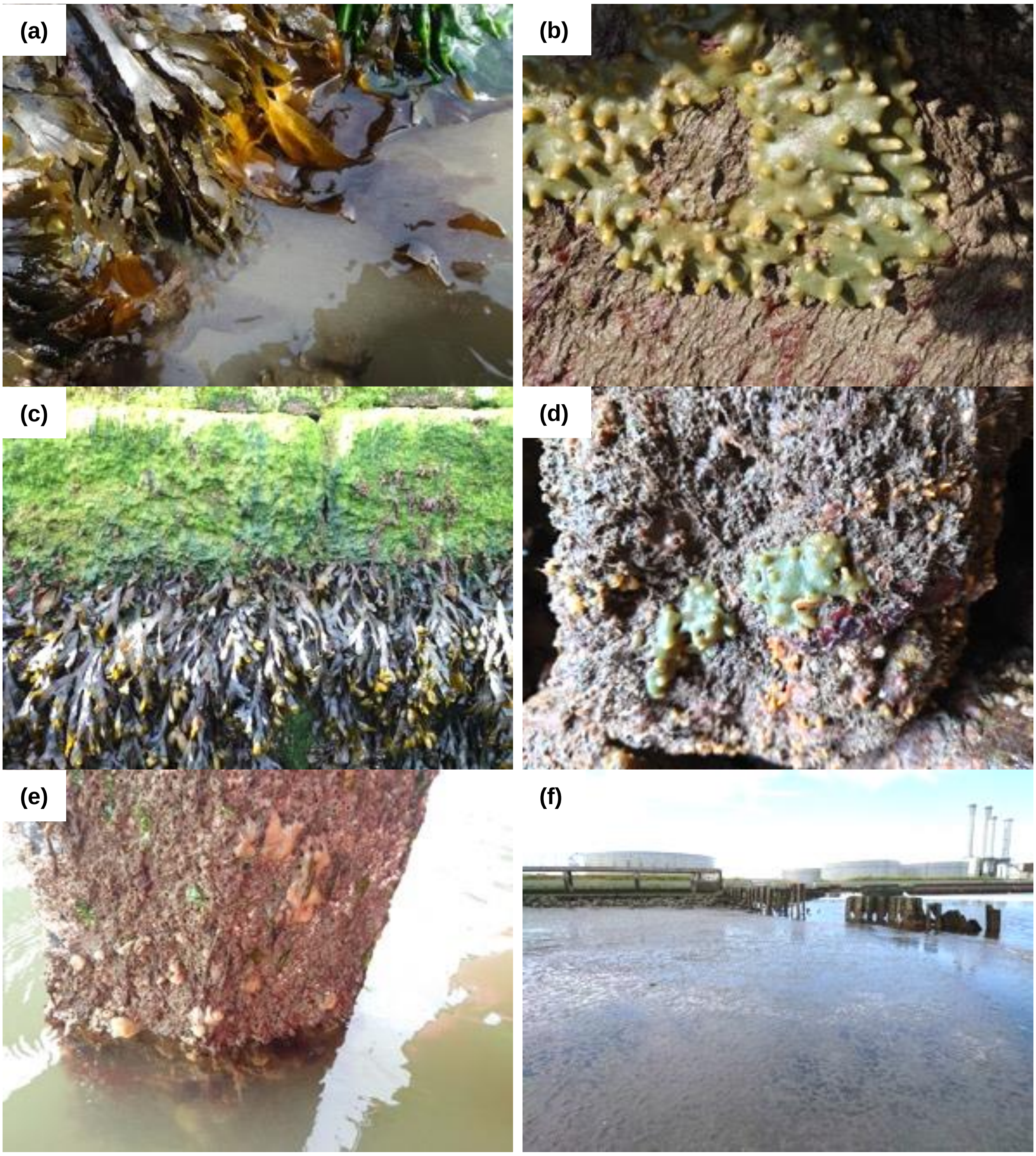

Figure 7.22(a) = fine red algae over sand covered boulder in *Fucus serratus zone*. (b) = young kelp plants (*Saccharina latissima*) at extreme low water. (c) = the sponge *Halichondria panicea* on lower shore boulder. (d) = encrusting fauna on heavily shaded small boulder including sponges, encrusting hydroids and scattered barnacles. (e) = An Oil Jetty pile with encrusting fauna of barnacles, hydroids, bryozoans, sponges and colonial sea squirts. There were fine red algae below the water. This was at low water of low spring tide (0.55m CD, North Wall). (f) = area of muddy sand in the foreground where the ESB jetty will be constructed, with the raised platform and associated concrete and boulder base in the left background (view SSW).

Poolbeg Yacht Club

As part of the proposed development the Poolbeg Yacht and Rowing Club and associated marina will be replaced by a larger marina complex extending upstream on the same side of the Liffey towards the Tom Clarke Bridge. Currently the marina comprises a main floating gangway with a main berth and subsidiary finger berths accessed from it (Figure 7.23 a and b). In all cases, these elements are supported by floats which are permanently submerged below the decking, and whose fiberglass surfaces are entirely covered by a thick biofilm of algae and marine fauna (Figure 7.23c and d). The algae were dominated by *Chondrus crispus*, *Ulva lactuca*, filamentous brown algae and fine red algae which were heavily epiphytised by diatoms. Attached fauna were dominated by large mussels, (*Mytilus edulis*), serpulid tubiferous worms and some barnacles and campanulariid hydroids. No anemones or sea squirts (Ascidians) were noted but could also be present. When a small area of algae was removed and placed in a bucket, several gammarid amphipods emerged, as well as an early stage juvenile green crab. This points to the fact that this epiobiotic mix of algae, tube worms and mussels etc., provide a microhabitat for small mobile crustaceans. A palaemonid shrimp and a mysid shrimp were also noticed in the water immediately adjacent to one of the floats, suggesting that these areas are likely to be used both for foraging and possibly for shelter by a range of small mobile invertebrates.

Figure 7.23(a) = general view of Poolbeg Marina. (b) = close up of decking with three floats visible. (c) and (d) = close-up of the heavy algal biofilm on the marina decking floats.

Fisheries

The proposed 3FM Project is situated within the Dublin Harbour area at the outer part of the Lower River Liffey estuary. The area in question stretches about 3km from the Tom Clarke Bridge downstream to the outlet from the Ringsend Wastewater Treatment Plant. This section of the estuary acts as a migratory route for Annex II species Atlantic salmon and river lamprey, which spawn in freshwaters and migrate to sea to feed. Small numbers of another Annex II species, sea lamprey (*Petromyzon marinus*), may also migrate through the development area. European eel (*Anguilla anguilla*), which spawn in the Sargasso Sea and feed in estuarine and freshwaters and which is also a protected species, also migrate through the port area. In addition to the freshwater migratory species mentioned, a range of resident or seasonally resident estuarine/marine species use the development area for feeding, none of which is protected or classed as of concern under the IUCN. Given that the proposed development could potentially impact some of these species, their status within the study area and the River Liffey is presented in the following section along with details of the resident/semi-resident species in the Lower Liffey Estuary.

The proposal development will also require the disposal of 1,189,000m^3 of dredge spoil at the Dublin Bay licensed dump site over several years and therefore the marine fish community in that area is also addressed.

Migratory Species – Atlantic Salmon

Atlantic salmon stocks have been declining rapidly throughout their range since the 1970's and are currently at their lowest recorded levels in rivers across North-Western Europe. As part of the management of Irish stocks there are over 30 salmon counters on key rivers around the island of Ireland that record the net inward migration of salmon to Irish rivers. This information is crucial for the management of the stocks and is used in conjunction with other information including rod catch statistics where these are available and catchment wide electrofishing (CWEF) survey data which is gathered on a wide range of rivers including those with and without salmon counters in order to estimate the density of juvenile salmon within these watercourses. The latter employs a timed electrofishing method, in this case 5 minutes, as a standard method. Additional information on salmon is also available from Water Framework Directive (WFD) related catchment wide surveys, which are undertaken in many of the same rivers every three or so years.

The data from these latter surveys are not used for salmon stock management per se, as they cover all species, but can provide useful site-specific data which can feed into local improvement works as required. These data are collected in the main by Inland Fisheries Ireland (IFI) personnel, with important inputs from ESB on regulated rivers and also from the Marine Institute. The counter, angling returns and CWEF data are analysed by the Technical Expert Group on Salmon (TEGOS) who in turn advise the North-South Standing Scientific Committee for Inland Fisheries (NSSSCIF) which replaced the previous Standing Scientific Committee in 2018. The data is used for a very wide range of applications ultimately related to managing the Irish salmon stocks with one of the key objectives to provide catch advice for the following year for angling. Thus, TEGOS issue an annual report based on the various sources of information gathered on the stock for that year along with relevant stock-related information carried over from previous years and then issue catch advice for the following year, i.e., the TEGOS report for 2022 includes catch advice for 2023. That advice may allow for a certain number of fish that can be harvested by anglers, whether a river can be open for Catch and Release (C&R), i.e., where the salmon is not killed, or if all salmon fishing is banned for that year.

Only on rivers which have reached or exceeded their Conservation Limit in a particular year in terms of numbers will a specified rod harvest be permitted the following year, while rivers where at least 65% or more of CL is reached or the fry density per five minutes exceeds 17 for 0+ fry, average, across multiple sites (Millane *et al.*, 2023) will it be open for C&R the following year. Where none of these criteria are met, a river will remain closed to all salmon angling the following year.

River Liffey Salmon

The River Liffey (catchment area 1,349km^2) is a regulated river with three hydroelectric dams, two toward the upper reaches are Golden Falls and Polaphouca and a third toward the middle to lower reaches is at Leixlip. Salmon can pass upstream of Leixlip using a lift system at the dam, but the numbers involved are undoubtedly lower than would be the case in the absence of the dam, which means that the spawning and nursery capacity of the entire middle reaches of the Liffey as far as Poulaphuca are significantly underutilised by the species. Taken as a whole, the production potential of the Liffey, based on the available habitat throughout the catchment, is estimated at 5,373 salmon for the Upper Liffey i.e., above Leixlip dam and 1,705 salmon for the Lower Liffey i.e., downstream of Leixlip dam and which includes the Rye Water, which is the main tributary joining the Liffey below the Leixlip dam.

Seasonality of the Liffey Salmon Run

There are two salmon counters on the River Liffey, one downstream at the head of the tide at Islandbridge weir and a second on the salmon lift at Leixlip dam. An analysis of the monthly data for the period 2019 to 2020 shows that most fish ascend through the Islandbridge counter in the months May to October inclusive with July and August generally the peak months (Figure 7.24). In 2009, 2013 and 2014, October produced higher than usual figures also.

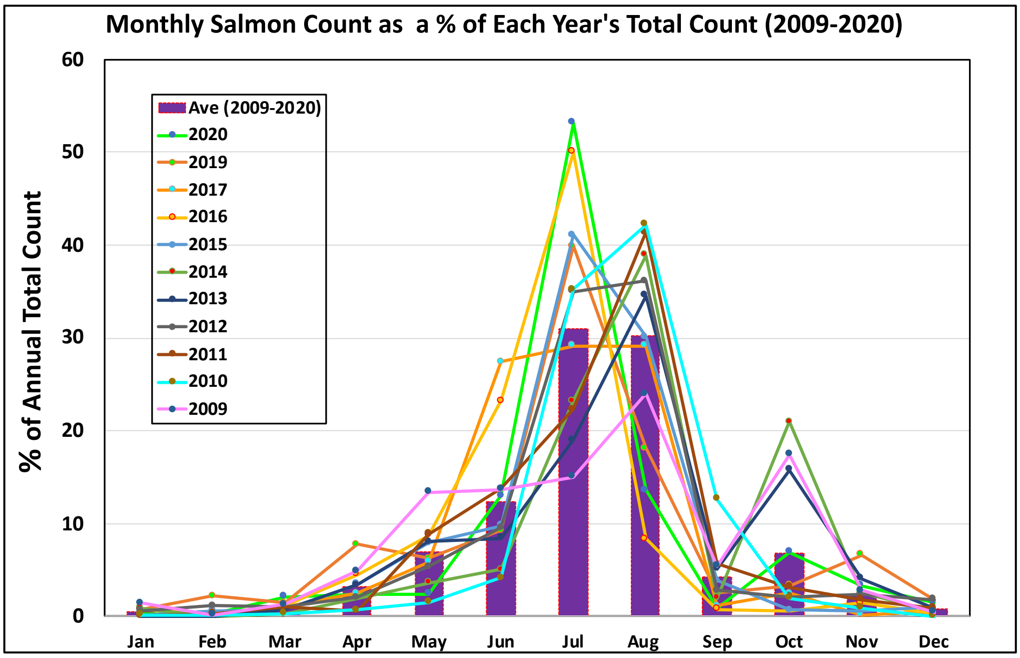

Figure 7.24 Monthly salmon counts through the River Liffey. *Annual Trends (2009-2022)*

Table 7.11 and Figure 7.25 presents the net upstream salmon counts for the Lower and Upper Liffey. The Lower Liffey counts are derived from the Islandbridge salmon counter which is inserted into the Islandbridge weir on the river near the Phoenix Park, and the Upper Liffey counts are for those salmon which pass upstream of the Leixlip dam in the fish lift. The data for 2009-2019 was supplied by the Marine Institute and was marked as verified. Those are the net upstream salmon movements recorded at the two counters. The data for 2020 and 2021 was provided by IFI, and the 2022 count came from the TEGOS annual report appendix for 2022 with catch advice for 2023, which was published online in February 2023 (Millane *et al.,* 2023).

The figure in Table 7.11 for the Islandbridge counter for 2018 was obtained from the TEGOS 2022 appendix. This figure is an [2]estimate based on averages for the relevant months for the previous five years because the counter was effectively out of service from 18th June to October inclusive in 2018. Figure 7.25 shows the very sharp decline in numbers in 2019. The next lowest figure was back in 2009 and that is just over twice as high as the average for the Lower Liffey counter from 2019-2022. It is clear therefore that the sharp drop in numbers since and including 2019 is not an artifact of the figures. Unfortunately, there are no figures available for the Leixlip counter for 2020, 2021 or 2022, but based on the figures for 2018 and 2019, it is clear that the numbers of salmon moving upstream at the dam have also dropped considerably, in fact even more dramatically than at Islandbridge. The Islandbridge counter is only a partial counter in that during flood conditions and high tide salmon can [3]bypass it over the weir and it can also dry out. [4]Routine checks on the counter in 2022 revealed that water levels were falling, and it eventually dried out in August and by 19th August of that year the fish pass had run completely dry. It was determined that the low flow of water in the river combined with the failed west sluice gate on the weir meant that water was not able to bypass the weir meaning that fish passage was completely blocked. The issue was rectified in September 2022.

2 Pers. comm. Michael Millane, Senior Research Officer (IFI)

3 See IFI Consolidated Fish Counter Summary Report for 2020 published online (IFI site) in April 2021

4 These observations are taken from the IFI Consolidated Fish Counter Summary Report for 2022 published online in May 2023.

Table 7.11 The net upstream numbers of salmon counted at the Islandbridge salmon counter and at Leixlip dam. The figure for 2018 at Islandbridge (marked *) is an estimate because the counter was out of action from June to October inclusive when the majority of salmon normally ascend.

Year	Islandbridge	Leixlip
2022	167	N/A
2021	245	N/A
2020	354	N/A
2019	271	12
2018	* 945	56
2017	679	251
2016	948	184
2015	1012	292
2014	849	244
2013	1109	381
2012	1028	420
2011	1589	957
2010	2018	1031
2009	613	280

The appendix which normally accompanies the TEGOS annual reports on salmon stocks with advice for the coming year, which lists the actual fish counter numbers for individual rivers was not published for 2023. However, based on the [5]CL defecit given in the main 2023 report, in Table 4 p22, (Tegos, 2023) it can be deduced that the net upstream migrating salmon numbers on the Lower Liffey are similar to the low levels recorded in recent years.

As a cross-check on the trends in the adult salmon runs in the Liffey, the catchment wide electrofishing (CWEF) surveys for juveniles i.e. numbers of fry for five-minute timed fishing can give us additional insights. In that regard, Table 7.12 lists the results for CWEF surveys between 2008 and 2021 inclusive. While these appear to show a declining trend, the trend is very variable and moreover there is no data for the Lower Liffey sites since 2018 and the data for the Upper Liffey is incomplete for the last three runs, so these data are of limited value. However, given that the CWEF densities reported for 2018 are generally higher than the 2016 and 2012 densities and not much lower than the 2011 densities, it might have been expected that they would have given rise to higher adult returns in 2021, assuming that it would take the 2018 fry (0+) another two years in the river to reach the 2+ smolt stage and that these would return in 2021 as grilse. Another CWEF survey is scheduled to be undertaken on Lower Liffey sites again in 2023 and that should shed further light on the current status of

[5] CL = Conservation Limit

the juvenile stock in the Liffey and indirectly shed more light on the prospects in the short-term for the adult stock.

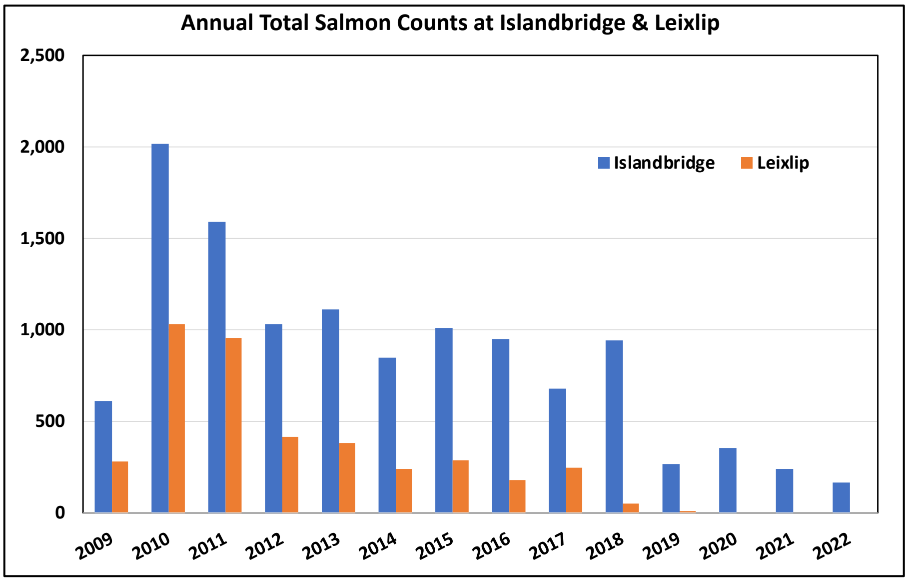

Figure 7.25 A graph of the net upstream salmon counts at Islandbridge weir and Leixlip dam. Note that there was no data for Leixlip for the years 2020-2022 inclusive.

Table 7.12 5-minute electrofishing fry densities in Upper and Lower Liffey with number of sites included in the average given in brackets (when provided), as published in the IFI 6CWEF Salmon Monitoring Reports.(* = incomplete, - = no data)

Year	Lower Liffey	Upper Liffey
2008	21.33 (4)	12.93 (10)
2009	40.12 (6)	5.11 (26)
2010	25.16 (10)	8.15 (35)
2011	17.47 (12)	16.20 (52)
2012	12.12 (5)	10.13 (26)
2016	6.75 (16)	2.63*
2018	16.69	5.33*
2021	-	1.5*
Catchment-average count published in 2021	15.64	10.51

Liffey Salmon Trends Compared to Wider Irish Trends

At the end of 2006 there was a ban on offshore drift-netting for salmon and 2007 saw a peak in annual returns across the country. Since then, the trend is downward although with quite a bit of year to year variability. On average this saw peaks in 2010, 2013, a rise from 2015 to 2017 and another peak in 2020 (Millane *et al.,* 2023). The Lower Liffey counter numbers vaguely follow a similar pattern, especially in relation to 2010, 2013 and to a

6 Report on Salmon Monitoring Programme 2021 (Funded under the Salmon Conservation Fund) IFI/2022/1-4590 - Available online on the IFI website under 'Publications' lesser extent in 2015. However, since 2019 the returns have taken a more pronounced drop in the Liffey compared to other rivers. For example, the other large east coast rivers, the Boyne to the north and the Slaney to the south, although variable, did not show an equivalent drop in their numbers from 2019 to 2022 inclusive (Figure 7.26 and Figure 7.27), apart from a drop in 2021 in the Slaney, which suggests that the Liffey numbers may be anomalous in that adult returns are falling more than in these, the only other large east coast rivers. Note that the data for the Boyne and the Slaney are only for grilse i.e., 1 Sea Winter (1SW) fish, as the Liffey run is composed mainly of 1SW salmon. Unlike the Liffey both the Boyne and Slaney have very substantial MSW (Multi Sea Winter) salmon runs.

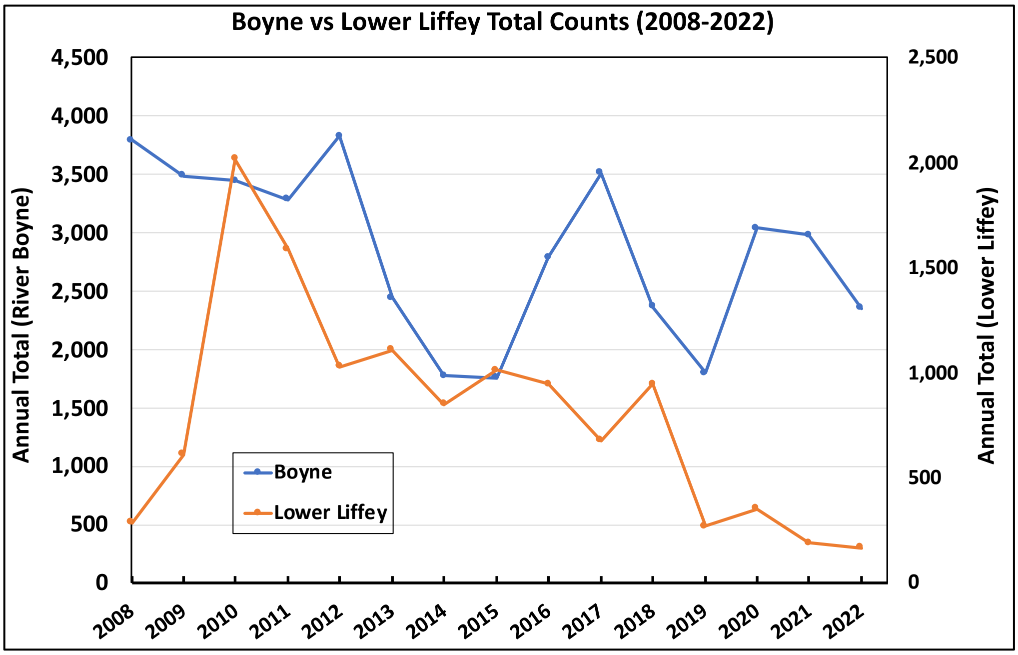

Figure 7.26 Line graph showing the numbers of net inward migrating salmon on the River Boyne and Lower River Liffey (2008-2022)

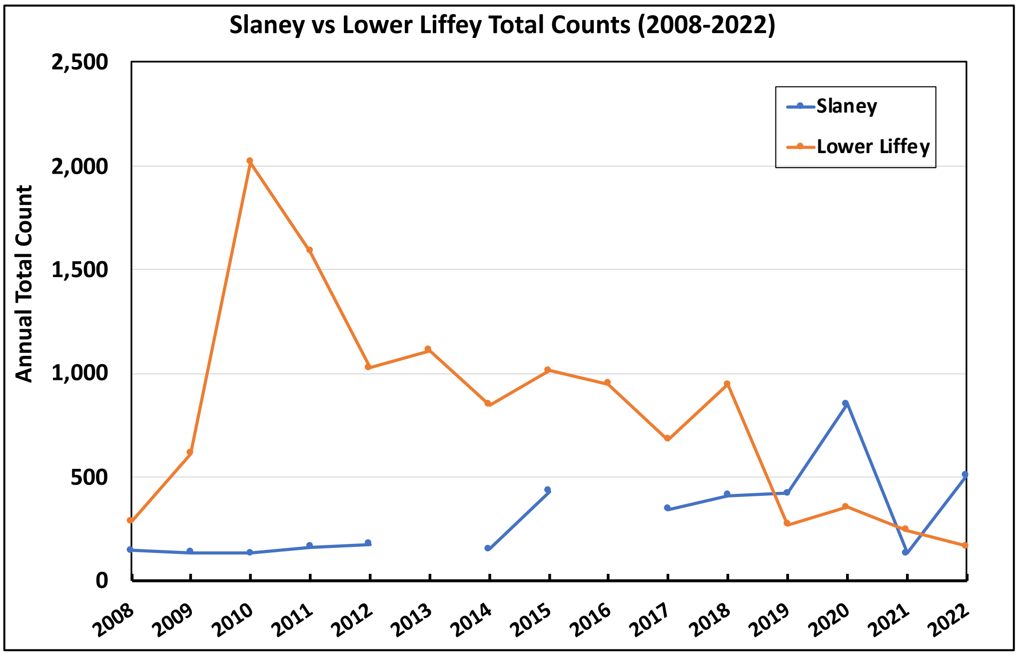

Figure 7.27 Line graph showing the numbers of net inward migrating salmon on the River Slaney and Lower River Liffey (2008-2022)

Liffey Trout Survey

In July and August 2021, IFI undertook detailed surveys at 22 sites on the middle reaches of the Liffey between Ballymore Eustace below Poulaphuca dam and Clane, upstream of Leixlip dam. They also surveyed ten sites on the main middle reach tributaries (Delanty *et al.,* 2022). While the main target in this survey was brown trout, salmon juveniles (0+) and parr (1+ and 2+) were also recorded in low numbers at most sites, in fact salmon were present at 20 of 22 main channel sites and at two of ten tributary sites. The highest densities were encountered, as would be expected, in the riffles and fast glides. These are minimum densities, as most sites had to be surveyed by boat due to water depth, which is a much less efficient method than if sites are wadeable for survey. While one cannot make any quantitative comparisons between the results of this survey and the record of adult salmon counts discussed above, the widespread occurrence of the juveniles and parr in these middle reaches, especially given that they are upstream of Leixlip dam, may indicate that the stock is in a better state than the declining counter returns for adults might suggest.

That notwithstanding, the widespread pressures on salmonids in the Liffey is acknowledged and issues of concern within the middle reaches of the Liffey are similar to those associated with many large river catchments in Ireland and include water quality, agriculture, localised extensive weed growth, drainage and embankment works, siltation, flow regimes managed by the ESB, hydromorphology and climate change. The majority of these concerns probably do not alter drastically year to year, rather they lead to a gradual deterioration in the quality of the available habitat. Thus, while these factors clearly contribute to the long-term pressure on the species in the Liffey, they cannot explain the sudden drop in numbers noted since and including 2019.

An exception to this is the flow regime which can alter dramatically from year to year depending on rainfall levels, and in the case of the Liffey, there is also the issue of artificial flow regulation from the dams. When this is coupled with the more than 20 weirs and barriers on the main channel of the Liffey, at least five between Islandbridge and Leixlip, it is clear that flow could well be impacting numbers from year to year. For example, the late summer of 2022 was exceptionally dry and the Islandbridge weir dried out in mid-August and no fish were able to move upstream until corrective measures were implemented in the weir the following month. In 2018, the Islandbridge counter was out of action from 18th June until the end of October and while the net annual count for Islandbridge for that year is given as 945, this was just an estimate based on average counts for the five previous years for the missing months, the actual net upstream count outside of this downtime was 125.

If we consider that summer 2018 was also very dry and warm, it is possible that fewer salmon than the estimated 945 might have passed through the counter that year. A comparison of the 2017 and 2018 figures for the Leixlip counter would seem to support this suggestion (Figure 7.25). In 2017 when seemingly fewer salmon were recorded at the Islandbridge salmon counter (679), 251 were also recorded at Leixlip i.e., just under 37% of the Islandbridge total, which is within the general range of the ratio between the two counts annually up to that point. In 2018, however, despite the estimated higher count for Islandbridge, the lowest number ever counted was recorded by the Leixlip counter i.e., just 56 salmon, i.e., = 6% of the Islandbridge total and if we were to use the 2017 figure for Islandbridge instead of the 2018 estimate, the Leixlip figure would still only be 8% of that run. So, if low water levels are impeding the upstream movement of salmon through the Islandbridge counter the existence of at least five more sizeable weirs between there and Leixlip may also be reducing the numbers reaching Leixlip. Unfortunately, this analysis cannot be tested for Leixlip for the remaining years (2019 to 2022) because the Leixlip counter was out of action from May to July in 2019 and was not in action at all for the remainder of that period.

If salmon are being halted for extended periods downstream of barriers, they become susceptible to both predation and poaching. There is evidence also from estuaries in England, that fish that can fail to move upstream during periods of low flow, especially if this is associated with other factors such as elevated temperatures. These factors can delay river entry but may also result in non-entry in some cases (Solomon and Sandbrook, 2004). IFI recently published a detailed assessment on the degree to which the many weirs and dams on the Liffey impede the passage of migratory fish (Donovan *et al.,* 2022). This concluded that almost all the dams and weirs on the Liffey, including the Islandbridge Weir, present at least a partial barrier to upstream movement of adult salmon during certain conditions of flow and that improvement in fish pasasage at these barriers would have a definite beneficial effect for salmon stocks on the river by opening up more spawning habitat to more fish both on the main channel and in certain tributaries.

Again, a more in-depth analysis would be required in order to identify the most influential factor or combination of factors giving rise to what appear to be a significant reduction in adult salmon returns to the Liffey since at least 2019.

Migratory Species – Eel

Eel is a catadromous species that spawn at sea and develop as adults in estuaries and freshwaters (rivers and lakes). They have declined in abundance all across Western Europe in recent times and are no longer caught commercially in Ireland, as a protection measure. The Liffey is not considered an important river for the species. However, it is one of the channels where the species is being monitored on a long- term basis in order to get an understanding of changes to relative abundance of recruitment since the implementation of the Eel Regulation (TEGE, 2021). The monitoring is being undertaken at Islandbridge weir at the head of the tide using an elver trap. It is important to note that no assumptions can be made about the total numbers of eel entering the river because the proportion bypassing the trap is not known.

The bulk of zero-year eels (glass eels and elvers) entering the Liffey at Islandbridge do so in the months of May to August with much smaller numbers in April and September (Figure 7.28). However, the numbers immigrating can vary quite considerably from year to year as is apparent in the data for the Liffey where peaks were noted in 2013, 2018 and 2022 (Figure 7.29). Some of these peaks are also discernible in data from other sites reflecting general country-wide recruitment of the species, whereas inter-site variation is also likely to relate to site-specific features that influence the numbers passing through a trap. Figure 7.29 compares the total weight of elvers taken in traps in Erne, Ardnacrusha (Shannon) and the Liffey from 2012 to 2020 inclusive. This indicates common peaks on the Erne and Liffey in the years 2012, 2013, 2017, 2018 and 2020 but none in 2014, 2015 and 2016. While the numbers are not yet available for the other sites in order to compare the large peak in recruitment on the Liffey in 2022, they will almost certainly be replicated in other index rivers around Ireland as well.

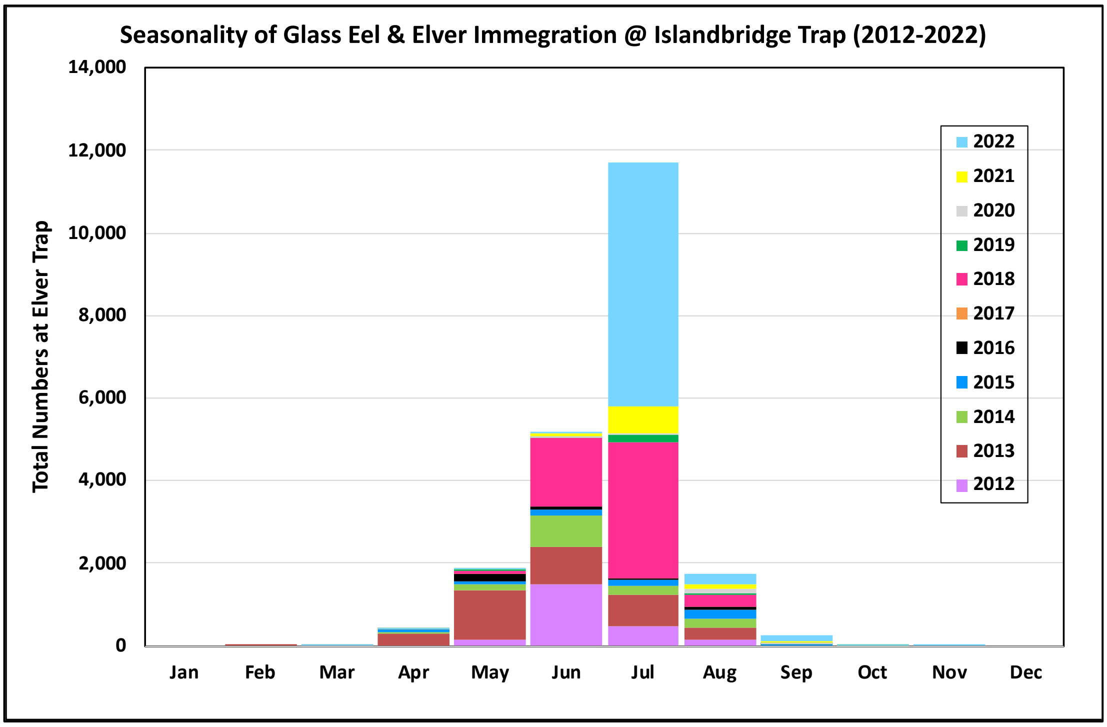

Figure 7.28 Seasonality of glass eels and elver numbers taken in the Islandbridge elver trap (2012-2022).

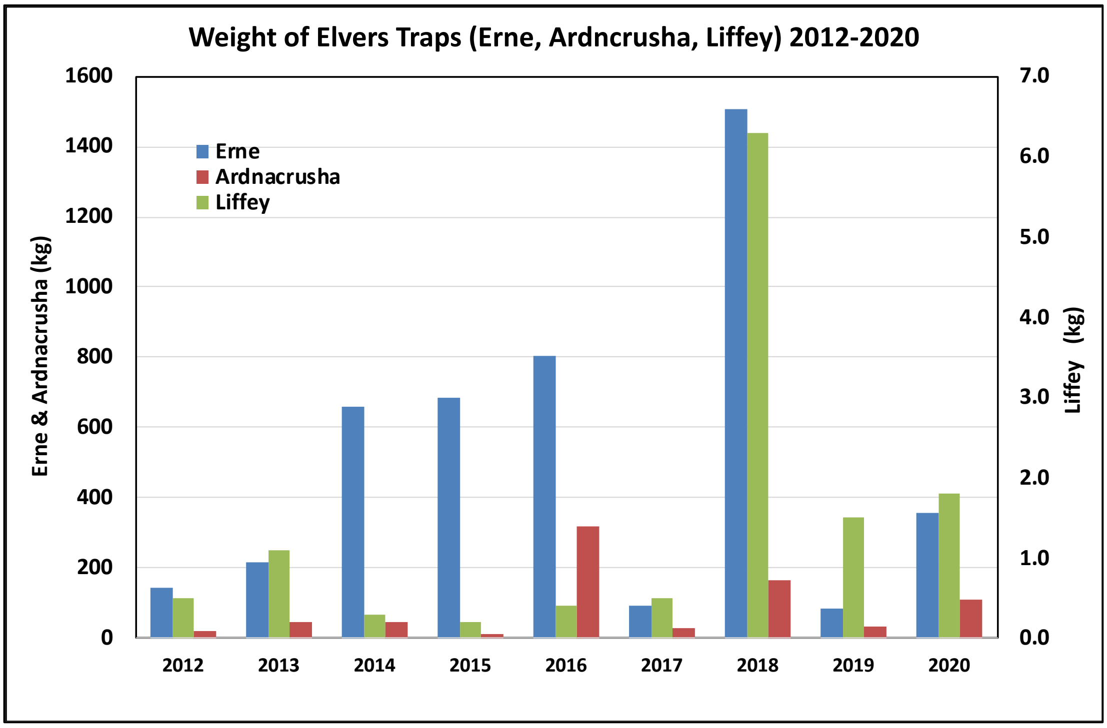

Figure 7.29 Total weight of elvers taken in traps on the Erne, at Ardnacrusha on the Shannon and at Islandbridge (2012-2020).

Migratory Species – Lamprey

Alterations to the substrate in the Islandbridge elver trap had the effect of enabling the passage of lamprey, mainly river lamprey, (*Lampetra fluviatilis*) but also some brook lamprey (*L. planeri*), in recent years. In the same way as elvers and glass eels do, the likelihood is that lamprey also bypass the trap, so that while the numbers may give some indication of inter-annual trends, they cannot be taken as total counts. The data in Figure 7.30 shows that river lamprey ascend the weir starting in low numbers in September, running all the way through the winter months and petering out again the following April. This seven-month period sees two distinct peaks, the first in November and the second the following March, with effectively no migration during summer, from May to the end of August. This pattern of migration fits in with a previous Inland Fisheries Ireland survey undertaken in the upper Liffey estuary when three river lampreys were taken in a fyke net in October 2010 as part of the WFD fish monitoring programme (Kelly *et al.,* 2011). It also broadly agrees with timings reported in the scientific literature (Kelly and King, 2001).

To date no juvenile sea lamprey (*Petromyzon marinus*) have been taken in the Islandbridge elver trap (Nigel Bond, MI, pers. comm.) since 2018, which suggest that the species cannot or rarely passes upstream of the weir. IFI have reported seeing the species spawning downstream of the weir in summer 2015. All three species of lamprey occurring in Ireland are Annex II species under the EU Habitats Directive.

It is not possible to say, based on the available data, if the dredging being undertaken in the port is having any significant impact on lamprey numbers. A crude comparison of the total dredging versus the total numbers recorded in the Islandbridge elver trap (Figure 7.31) would not suggest that there is any clear impact. However, in the absence of a knowledge of the absolute numbers passing upstream, combined with a longer time series, i.e., especially during years without dredging, it is not likely that these data can shed any light on the actual interaction between dredging and upstream escapement of the species.

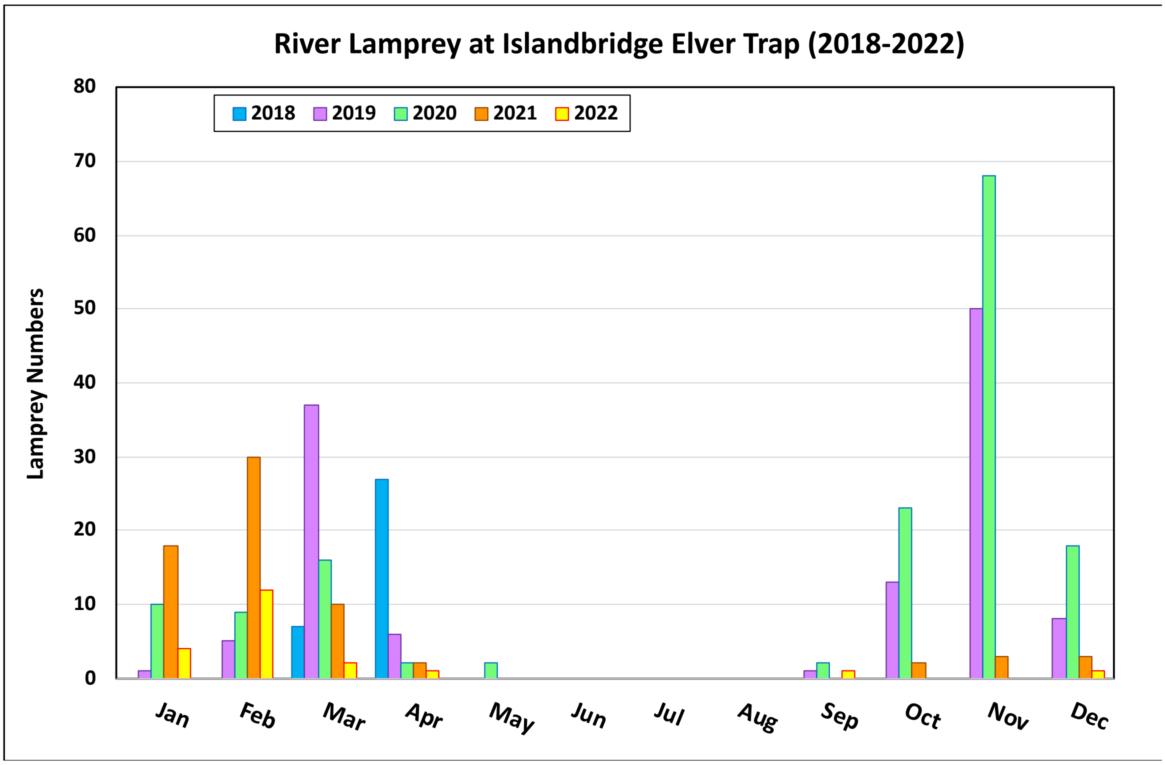

Figure 7.30 Seasonality of river lamprey numbers taken in the Islandbridge elver trap (2018-2022). Data courtesy of Nigel Bond, Marine Institute.

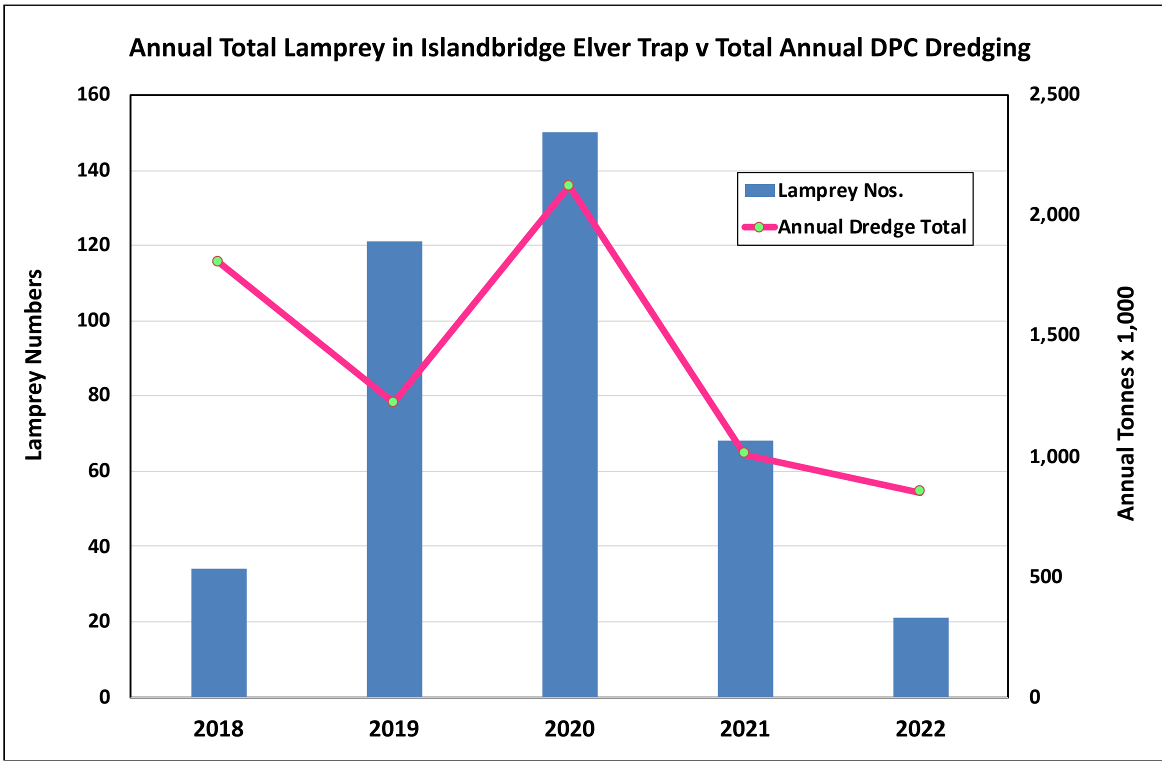

Figure 7.31 Total river lamprey taken in the Islandbridge elver trap and the total tonnage of dredging undertaken in Dublin Port (2018-2022).

Marine and Estuarine Fish within the Study Area

The 3FM Project is situated within the Lower Liffey Estuary, a waterbody extending from Talbot Memorial Bridge upstream to just seaward of the North Bull and Poolbeg Lighthouses at the downstream Dublin Bay end, an area of 4.8km^2. Inland Fisheries Ireland surveyed this part of the estuary in 2008, 2010 and 2022 as part of the Water Framework Directive Fish Monitoring Programme using beam trawls, beach seines and fyke nets (Kelly *et al.,* 2009, 2011, Wightman *et al.,* 2022). They recorded 22 species across the three surveys: 14 in 2008; 17 in 2010; and nine in 2022. Six of the 22 species were only encountered as a single specimen on just one occasions. The most abundant species, usually taken in higher numbers in beach seines were juvenile mullet, sprat, sand goby, lesser sandeel and sand smelt. These are all common marine/estuarine species around the Irish coast. Most species were taken in small numbers, generally less than five to ten individuals, the exceptions being sprat (212) and juvenile mullet (1,078), sand gobies and lesser sandeel (Table 7.13).

In June 2013, May 2018, and July 2020 (RPS 2014, 2020 and ASU, 2020): 6, 4 and 4 beam trawl tows respectively were taken within the main shipping channel and the basins with Dublin Port and 10 species, mainly bottom or near-bottom dwellers were recorded including in particular plaice, sand goby, flounder and butterfish (Table 7.14). The large catches sprat, and mullet taken by IFI, were taken in beach seines, as opposed to the more benthic species taken in the beam trawls. All of the common and more frequently listed species in both tables can be considered typical estuarine species throughout North-Western Europe, while the less frequently encountered species, are more fully marine, entering the lower parts of estuaries more as ‘marine stragglers’ than as truly estuarine species. One important species, not captured in any of the surveys listed above, is bass, (*Dicentrarchus labrax*), which is a very important species for recreational fishing and which at juvenile and young adult stage is common in estuaries and is known to use the lower Liffey Estuary (see below).

Table 7.13 WFD transitional waters fish survey results for the Lower Liffey from IFI (Kelly *et al.*, 2009, 2011, and Wightman *et al.*, 2022)

Liffey Lower Estuary (IFI)	2008 (Sept)	2010 (Oct)	2022 (Oct)	Rank
Sprat (*Sprattus sprattus*)	212	1	7	2
Sand Goby (*Pomatoschistus minutus*)	43	24	6	3
Mullet (*Chelon labrosus*)	5	1078		1
Lesser sandeel (*Ammodytes tobianus*)		3	57	4
Sand Smelt (*Atherina presbyter*)	10	2	1	5
Salmon (*Salmo salar*)	1			17
Cod (*Gadus morhua*)	6	3		8
Whiting (*Merlangius marlangus*)	2			15
Pollack (*Pollachius pollachius*)	5	3		9
Five-bearded rockling (*Ciliata Mustela*)		3	4	10
Eel (*Anguilla anguilla*)	4		1	12
Flounder (*Platichthys flesus*)	3	9	1	6
Plaice (*Pleuronectes platessa*)	1	2	2	13
Dab (*Limanda limanda*)	1			17
Long-spined Sea Scorpion (*Taurulus bubalis*)	2	4		11
3-spined stickleback (*Gasterosteus aculeatus*)	10		1	7
15-spined stickleback (*Spinachia spinachia*)		3		14
Greater pipefish (*Syngnathus acus*)		2		15
Red gurnard (*Aspitrigla cuculus*)		1		17
Corkwing wrasse (*Crenilabrus melops*)		1		17
Ballan wrasse (*Labrus berglyta*)		1		17
Butterfish (*Pholis gunnellus*)		1		17
No. of Species	**14**	**17**	**9**	
No. of individuals	**305**	**1141**	**80**	

Table 7.14 Fish taken in beam trawls within Dublin Port in 2013, 2018 and 2020 (RPS, 2014, 2020 and ASU, 2020)

Liffey Lower Estuary	2013 (June)	2018 (May)	2020 (July)
Sand goby *(Pomatoschistus minutus)*	9		67
Flounder *(Platichthys flesus)*	3	1	1
Plaice *(Pleuronectes platessa)*	20	15	22
Dab *(Limanda limanda)*			1
5-beared rockling *(Ciliata mustela)*	1		
Butterfish *(Pholis gunnellus)*	3	1	1
Dragonet *(Callionymus lyra)*	1	1	
Nilsson's pipefish *(Syngnathus rostellatus)*			2
Short-spined Sea scorpion *(Myoxocephalus scorpius)*			1
Pogge *(Agonus cataphractus)*		4	1

Recreational Fishing

Recreational fishing in the Liffey Estuary, is concentrated mainly toward the outer (eastern) end of Dublin Port just seaward of the 3FM Project. According to the IFI Angling Ireland website, the South Bull Wall is a popular shore angling location where mackerel are caught in season and conger and small pollack are also targeted. The site also mentions that mullet and bass can be taken in the hot water outlet of the Poolbeg power station. An older leaflet from the Central Fisheries Board also list flounder and occasional sea trout for the South Bull Wall and a 2012 IFI angling report also notes that smooth hound (*Mustela mustela*) can be caught from the South Bull Wall[7]. Dunlop (2009), notes that mullet move well up the River Liffey and through the city centre in midsummer and have been caught as far upstream as Heuston Station and that mullet are also present in the lower reaches of the River Dodder, which enters the outer Liffey Estuary at Ringsend. He also notes that between there and Pigeon House power station that mullet and school bass (mainly immature fish) may congregate attracted by cooling water from power generation in the area. At the outer end of the Great South Wall below Poolbeg Lighouse bass, mackerel, conger and smooth hound can be caught depending on the time of year and the methods employed.

Small boat angling is also occasionally undertaken within the wider Dublin Bay and one such day's fishing in Dublin Bay in May 2012 yielded 12 species including mackerel, launce (greater sand eel), lesser spotted dogfish, grey gurnard, whiting, dab, pollack, coalie (saithe), ballan wrasse, goldsinny wrasse, herring and poor cod. This would have included fishing over sandy areas and off rocky areas (reported on the Angling Ireland website).

7.3.2.2 Benthic Assessment – Burford Bank Disposal Area

Granulometric Analysis

Results from the granulometric assessment indicates the presence of sands across large parts of the survey area (Table 7.15, Figure 7.32 and Figure 7.33). Results from the video survey also indicate the presence of areas of mixed sediments (gravels and large cobble areas) within the survey area. A single location within the disposal area (S_09) showed relatively high silt/clay levels compared to the other sites surveyed. Loss on Ignition values reflect the primarily sandy nature of the soft sediment of the survey area (Table 7.15).

7 A GUIDE TO SEA ANGLING IN THE EASTERN FISHERIES REGION by Norman Dunlop (ERFB, 2009).

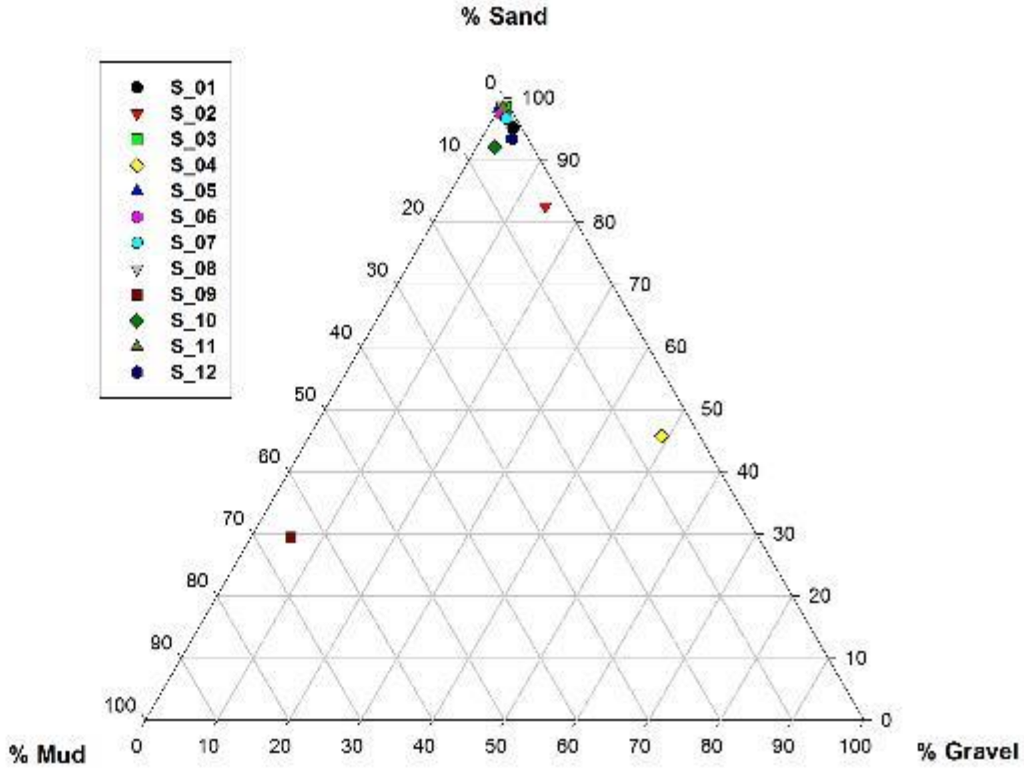

Figure 7.32 Ternary Plot of granulometric results from the Burford Bank disposal area.

Table 7.15 Granulometric and Loss on Ignition results from samples taken within Dublin Bay

	S_01	S_02	S_03	S_04	S_05
% Gravel	3.6%	14.4%	1.0%	49.0%	0.0%
% Sand	95.2%	82.6%	98.5%	45.7%	98.4%
% Mud	1.2%	3.0%	0.6%	5.3%	1.6%
% LOI	0.77%	0.82%	0.65%	1.20%	0.34%
Textural Group	Slightly Gravelly Sand	Gravelly Sand	Slightly Gravelly Sand	Muddy Sandy Gravel	Fine Sand
	S_06	**S_07**	**S_08**	**S_09**	**S_10**
% Gravel	0.8%	1.9%	0.2%	5.6%	2.6%
% Sand	97.5%	96.7%	99.0%	29.5%	92.1%
% Mud	1.7%	1.4%	0.9%	64.9%	5.3%
% LOI	0.83%	0.79%	0.47%	2.49%	0.83%
Textural Group	Slightly Gravelly Sand	Slightly Gravelly Sand	Slightly Gravelly Sand	Gravelly Mud	Slightly Gravelly Sand
	S_11	**S_12**			
% Gravel	0.6%	4.3%			
% Sand	98.5%	93.5%			
% Mud	0.9%	2.2%			
% LOI	0.47%	0.54%			
Textural Group	Slightly Gravelly Sand	Slightly Gravelly Sand			

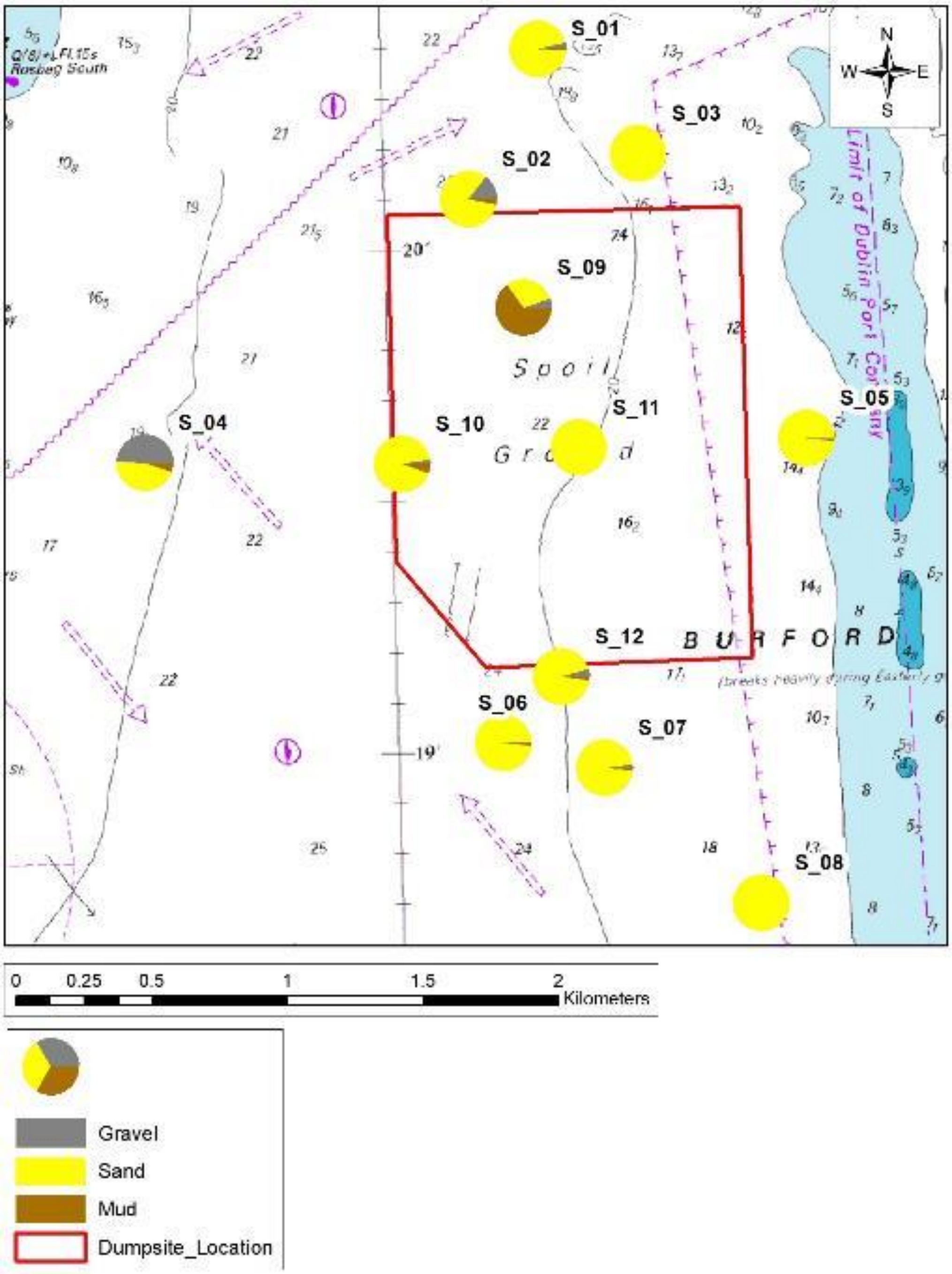

Figure 7.33 Distribution of PSA within the survey area. (Grey – gravel; Yellow – sand; Brown – mud)

Infaunal Assessment

A total of 132 taxa were recorded from the grab samples within, and adjacent to, the disposal area at the Burford Bank (Appendix 7.3.1b). Of these, 123 taxa were countable, and nine taxa were non-countable and marked as Present when encountered. These nine taxa were removed from further data analysis. Diversity indices calculated from the countable taxa are presented in Table 7.16. Two replicates at S_11 (S_11b and S_11c) returned the highest number of species (>30) and individuals (737 and 147 respectively). However, the remaining replicate at S_11 (S_11a) returned only six individuals from four species, highlighting the mosaic nature of the seabed at this location. The lowest species number and abundances was recorded at S_03c, with only two individuals from two species recorded.

Table 7.16 Diversity indices derived from the infaunal grab data from the disposal site in Dublin Bay.

	S_01	S_02	S_03a	S_03b	S_03c	S_04	S_05	S_06	S_07a	S_07b
No. of Species	14	23	13	4	2	19	3	18	12	12
No. of Individuals	73	50	25	8	2	49	4	39	18	16
Shannon-Wiener	1.73	2.81	2.26	1.07	0.693	2.52	1.04	2.41	2.37	2.43
Pielou's Evenness	0.655	0.896	0.879	0.774	1	0.857	0.946	0.832	0.954	0.976
Simpson's Dominance	0.279	0.096	0.149	0.438	0.5	0.119	0.375	0.141	0.105	0.094

	S_07c	S_08	S_09	S_10a	S_10b	S_10c	S_11a	S_11b	S_11c	S_12a
No. of Species	12	5	17	21	13	20	4	32	34	11
No. of Individuals	16	7	29	46	17	58	6	737	147	21
Shannon-Wiener	2.39	1.48	2.69	2.67	2.48	2.19	1.33	1.93	2.41	2.23
Pielou's Evenness	0.963	0.917	0.949	0.876	0.965	0.73	0.959	0.558	0.684	0.929
Simpson's Dominance	0.102	0.265	0.079	0.102	0.093	0.219	0.278	0.28	0.234	0.125

	S_12b	S_12c
No. of Species	12	9
No. of Individuals	25	15
Shannon-Wiener	2.13	2.06
Pielou's Evenness	0.857	0.938
Simpson's Dominance	0.158	0.147

Results from the multivariate analysis on the infaunal grab data identified the presence of three discrete faunal groupings, Groups 1, 2 and 3 (Figure 7.34 & Figure 7.35). Group 3 further contained two discrete assemblages (3A and 3B) with differences identified due to the relative differences of the fauna present within Group 3.

The species identified in the survey (Table 7.17) are typical of sandy and mixed subtidal communities, with all species identified common in Irish coastal waters. These taxa have been recorded from the area in previous surveys. The polychaetes, *Spiophanes bombyx* (15 grabs), *Nephtys spp.* (14 grabs) and *Lagis koreni* (11 grabs) as well as Nemertea (11 grabs) were identified at most locations. The mollusc *Mytilus edulis* had the highest abundance, with 433 individuals recorded across 5 grabs, although it was especially abundant in two replicates at S_11 (b & c). The bivalve *Abra alba* was also abundant with 79 individuals recorded in 4 grabs.

Table 7.17 Results from multivariate analysis of the fauna from each faunal group identified in the survey area. Group 3 has further been analysed per sub-group (3A and 3B).

GROUP 1: (Average Similarity: 40.06)		
Mytilus edulis	*Harmathoe spp.*	*Pisidia longicornis*
Onchidoris bilamellata	*Aoridae*	*Spirobranchus lamarcki*
Chirona hameri	*Actiniaria*	*Lagis koreni*
Phyllodoce spp.	*Ampelisca spinipes*	*Tapetinae*
Echinidea	*Anomiidae*	*Platyhelminthes*
GROUP 2: (Average Similarity: 36.31)		
Nephtys spp.	*Glycera spp.*	*Polycirrus spp.*
GROUP 3: (Average Similarity: 33.35)		
Spiophanes bombyx	*Chaetozone spp.*	*Nephtys spp.*
Nemertea	*Lagis koreni*	*Abra spp.*
Amphiura filiformis	*Kurtiella bidentata*	*Stheneleis limicola*
Lumbrineris aniara agg	*Fabulina fabula*	*Scalibregma inflatum*
Spisula spp	*Eumida sp.*	*Phyllodoce spp.*
GROUP 3A: (Average Similarity: 40.12)		
Chaetozone spp.	*Spiophanes bombyx*	*Abra spp.*
Nephtys spp.	*Fabulina fabula*	*Stheneleis limicola*
Spisula spp.	*Nemertea*	

GROUP 3B: (Average Similarity: 43.03)		
Amphiura filiformis	*Spiophanes bombyx*	*Nemertea*
Kurtiella bidentata	*Lumbrineris aniara agg*	*Chaetozone spp.*
Lagis koreni	*Nephtys spp.*	*Pholoe baltica*
Nucula spp.	*Scalibregma inflatum*	*Mactra spp.*

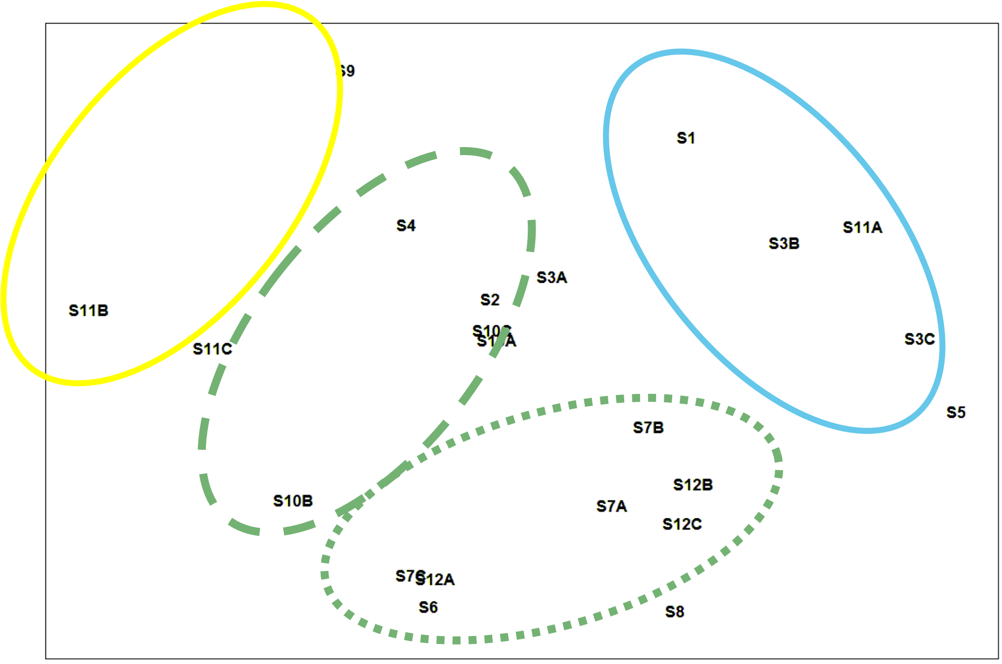

Figure 7.34 MDS Plot of Burford Bank disposal survey area (Stress = 0.19). Group 1 – Yellow, Group 2 – Blue; Group 3 – Green (3A – dots; 3B - dashes).

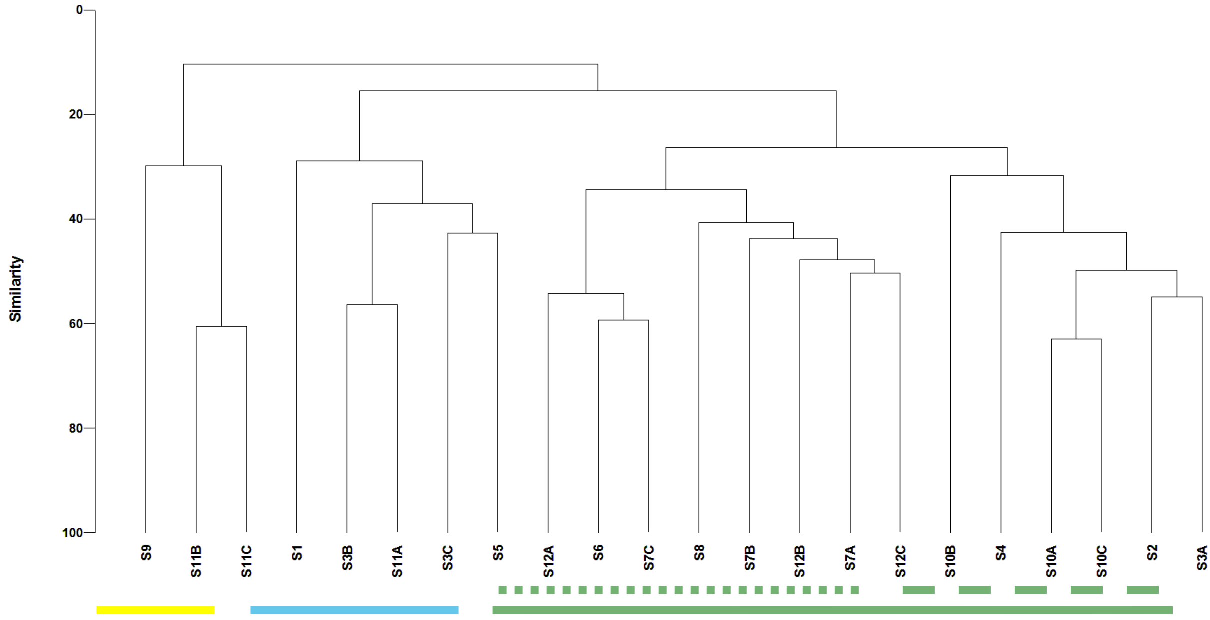

Figure 7.35 Cluster dendogram indicating the distribution of sites based on faunal distribution within and in the vicinity of the Burford Bank disposal site. Group 1 – Yellow, Group 2 – Blue; Group 3 – Green [3A – dots; 3B – dashes]

Video Assessment

The following section outlines the findings from the video survey undertaken in 2022. The photographic frames that accompany the paragraphs display frame grabs from the present survey (Frame a), 2018 survey (Frame b) and 2016 survey (Frame c).

Drop 1:

The site at Drop 1 consisted of rippled, slightly muddy sands with occasional burrows present on the sediment surface. The brittlestar *Ophiura* sp. was present on the site. This is consistent with findings from previous surveys undertaken in 2018 (b) and 2016 (c) (Figure 7.36).

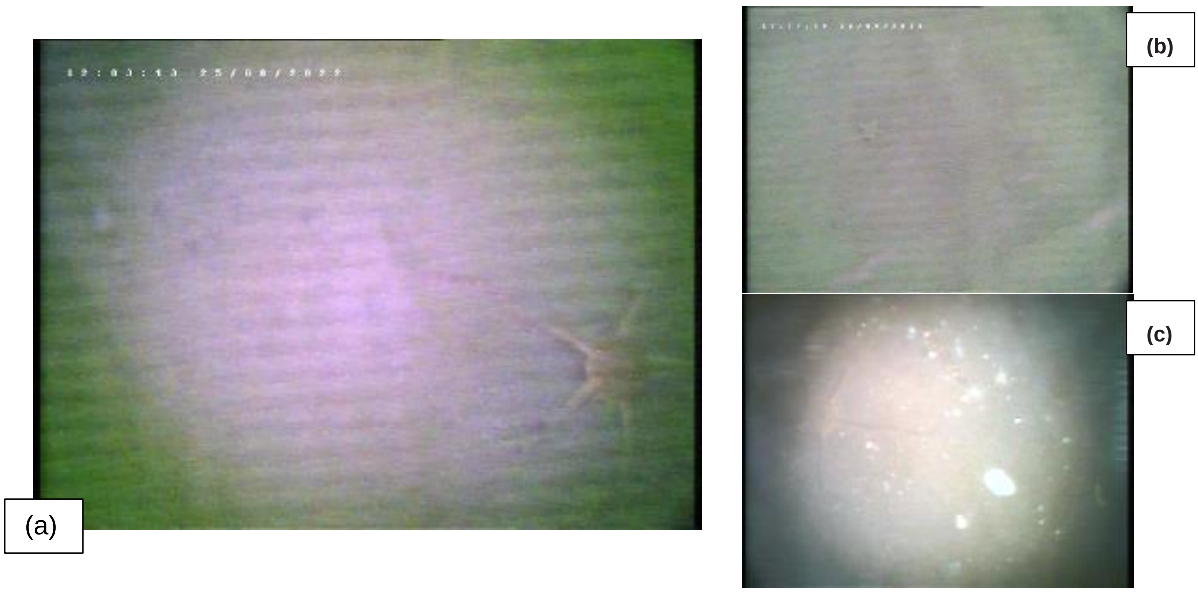

Figure 7.36 The brittlestar *Ophiura* sp. present on sandy sediment (a - 2022; b – 2018; c – 2016).

Drop 2:

Due to strong tidal currents at the time at Drop 2, video quality was poor. Sandy sediment was identified at the site, with little more meaningful data collected. Sediment was previously identified as rippled sands in 2018 (b) and 2016 (c). (Figure 7.37).

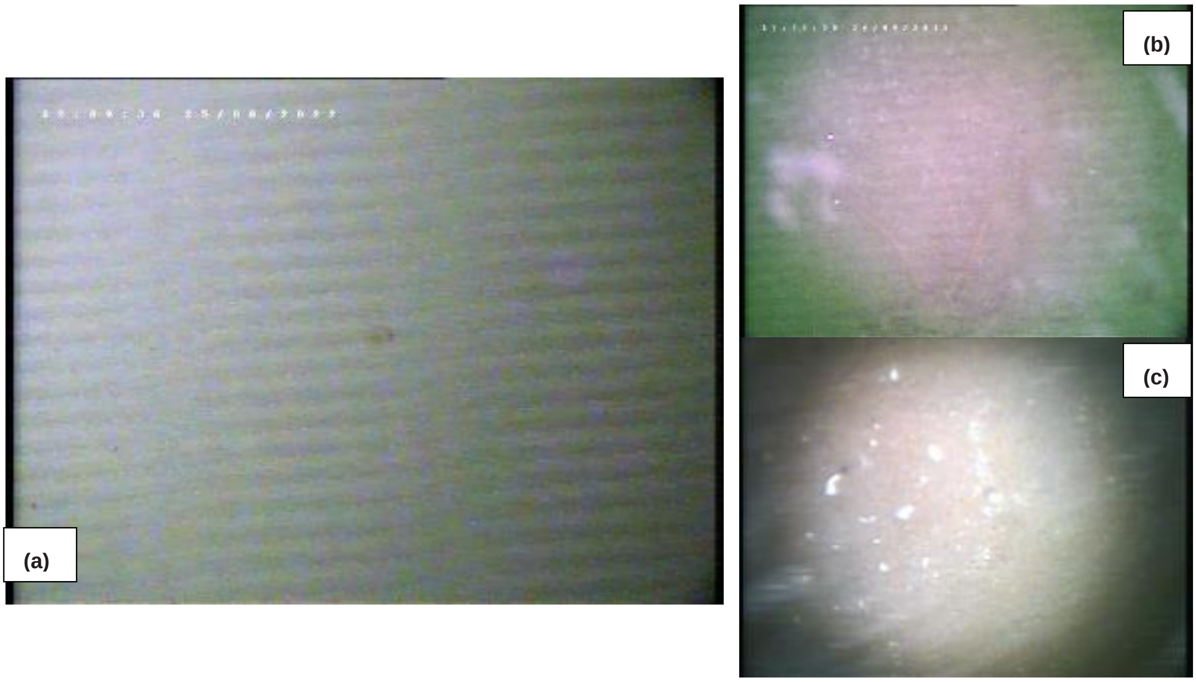

Figure 7.37 Sediment at drop site 2 (a - 2022; b – 2018; c – 2016).

Drop 3:

This site consists of firm rippled sands, with occasional shell present on the sediment surface. The common starfish *Asterias rubens* was present on the site (Frame a; Figure 7.38). This is similar to that identified in 2018 (b) and 2016 (c).

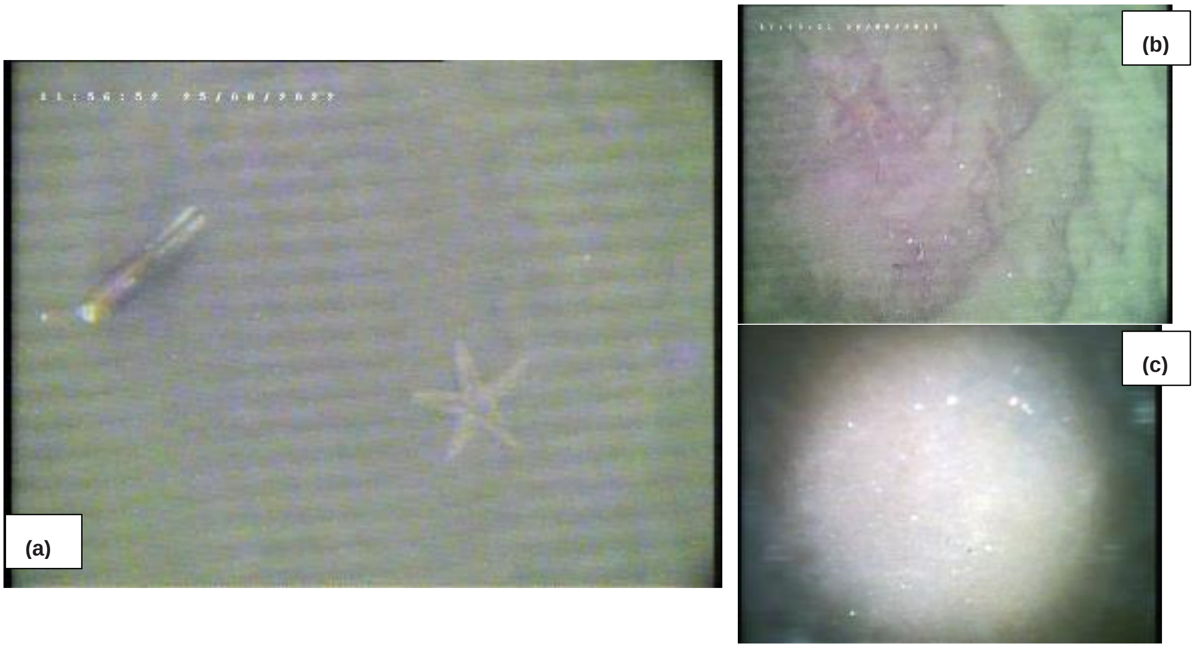

Figure 7.38 Sediment at drop site 3 (a - 2022; b – 2018; c – 2016).

Drop 4:

This site consists of gravelly sands with occasional hydroids and brittle stars, and one thornback ray noted on site. The coarser nature of this site compared to other sites is the same as findings in 2018 (b) and 2016 (c) which recorded gravelly sands present in the area (Figure 7.39).

Figure 7.39 Mixed sediment identified along site 4 (a - 2022; b – 2018; c – 2016).

Drop 5:

As with previous surveys in 2018 (b) and 2016 (c), this site consists of mixed sediment with sand, gravel and small stones present on the seabed. Keelworms (*Spirobranchus* spp.) and Dead man's fingers (*Alcyonium digitatum*) are also common across the site, along with the common starfish (*Asterias rubens*) and burrowing anemones. (Figure 7.40 and Figure 7.41).

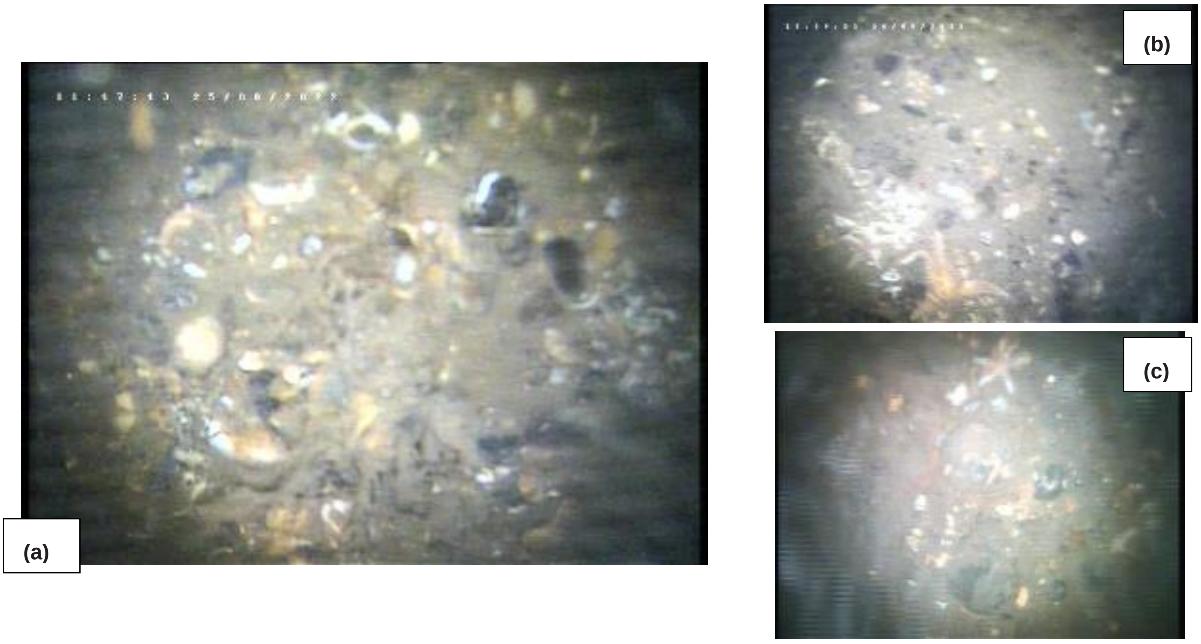

Figure 7.40 Hydroids on mixed sediment at site 5 (a – 2022; b – 2018; c – 2016).

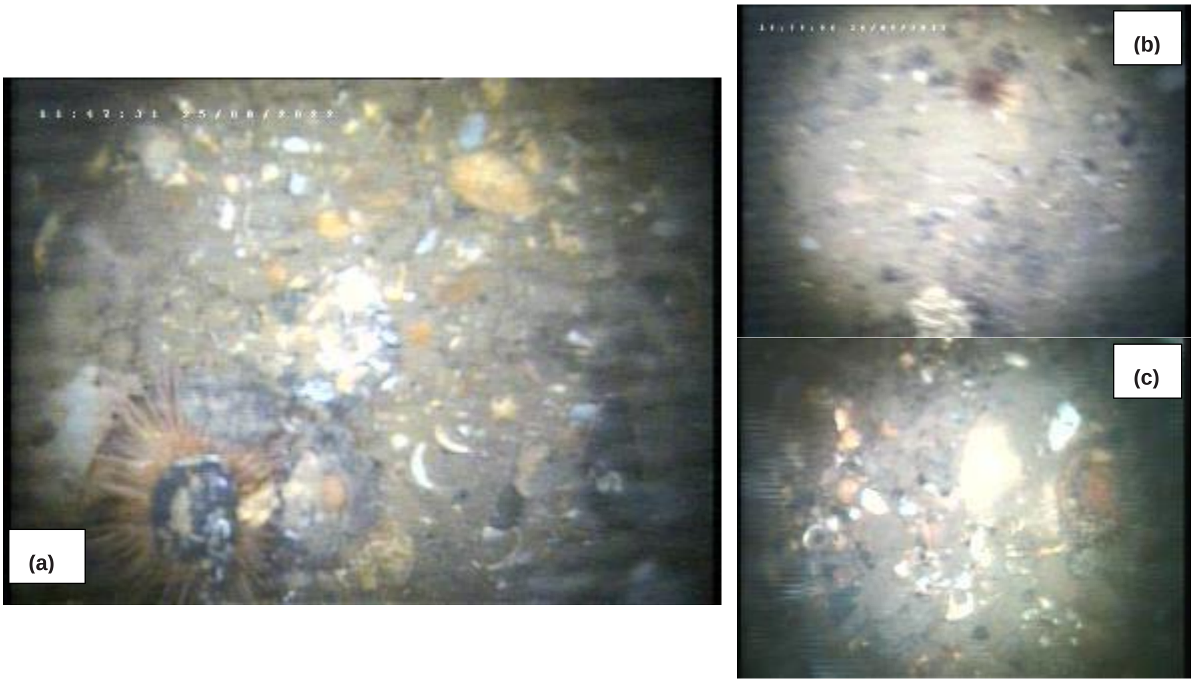

Figure 7.41 Burrowing anemone in mixed sediment at site 5 (a – 2022; b – 2018; c – 2016).

Drop 6:

Similar to Drop 5. This site consisted of mixed gravels and cobble in sands with small stones present on the sediment surface. Dead man's fingers (*A. digitatum*), starfish (*A. rubens*) and burrowing anemones were identified on site. This is similar to habitats identified in 2018 (b) and 2016 (c) (Figure 7.42 & Figure 7.43).

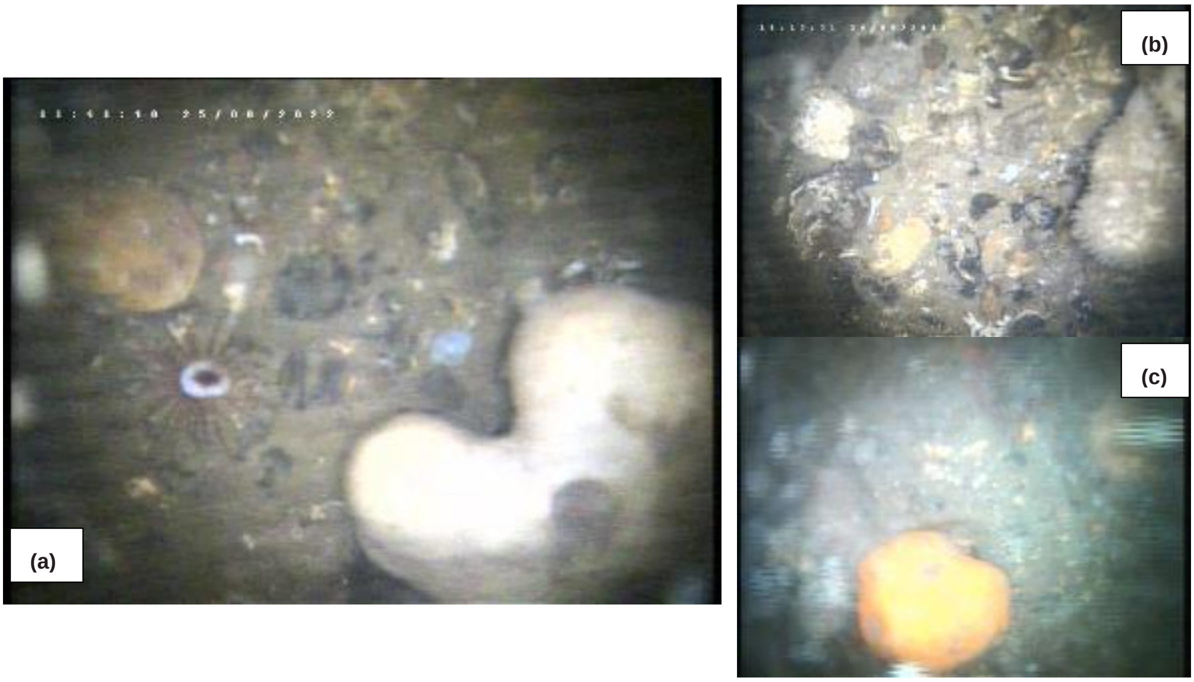

Figure 7.42 Dead man's fingers, *Alcyonium digitatum* with keelworms (*Spirobranchus* spp.) and burrowing anemones in mixed sediment at site 6 (a – 2022; b – 2018; c – 2016).

Figure 7.43 Starfish and keelworms in mixed sediment at video site 6 (a – 2022; b – 2018; c – 2016).

Drop 7:

Fine rippled sands present across the site. This is similar to habitats identified in 2018 (b) & 2016 (c) (Figure 7.44).

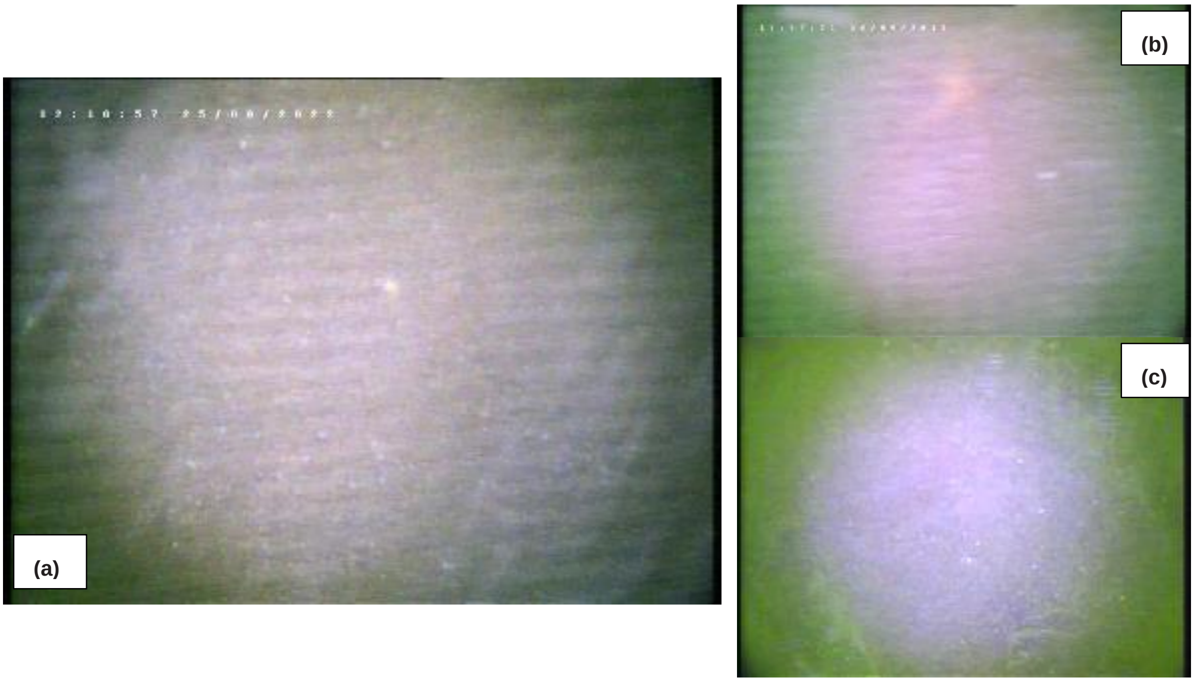

Figure 7.44 Sand and mixed sediment at site 8. (a – 2022; b – 2018; c - 2016).

Drop 9:

This site is dominated by sands with occasional shell gravel present in the area. A previous survey in 2016 (Figure 26 c) showed evidence of finer material deposited on the seabed at this site. This fine material was not present in 2018 (b) and recorded as absent during the present survey (a) (Figure 7.45).

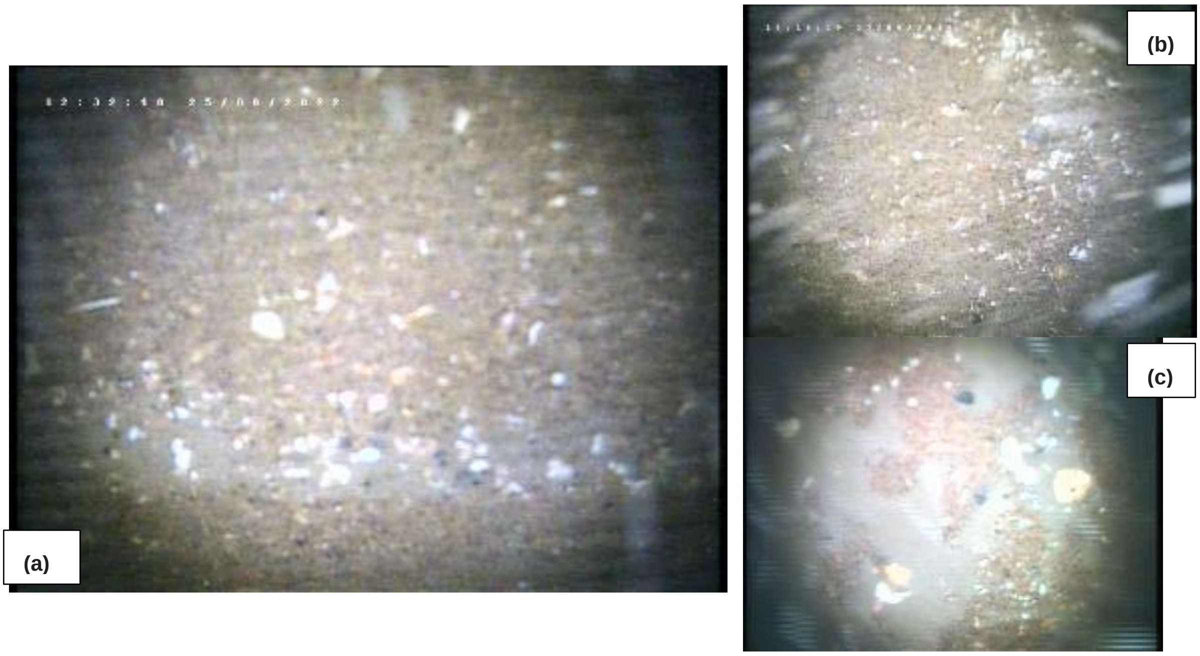

Figure 7.45 Sand at site 9 (a – 2022; b – 2018; c – 2016).

Drop 10:

As with previous survey at this location, there was significant current at the site making video collection difficult. The seabed consists of rippled sands with little evidence of surface fauna present during the current survey. Brittle stars (*Ophiura*), present in 2018 (Frame b) were previously recorded at the site. The habitat identified in the present survey is similar to that identified in 2018 (b) and 2016 (c) (Figure 7.46).

Figure 7.46 Rippled sand at site 10 (a – 2022; b – 2018; c – 2016).

Drop 11: (within the disposal area)

This is one of five video locations within the disposal site and these were also surveyed in 2016 and 2018. Previous surveys classified this site as '*Rippled sands with shell gravel present on the sediment surface*' which is consistent with the footage from the present survey. Bryozoans were identified on site during the present survey. There is no evidence of fine sediment deposition present in the area during the current survey (Figure 7.47).

Figure 7.47 Rippled sand and shell gravel at site 11 (a – 2022; b – 2018; c – 2016).

Drop 12: (within the disposal area)

As with previous surveys the site is dominated by rippled sand, with occasional shell gravel present on the sediment surface. There is no evidence of fine sediment deposition at site (Figure 7.48).

Figure 7.48 Sand and mixed sediment at site 12. (a – 2022; b – 2018; c – 2016).

Drop 13:

This site consists of fine, rippled sand with occasional gravel and shells on sediment surface. This is similar to that identified in 2018 (b) and 2016 (c). There was no visible surface fauna noted in the video (Figure 7.49).

Figure 7.49 Rippled sand and shell gravel at site 13 (a – 2022; b – 2018; c – 2016).

Drop 14:

This site is dominated by fine rippled sands with the brittle star *Ophiura* sp. present on site. This habitat is similar to that identified in previous surveys in 2018 (b) and 2016 (c) (Figure 7.50).

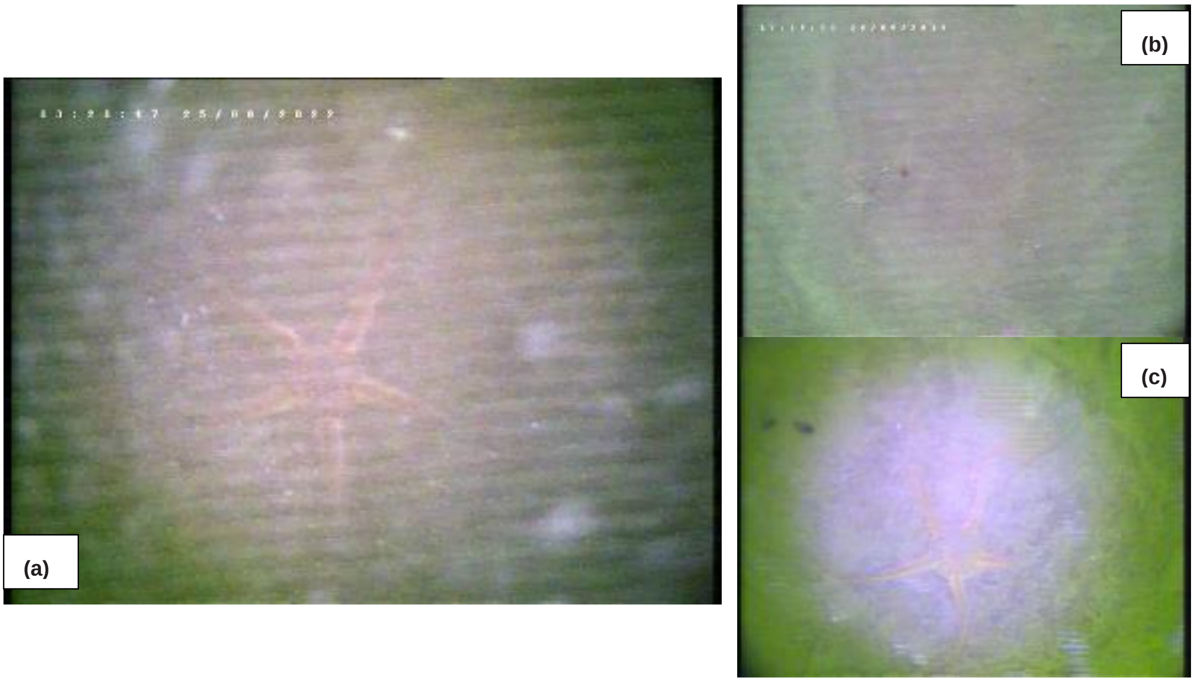

Figure 7.50 *Ophiura* sp. on fine rippled sands at site 14 (a – 2022; b – 2018; c – 2016).

Drop 15:

This site has been classified as fine to medium sand with the brittlestars *Ophiothrix fragilis* and *Ophiura* sp. present on site with occasional dead-man's fingers (*A. digitatum*), spider crabs and hydroids scattered across the transect. This is similar to the findings in 2018 (b) and 2016 (c) (Figure 7.51).

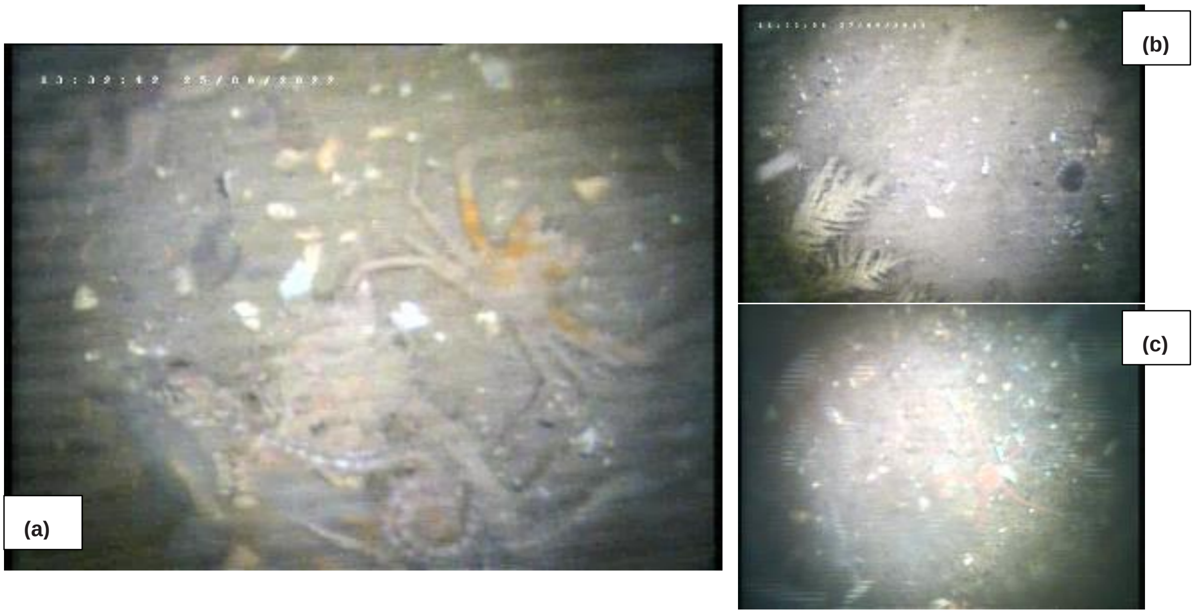

Figure 7.51 Brittlestars and spider crabs (possibly *Hyas coarctatus*) on fine sand with shell gravel at site 15 (a – 2022; b – 2018; b – 2016).

Drop 16: (within the disposal area)

Results from the present survey have identified a heterogenous area, with areas of fine rippled sands (Figure 7.52 a) and mixed gravels and sands (Figure 7.53 a) present in the area. It should be noted that hydroids which were absent in 2018 were present in the current survey and large numbers of the common starfish, *A. rubens*, as well as the brittle star *Ophiura* sp. were also present across the site (Figure 7.52 and Figure 7.53).

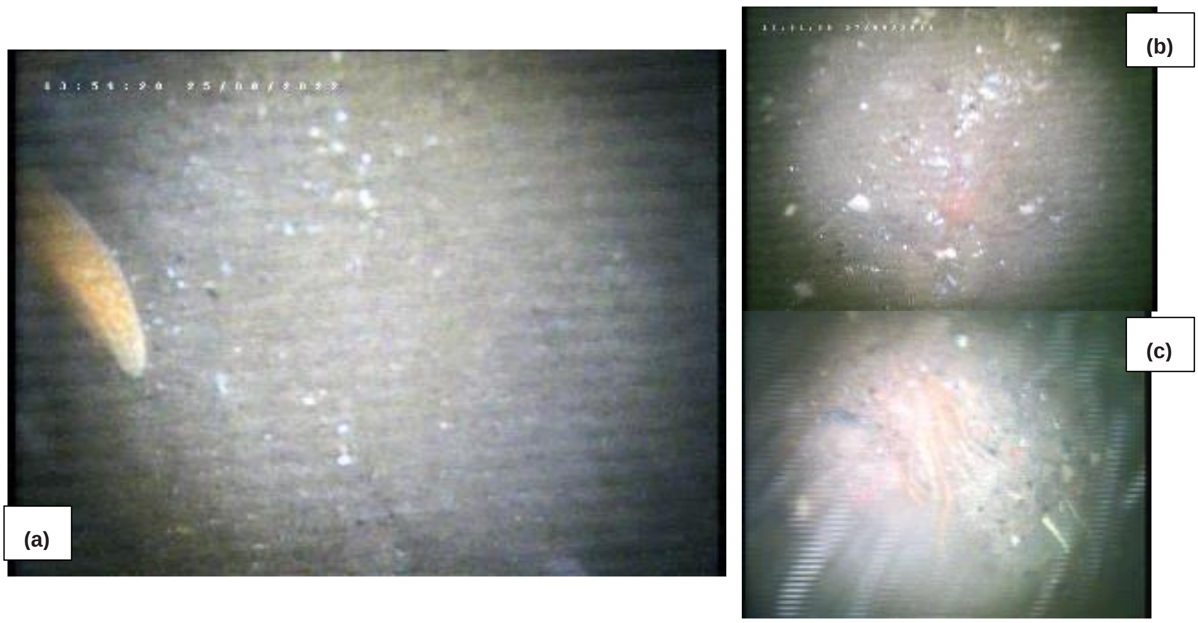

Figure 7.52 Fine sand with shell gravel present at Site 16. The brittlestar, *Ophiura* sp., is present in parts across the site (a – 2022; b – 2018; b – 2016).

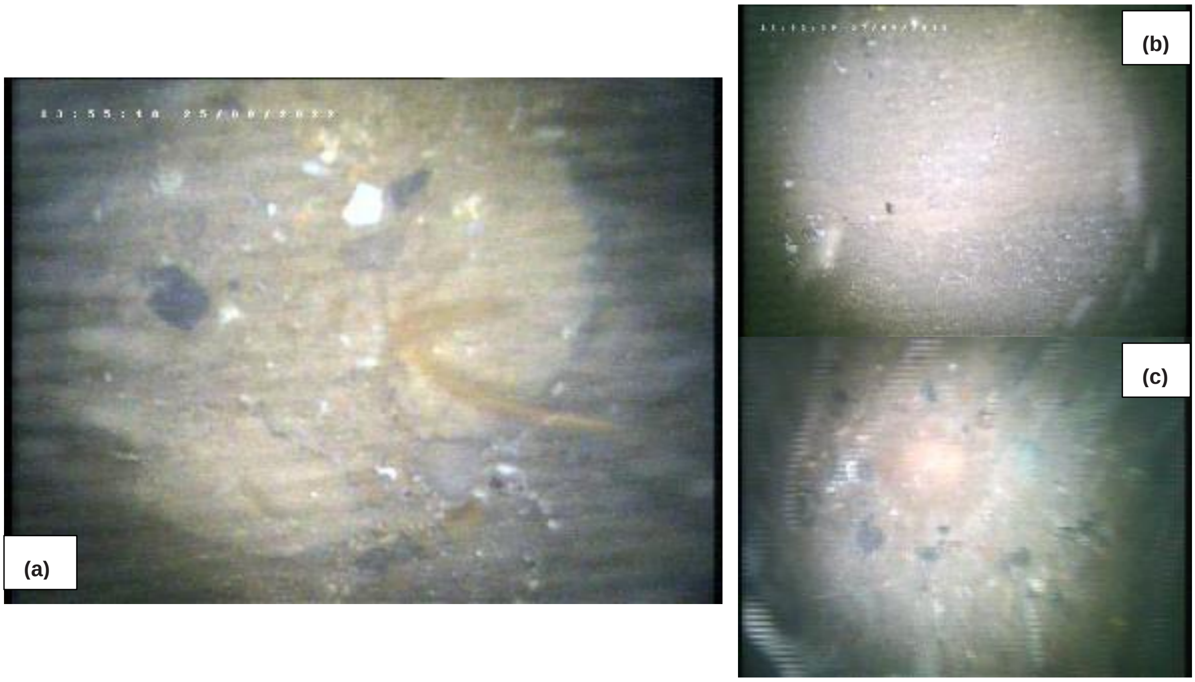

Figure 7.53 Fine rippled sand at Site 16 with coarse bed material and burrowing anemone present (a – 2022; b – 2018; c – 2016).

Drop 18:

This site consisted of fine rippled sand with no fauna visible on the sediment surface. This is consistent with results from 2018 (b) and 2016 (c) (Figure 7.54).

Figure 7.54 Fine rippled sand at site 18 (a – 2022; b – 2018; c – 2016).

Drop 19:

The site consists of fine to medium rippled sand with occasional shell gravel across the site. This is similar to the substrate type identified here in 2018 (b) and 2016 (c) (Figure 7.55).

Figure 7.55 Fine to medium sand at site 19 (a – 2022; b– 2018; c – 2016).

Drop 20: (within the disposal area)

Anoxia identified in 2018 (Frame b, Figure 7.56) was not evident at this site during the present survey. Brittle stars (*O. fragilis* and *Ophiura* sp. were present in large numbers, and the hermit crab, *Pagurus bernhardus* was also noted on site. Overall, results from the present survey are consistent with findings from the 2016 survey (c). (Figure 7.56).

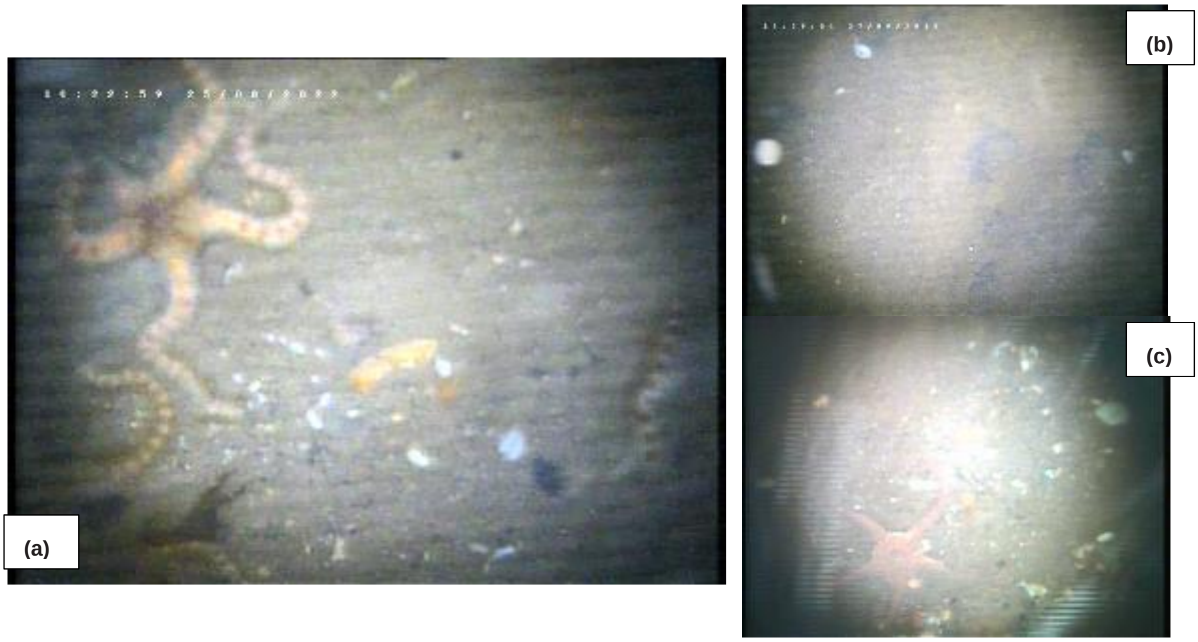

Figure 7.56 *Ophiothrix fragilis* present on fine gravel sand at Site 20 (a – 2022; b – 2018; c – 2016).

Drop 21: (within the disposal area)

During the present survey, the site was identified as dominated by fine, rippled sands with the brittlestar *Ophiura* sp. present across the site. This is a similar habitat to that identified in 2018 (b) and 2016 (c) (Figure 7.57).

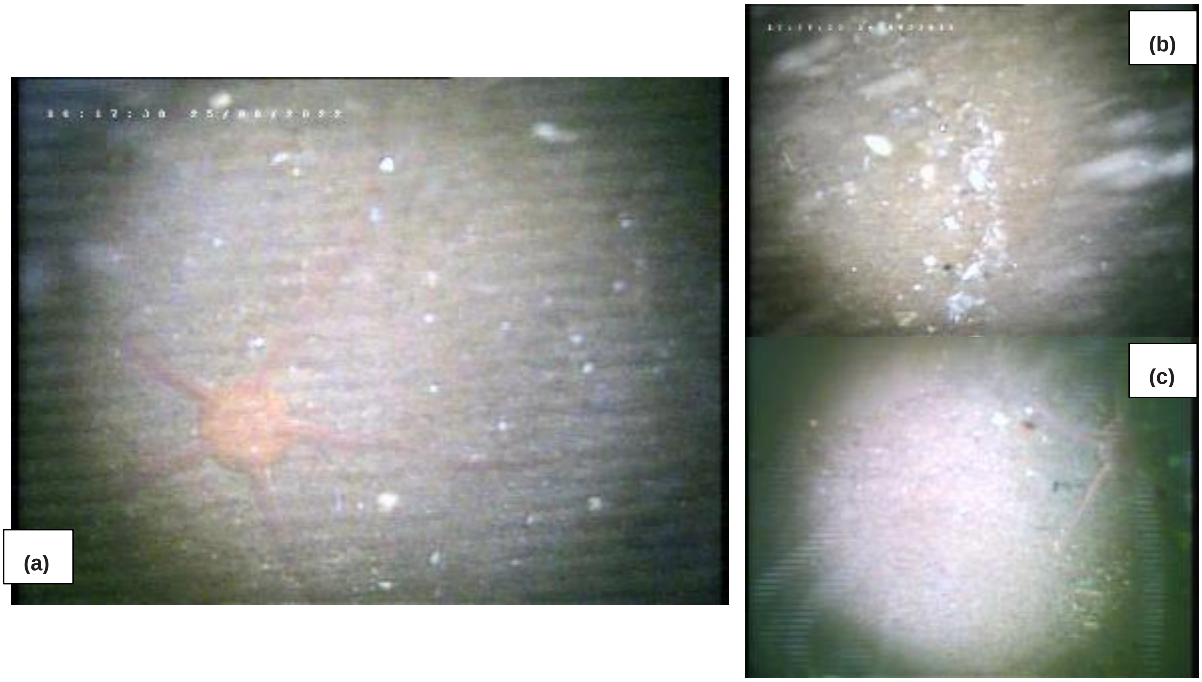

Figure 7.57 Rippled sand with shell gravel and *Ophiura* sp. (a – 2022; b – 2018; c – 2016).

Drop 22:

This site is similar to that identified in 2018 (b) and 2016 (c). The area is dominated by rippled sand with shell fragments present on the sediment surface. *Ophiura* sp. present in parts (Figure 7.58).

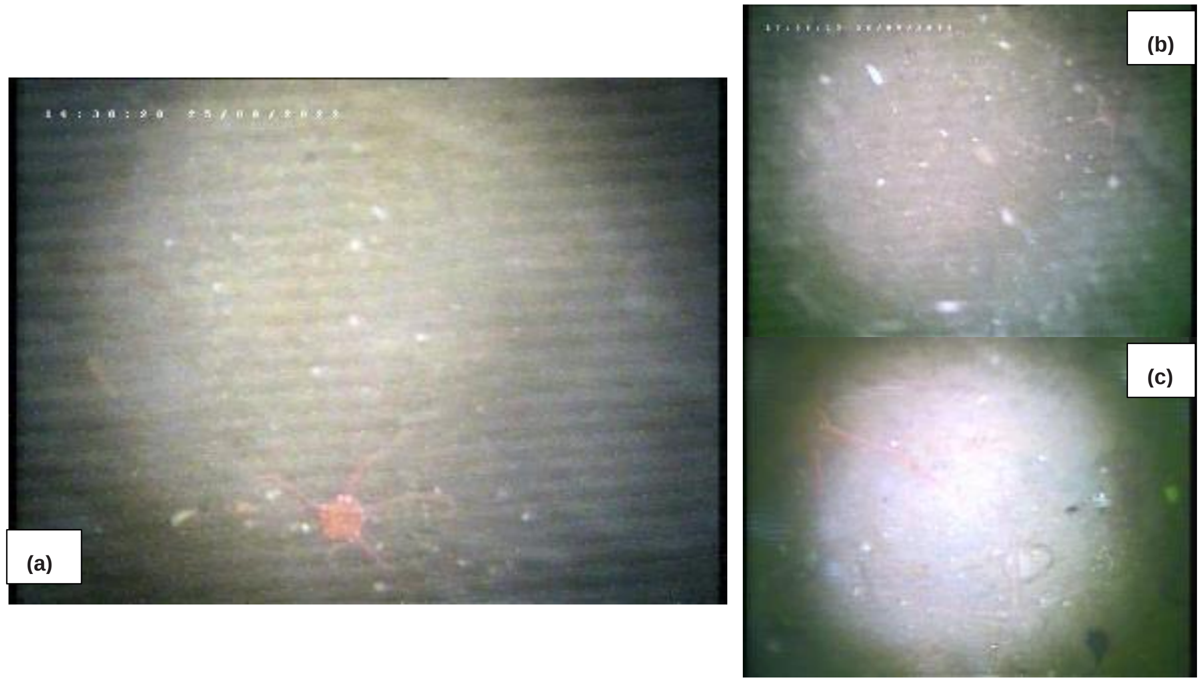

Figure 7.58 *Ophiura* sp. on rippled sand at Site 22 (a – 2022; b – 2018; c – 2016).

Drop 23:

Rippled sand with shell gravel present on the sediment surface. The brittlestar *Ophiura* sp. is present on the sediment surface. Overall, findings from the present survey are consistent with 2018 (b) and 2016 (c) surveys (Figure 7.59).

Figure 7.59 *Ophiura* sp. on rippled sand at Site 23 (a – 2022; b – 2018; c – 2016).

Drop 24:

Rippled muddy sand with occasional shell gravel. The brittlestars *Ophiura* sp. and *Ophiothrix* sp. are present across the site. This is similar to that recorded in 2018 (b) and 2016 (c) (Figure 7.60).

Figure 7.60 *Ophiothrix* sp. on rippled muddy sand (a – 2022; b – 2018; c – 2016).

Drop 25:

This site is dominated by fine rippled sands and occasional shell gravel and remains similar to that identified in 2018 (b) and 2016 (c) (Figure 7.61).

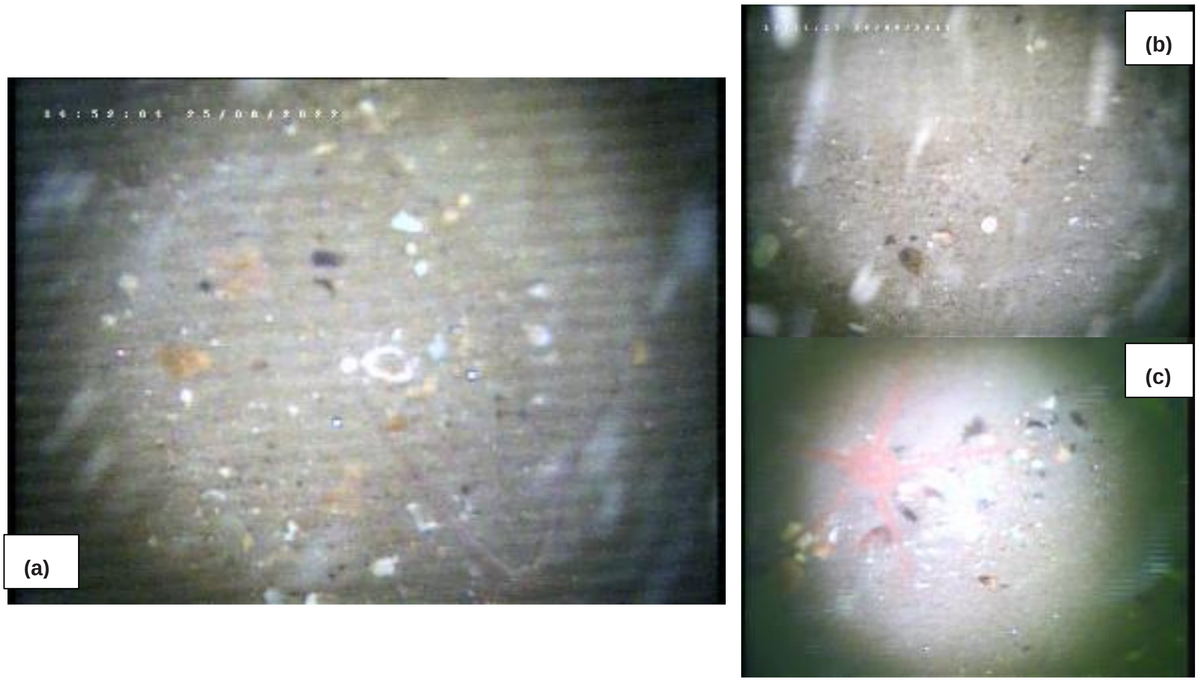

Figure 7.61 Firm rippled sand with shell gravel at Site 25 (a – 2022; b – 2018; c – 2016).

Drop 26:

Rippled sand with shell gravel present on the sediment surface. Occasional *Ophiura* sp. present on the sediment surface. This is the same habitat identified in 2018 (b) and 2016 (c) (Figure 7.62).

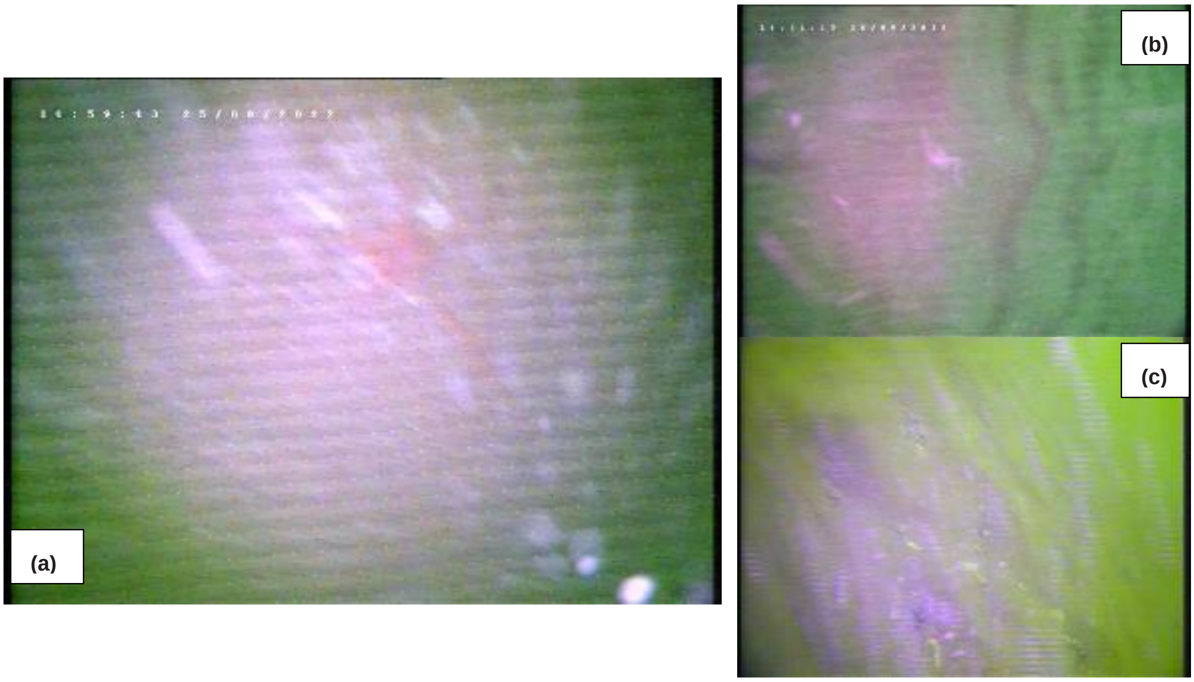

Figure 7.62 Rippled sand at site 26 (a – 2022; b – 2018; c – 2016).

Drop 27:

The site, located approximately 2km southwest of the disposal area, consists of fine sand with a muddy element to it. The brittlestars, *Ophiothrix* sp. and *Ophiura* sp. are common across the survey area (Figure 7.63).

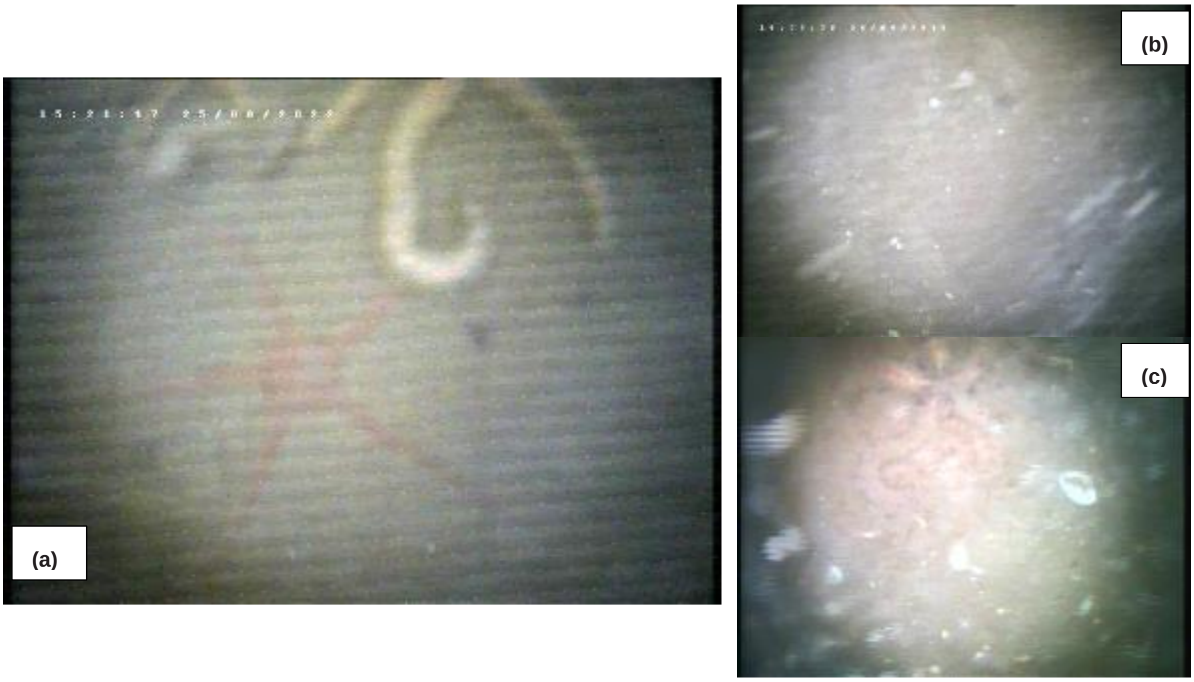

Figure 7.63 Fine rippled sands with *Ophiura sp.*at Site 27 (a – 2022; b – 2018; c – 2016).

Drop 28:

Seabed consists of rippled sands with occasional shell gravel. The brittlestar *Ophiura* sp. was identified on site. This is similar habitat to that identified in 2018 (b) and 2016 (c) (Figure 7.64).

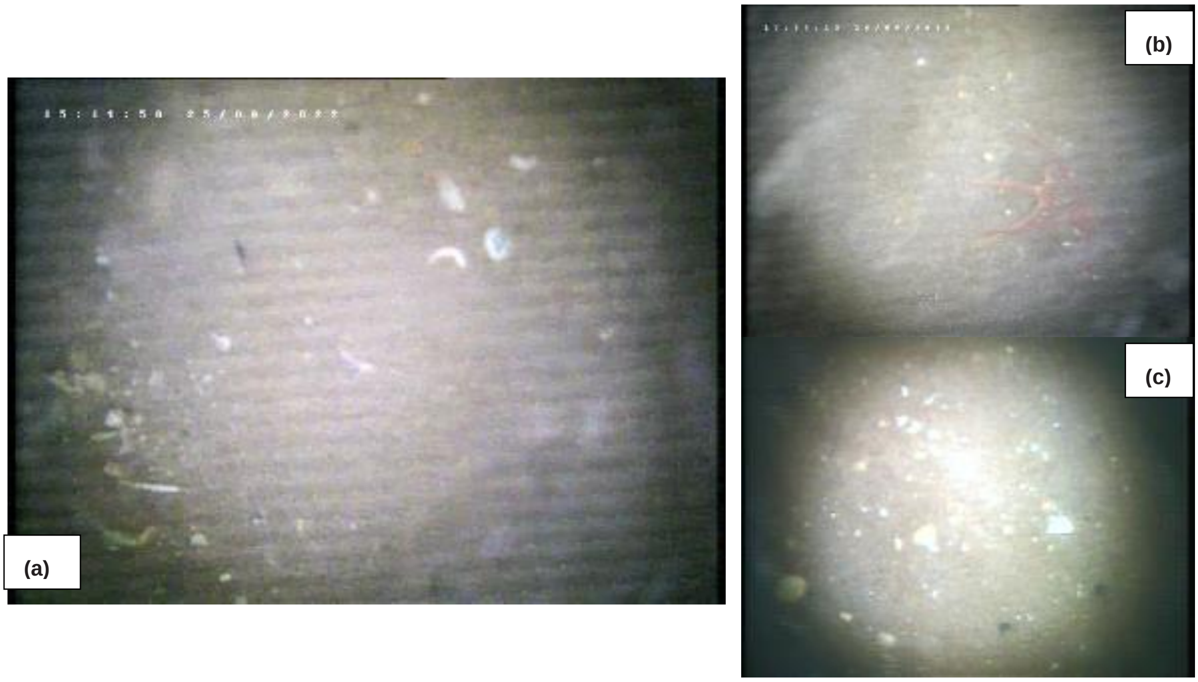

Figure 7.64 Rippled sands with occasional shell gravel. present at site 28 (a – 2022; b – 2018; c – 2016).

Drop 29:

Firm rippled sand with occasional shell gravel was present across the survey area, with *Ophiura* sp. present. This is similar to 2018 (b) & 2016 (c) (Figure 7.65).

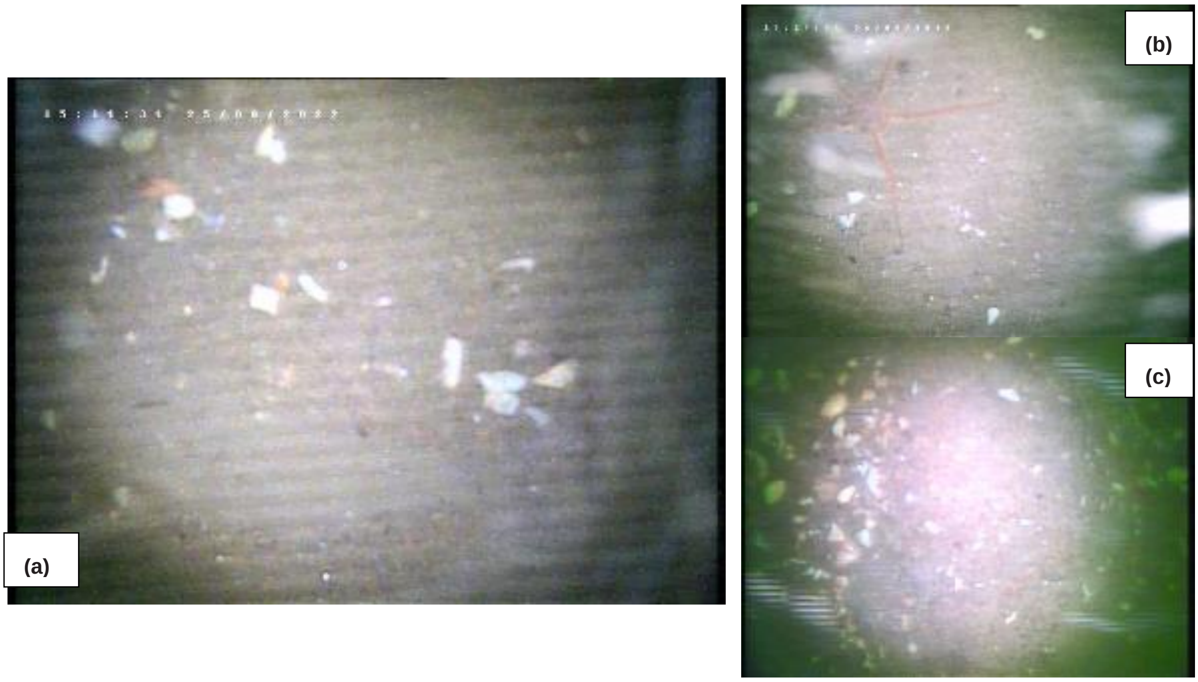

Figure 7.65 Shell gravel on rippled sand (a – 2022; b – 2018; c – 2016).

Drop 30:

This site has been classified as fine rippled sand with occasional shell gravel. This is similar to the habitats identified in 2018 (b) and 2016 (c) (Figure 7.66).

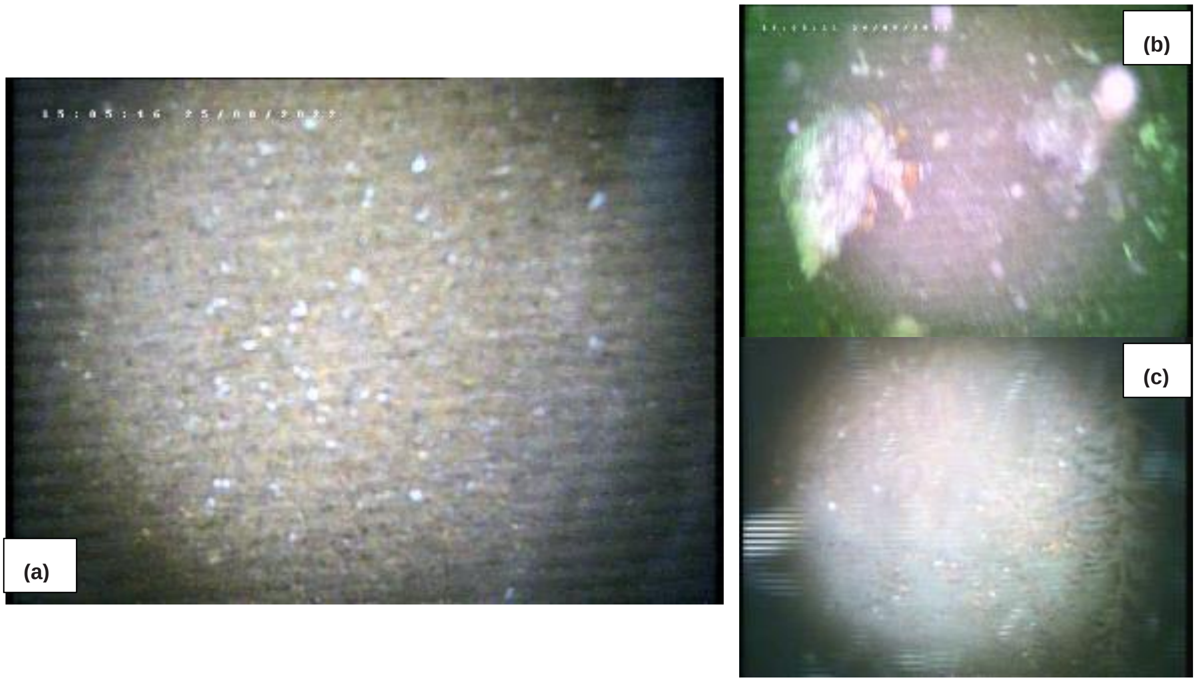

Figure 7.66 Fine to medium rippled sand with occasional shell gravel (a – 2022; b – 2018; c – 2016).

Drop 31:

Fine rippled sands with shell gravel. The brittlestars *Ophiothrix sp.* and *Ophiura* sp. were present on site as well as occasional burrowing anemones. This site is similar to that identified in 2018 (b) and 2016 (c) (Figure 7.67).

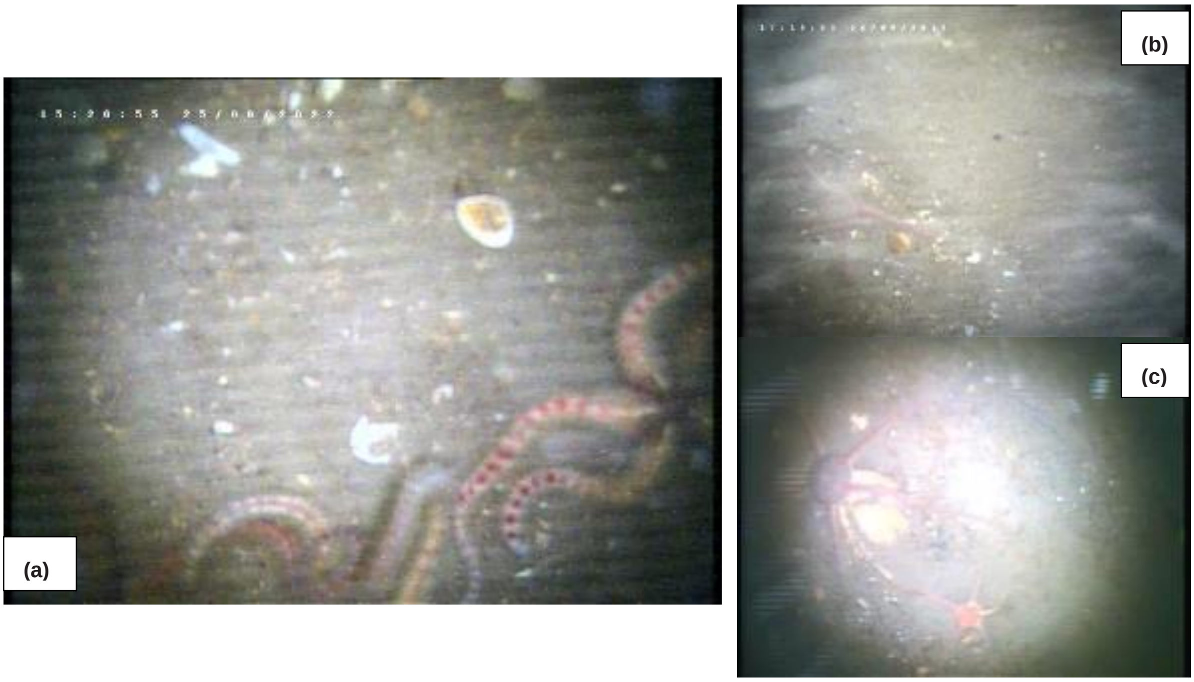

Figure 7.67 *Ophiothrix* sp. on rippled sand at Site 31 (a – 2022; b – 2018; c – 2016).

Fisheries

Overview

Due to a fault with the winch on the survey vessel, it took longer than anticipated for the trawl to reach the bottom and for this reason it is not possible to give an accurate length of tows, which overall are believed to have ranged from about 500m to about 1km. Moreover, while each trawl followed the line of the 2018 trawls (A-G), a very strong wind on the day combined with tidal drag meant that the trawl lines as illustrated in

Figure 7.9 can only be taken as a guide. Furthermore, due to the inclement conditions at the time Trawl H was not towed. Two trawls, D1 and G had very little in them, particularly trawl G. A repeat trawl (D2) was taken, which had a much heavier catch. Notwithstanding the issues above, the trawls provide a reasonable assessment of the main demersal/benthic fish and epibenthic invertebrates in and around the dump site and allow a meaningful comparison with previous surveys.

Photographs of the contents of each of the seven trawls collected are presented in Appendix 7.3.1c.

Fish

Table 7.18 lists the fish species and numbers taken in each trawl and Table 7.19 lists the invertebrates taken in trawls. Six of the eight attempted trawls had fish, Trawl D was repeated with fish caught in the repeat trawl (D2) only. 14 species of fish were taken in the six trawls and a total of 108 individuals. Of the six trawls which contained fish, four species: plaice (5), dab (5), scald fish (3) and dragonet (5), occurred in three or more, with thornback ray and greater sandeel occurring in two of the six and the remaining species recorded in just one each of the trawls. When the site was trawled in September 2018 (ASU, 2019), there were 16 species of fish recorded and 525 individuals taken across 8 trawls, an average of 8.8 species per trawl compared to an average of four species in each trawl containing fish in 2022. Of the species caught, 9 were common to both surveys including dab, plaice, goby, dragonet, whiting, gurnard, lesser sand eel and thornback ray.

Species taken in the 2018 survey which were not present in the 2022 survey included poor cod, cod, red mullet, herring, scad, cuckoo ray and Nilsson's pipefish. Of these, poor cod and Nilsson's pipefish occurred in half or more of the 2018 trawls. Species present in the 2022 survey but absent from the 2018 survey included spotted ray, pogge, greater sand eel, sole and scald fish, the latter species present in three of the six trawls which contained fish. Some of these differences can be explained by chance e.g., in the case of scad, sole, cuckoo ray and spotted ray, all of which occurred in just a single trawl in both surveys. However, other differences such the virtual absence of gobies and to a lesser extent Nilsson's pipefish and poor cod from the 2022 trawls, when they were frequently encountered in the 2018 survey is not easily explained. Shoaling i.e., clumped distribution, depth preferences, seasonal effects and inter-annual rates of recruitment may also be contributing to the observed differences. Also, September 2018 was a very warm month, which may have influenced the occurrence of some species e.g., red mullet. The disparity in total numbers, 542 in September 2018 compared to 108 in July 2022 may have been connected with either subtle changes in substrate or invertebrate biomass at the site. In this regard, it may be notable that in 2018 there had been 178,000 tonnes of maintenance dredge spoil disposed of at the site five months prior to the trawl survey, which may have provided a boost in benthic productivity which in turn would have attracted in fish, while the site had been fallow for a year at the time of the July 2022 survey. This analysis would be in line with the findings of Pezy *et al.,* (2017), who showed increases in dab, place and sole following disposal at a sandy dumpsite site in France. However, these factors are unlikely to explain all the differences noted.

Table 7.18 Fish taken in trawls listed in decreasing order of total numbers taken.

Fish	A	B	C	D1	D2	E	F	G
Plaice (*Pleuronectes platessa*)	1		1		1	2	1	
Dab (*Limanda limanda*)	1	2	2		24	6		
Sole (*Solea solea*)					2			
Scald fish (*Arnoglossus laterna*)					4	2	2	
Pogge (*Agonus cataphractus*)	3							
Sandeel (*Ammodytes* sp.)							4	
Greater sandeel (*Hyperoplus lanceolatus*)	1						1	
Whiting (*Merlangius merlangus*)		1						
Dragonet (*Callionymus lyra*)		1	7		18	2	4	
Gurnard *Eutrigla gurnardus*)					3			
Goby (*Pomatoschistus* sp.)		1						
Lesser weever fish (*Echiichthys vipera*)							3	
Thornback (*Raja clavata*)			1		4			
Spotted Ray (*Raja montagui*)					3			
Dogfish case	1							
Total Fish Nos	**6**	**5**	**11**	**0**	**59**	**12**	**15**	**0**
Fish Species	**4**	**4**	**4**	**0**	**8**	**4**	**6**	**0**

Invertebrates

A large haul of epibenthic invertebrates were taken in several of the trawls with a minimum of 30 species recorded, some in high numbers or biomass e.g., the soft coral Deadman's fingers (*Alcyonium digitatum*) and the brittle star species (*Ophiothrix fragilis*) – Table 7.19. Compass jellyfish (*Chrysaora hysoscella*), a pelagic species, which were taken in several trawls is not listed in Table 7.19. While there were fewer invertebrate species recorded in 2018, most of the frequently occurring species or groups were common to both surveys including: hermit crabs, Aesop prawns, small spider crabs, common starfish, *Ophiothrix*, *Ophiura*, Deadman's fingers, common whelk, and hydroids and bryozoans. Species that were more common in the 2022 survey but not in the 2018 survey included green sea urchin and sea chervil, while *Crangon* sp. and swimming crabs (*Liocarcinus* sp.) were more frequent in the 2018 survey. In general, however, both in terms of biomass and diversity the epibenthic invertebrate profile of both surveys can be said to be very similar. Table 7.20 compares the frequency of occurrence of the main species in the 2018 and 2022 surveys.

The 2022 survey was carried out after an approximately one year interval since the previous dredge spoil disposal at the site, whereas the 2018 survey was undertaken six months after the previous disposal event.

Invertebrates - Epibenthic Community Present

Ellis *et al.* (2000) described six macro-epibenthic invertebrate and demersal fish assemblages in the Irish Sea, St. George's Channel and Bristol Channel based on data from 101 trawl sites across the survey area. Based on the fish and invertebrates in these groupings, the 2022 trawl survey shares the greatest overlap (66%) with the *Pleuronectes- Limanda* assemblage, which is common at both sides of the Irish Sea around the 20m depth mark on sandy bottoms. Dominant species include plaice, dab and common starfish among others. In addition, the presence of species more typical of coarser substrates, e.g., the green urchin, and the barnacle (*Balanus crenatus*) indicates that at a smaller scale the site contains a mosaic of communities.

The range of dominant species of both fish and invertebrates collected on two separate occasions within the dump site study area indicates that it is characterised by recognised faunal assemblages and as such can be considered, at least at a high level, to be representative of communities that would be expected to occur in areas with similar hydrographic and seabed substrates within the Irish Sea , i.e. at relatively shallow subtidal depths over a mix of sand and locally coarser mixed sediments.

One would expect that variations in the dominance of certain invertebrate and fish species would arise following individual disposal events but that within a relatively short timescale of six to 12 months post deposition that the fish and other epibenthic communities characteristic of such sites under undisturbed conditions would begin to re-establish their typical equilibrium.

Table 7.19 Invertebrates taken in trawls. Data mainly as counts, some as weights (kg) or P to denote the presence of colonial forms or non-counted individuals. The soft coral *Alcyonium* is listed as numbers of colonies or weight.

Species	A	B	C	D1	D2	E	F	G
Green sea urchin (*Psammechinus milliaris*)	17	1	2		3	2		
Common starfish (*Asterias rubens*)	19	2	17	3	24	22	7	1
Sand Star (*Astropecten irregularis*)							1	
Brittle star (*Ophiothrix fragilis*)	1		1.5kg	28	>10kg	13		
Brittle star (*Ophiura* sp.)	6	4	24		P	33	13	1
A small sea cucumber (*Ocnus brunneus*)			10					
Barnacle (*Balanus crenatus*)	P					P	P	
Aesop prawn (*Pandalus montagui*)	23	1						
Porcelain crabs	2							
Hermit crab (*Pagurus bernhardus*)		2	7		16	3	7	
Brown shrimp (*Crangon* sp.		1						
Small spider crabs (*Macropodia* spp.)		3	1	1		1	3	
Small spider crab (*Hyas coarctatus*)			1					
Harbour crab (*Liocarcinus depurator*			1					
Red whelk (*Neptunea antiqua*)					3	2		
Whelk (*Buccinum undatum*)			1		8	1	1	
Painted top shell (*Calliostoma zizyphinumii*)	1							
Lobe shell (*Philine quadripartite*)					1			
Sea slugs (Onchidorididae)		4				P	P	
Little cuttlefish (*Sepiola atlantica*)	2							
Stout bobtail (*Rossio macrostoma*)		3						
Variegated scallop (*Mimachlamys varia*)			1		3			
Horse mussel (*Mytilus galloprovincialis*)					P			
Sea Mouse (*Aphrodita aculeata*)	1				1			
Sea chervil (bryozoa) (*Alcyonidium diaphanum*)	P	P	P	P		P		
Bryozoan (*Anguinella palmata*)		P	P	P		P		P
Hydroid (*Hydrallmania falcata*)		P		P		P	P	P
Deadman’s fingers (*Alcyonium digitatum*)	18kg	0.5kg	3.3kg		2kg	8	2	
Plumose anemone (*Metridium senile*)							11	1
Solitary sea squirt (indet.) Ascidian			2			2		

Table 7.20 Frequency of occurrence of invertebrate species or genera in 2022 trawls compared with 2018 trawls.

Invertebrate	Frequency of Occurrence in Trawls	
	2018	2022
Common starfish (*Asterias rubens*)	88%	100%
Brittle star (*Ophiura* spp.)	75%	100%
Deadman's Fingers *(Alcyonium digitatum)*	100%	86%
Brittle Star (*Ophiothrix fragilis*)	63%	71%
Majidae (small spider crabs)	75%	71%
Green sea urchin (*Psammechinus miliaris*)	11%	71%
Hermit crab (*Pagurus bernhardus*)	63%	71%
Common whelk (*Buccinum und*atum)	63%	57%
Plumose anemone (*Metridium senile*)	75%	28%
Aesops prawn *(Pandulus montagui)*	75%	28%
Swimming crabs (*Liocarcinus* spp)	14%	100%

7.3.2.3 Habitat Assessment

Results of the Infaunal grab survey and video assessment were analysed to identify habitat distributions within the survey area. Where possible, habitats were assigned based on the JNCC System (JNCC, 2022) and associated EUNIS System (EUNIS, 2022). These were identified based on fauna, grain size and depth and the distribution of these habitats is presented in Figure 7.68 and Figure 7.69.

Dublin Harbour area

Two coarse benthos areas were identified in the present survey; within the vessel turning area near berth 50 which was dominated by bare gravels and cobbles (B_10), and an area of increased water flow immediately downstream of the Tom Clarke Bridge (B_02) where coarse substrate also dominated. Site B_02 consists of crinoids and other fauna typical of coarse benthos estuarine habitats and has been classified as '*Faunal communities on variable salinity Atlantic infralittoral mixed sediment*' [EUNIS: MB424] / '*Sublittoral mixed sediment in variable salinity (estuaries)*' [JNCC: SS.SMxSMxVS]. The site within the turning circle at B_10 has been classified as '*Sublittoral coarse sediment*' [EUNIS: MB3 / JNCC: SS.SCS].

Results from the subtidal soft sediment areas identified the presence of two discrete faunal assemblages. Three sites located along the shallow water sections of the inner port area contain fauna typical of habitat '*Oligochaetes in variable or reduced salinity Atlantic infralittoral sediment* [EUNIS: MB6256] / *Oligochaetes in variable or reduced salinity infralittoral muddy sediment*' [JNCC: SS.SMu.SMuVS.OlVS]. The remaining subtidal soft sediment sites have been classified as 'Capitella capitata *in enriched Atlantic infralittoral muddy sediments*' [EUNIS: MB6246] / 'Capitella capitata *in enriched sublittoral sediments*' [JNCC: SS.SMu.ISaMu.Cap].

Results from the intertidal walkover survey identified the presence of several discrete biotopes across the narrow bands of soft sediment which are exposed at extreme low water. These include the presence of 'Lanice conchilega *in Atlantic littoral sand*' EUNIS:MA5255] / 'Lanice conchilega *in littoral sand*' [JNCC: LS.LSa.MuSa.Lan] in areas of muddy sands near the Poolbeg Generating station. Other areas in the vicinity of the effluent outfall adjacent to the Poolbeg Generating station are characterised by large numbers of the opportunistic polychaete *Capitella capitata*, indicating that the area is subjected to increased nutrient input resulting in large numbers of Capitellids in the sediment in this area and is considered an extension of the subtidal habitat 'Capitella capitata *in enriched Atlantic infralittoral muddy sediments*' [EUNIS: MB6246] / 'Capitella capitata *in enriched sublittoral sediments*' [JNCC: SS.SMu.ISaMu.Cap].

The intertidal area between the Poolbeg Marina and the Tom Clarke Bridge consists of muds and sandy muds, and has been classified as *Faunal communities of variable salinity Atlantic littoral mud* [EUNIS: MA622] / *Polychaete/Oligochaete-dominated mid estuarine mud shores* [JNCC: LS.LMu.MEst]. This habitat is typical of sandy mud and muddy shores in areas with a significant freshwater influence.

Although there is a large degree of overlap in the fauna present between the two main subtidal faunal groups identified in the port area, differences were noted in the relative abundances of the dominant species present in each group. The SS.SMu.ISaMu.Cap faunal group has a higher Simpson's Dominance values (0.634 ± 0.27 to 0.302 ± 0.1) and lower Shannon diversity values (0.837 ± 0.68 to 1.43 ± 0.03) than the SS.SMu.SMuVS.OlVS faunal group. The reason for this is because the primary biotope identified along the port area (SS.SMu.ISaMu.Cap) contains high numbers of opportunistic species, resulting in these high dominance and low abundance figures. Overall, the fauna and habitats identified in the Dublin Harbour area are typical of estuarine systems and common in Irish coastal waters. In addition, they are similar in nature to habitats previously identified from the greater Dublin Port in previous surveys from the same area.

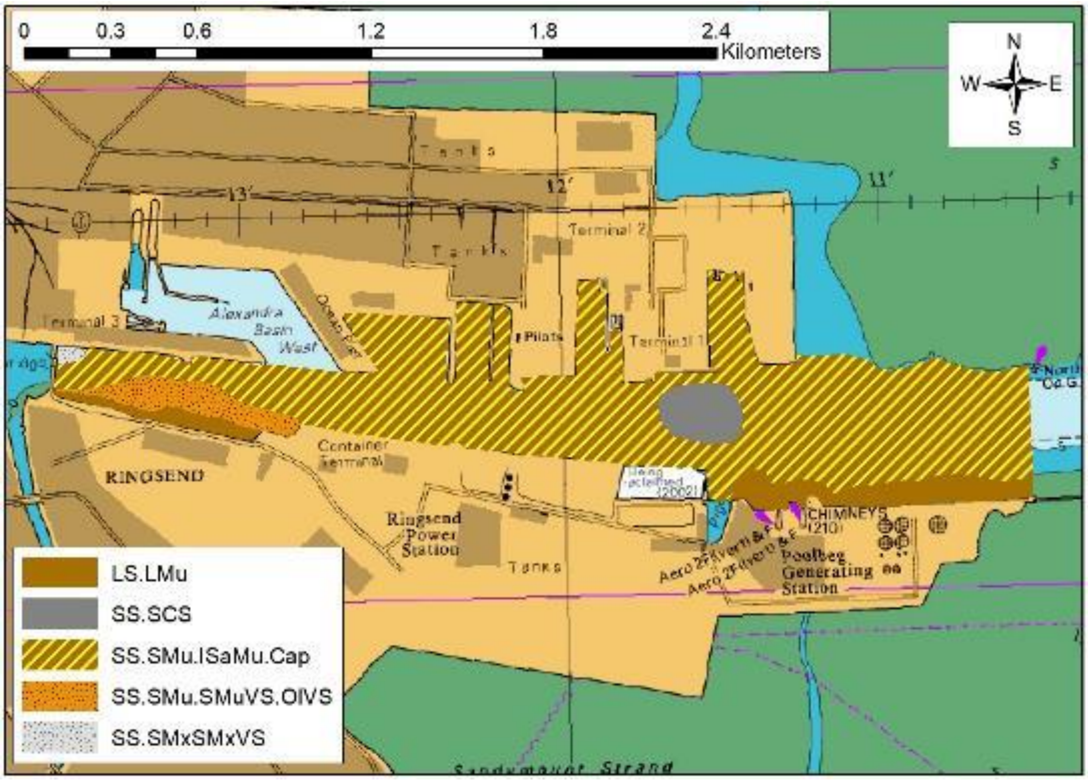

Figure 7.68 Habitat distribution map of benthic communities identified in the present survey from the Dublin Harbour survey area.

Burford Bank Disposal Area

Video data collected from the present survey is similar to previous surveys undertaken in 2016 and 2018 at the disposal site indicating little visual change on the seabed within, and adjacent to, the disposal site at the Burford Bank. In 2018, changes compared to the 2016 baseline were identified at two video drops within the disposal area – Drop 16 and Drop 20. Results from Drop 16 indicate a heterogenous area containing both fine rippled sands and mixed sands and gravels present, outlining local patchiness of these habitats in this area. At Drop 20, evidence of anoxia was present in the video data obtained in 2018, which was not present in 2016 and was also absent during the present survey. The reasons for these changes are unknown, indicating either a recovery from disposal at the site (at Drop 20), or local patchiness and sediment heterogeneity at these locations (Drop 16).

As with previous surveys, the dominant sediment type across the disposal area is fine rippled sand, with occasional to frequent elements of gravel and shell gravel within the sediment matrix. Finer sediments were again identified to the west and south-west of the disposal area. Results from the particle size analysis reflect this, with the site dominated by sands with the noted exceptions being S_04 located to the west of the disposal site, which contains a large amount of coarse material (49% Gravel) and S_09, which is located within the disposal site and has higher than previously reported muddy sediment (64.9% Muds).

Analysis of the subtidal benthic faunal data indicates the presence of three discrete faunal groups across the survey area (Figure 7.69). Group 1 is located entirely within the disposal area and consists of three sites located in the northern and central part of the disposal area. The fauna is typical of mixed sediment communities with a mixture of coarse and fine sediments. This group consists of the highest mean number of species (27.2 ± 9.3) and contained the site with the highest number of individuals (S_11B with 737 individuals returned in the grab, primarily the mussel *Mytilus edulis*). It is difficult to assign this grouping to a EUNIS or JNCC habitat and it is considered that this community is a transitional community following the disposal of dredge spoil within the disposal area.

Group 2 is a low diversity group, dominated by low numbers of the polychaete *Nephtys* sp. across the site. Overall diversity is lowest within this group (Shannon Diversity of 1.17 ± 0.4 compared to 2.34 ± 0.4 for Grp 1 and 2.31 ± 0.3 for Grp 3). The fauna present at all sites in this group are typical of sandy communities and is located along the northern and eastern parts of the survey area and mirrors findings from previous surveys at the disposal site in 2016 and 2018. This site has been tentatively assigned the EUNIS classification of MB523 – Faunal communities of full salinity Atlantic Infralittoral sand (JNCC: SS.SSa.IFiSa – Infralittoral fine sand) and contains characteristics of the MB5233 – *Nephtys cirrosa* and *Bathyporeia* spp in Atlantic infralittoral sand biotope (JNCC: SS.SSa.IFiSa.NcirBat - *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand). This biotope is characteristic of sublittoral communities which occur <30m below chart datum and are subjected physical disturbance as a result of wave action and occasionally strong tidal streams.

Group 3 contains fauna typical of the biotope *Amphiura filiformis*, *Kurtiella bidentata* and *Abra nitida* in circalittoral sandy mud (EUNIS MC6211 / JNCC: SS.SMu.CSaMu.AfilMysAnit) and is similar in nature to the findings of the 2018 and 2016 surveys for the muddier sites along the western extent of the survey area.

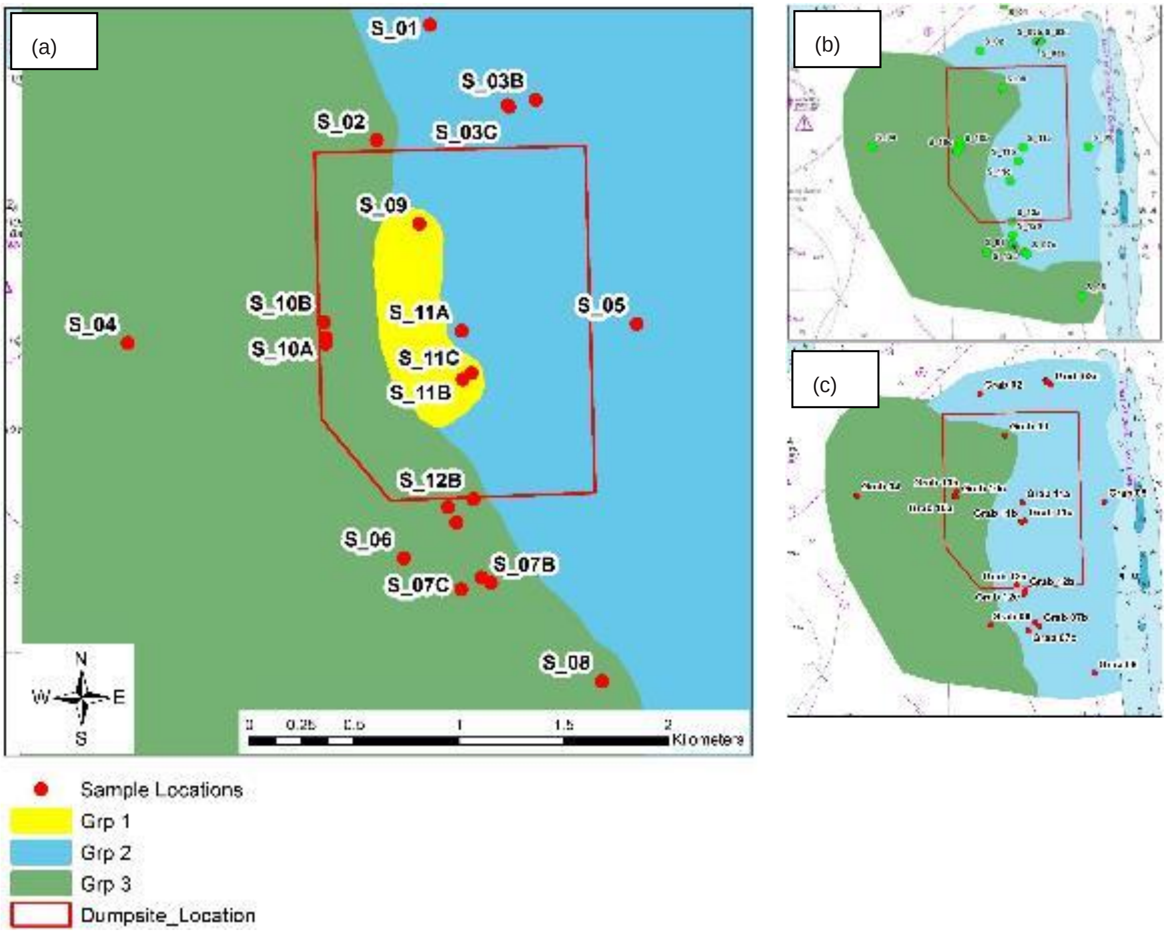

Figure 7.69 Spatial distribution of fauna groups identified in 2022 (a), with faunal distribution groups colour coded for similar groups identified in 2018 (b) and 2016 (c) for comparison.

7.3.3 Impact Assessment

7.3.3.1 Sub-Tidal Benthos

Dublin Harbour Area

Results from the Dublin Harbour area are similar to results obtained from surveys undertaken for the ABR Project (RPS, 2014) and the subsequent MP2 Project (RPS, 2020). The fauna is dominated by highly opportunistic species, typical of estuarine systems with increased nutrient loading. In addition, the area within Dublin Harbour is subjected to regular episodic disturbance events, associated with maintenance dredging, sediment disturbance from shipping activities and increased river flows during flood events. The faunal communities identified in the present are very similar to previous surveys, indicating a resilience to the disturbances outlined.

Relevant Characteristics of the proposal

There are a number of characteristics of the proposed development which will have impacts on the benthos and fisheries within Dublin Port. These include the placement of large numbers of piles in sections from the Tom

Clarke Bridge to the proposed Lo-Lo Container Terminal development at Area N and large pockets of subtidal benthos to be dredged as part of the development. The 3FM Project includes three main dredging components and one minor one, see Table 7.21 Proposed Dredge Areas in the 3FM Project and the volumes extracted from each along with timing of disposal.

Dredge Area	Volume Extracted (m3)	Dredge Area (ha)	Dredging & Disposal Campaign
Turning Circle	444,000	9.4	Year 2 – Year 4, Q4 and Q1
Area N – Proposed Lo-Lo Terminal	605,000	10.2	Year 4 – Year 6, Q4 and Q1
Maritime Village	197,000	6.0	Year 10 – Year 12, Q4 and Q1
Area K – Proposed Ro-Ro Terminal	13,000	0.4	Year 12 Q4 – Year 13 Q1
Total Dredge Volume/Area	**1,259,000m3**	**26.0ha**	
Volume not suitable for disposal at sea (top 1.0m at Maritime Village)	(70,000)		
Volume suitable for disposl at sea	**1,189,000m3**		

which presents the areas (ha) to be dredged and the volumes (m^3) to be extracted and disposed of, along with the proposed disposal periods in each case.

Table 7.21 Proposed Dredge Areas in the 3FM Project and the volumes extracted from each along with timing of disposal.

Dredge Area	Volume Extracted (m^3)	Dredge Area (ha)	Dredging & Disposal Campaign
Turning Circle	444,000	9.4	Year 2 – Year 4, Q4 and Q1
Area N – Proposed Lo-Lo Terminal	605,000	10.2	Year 4 – Year 6, Q4 and Q1
Maritime Village	197,000	6.0	Year 10 – Year 12, Q4 and Q1
Area K – Proposed Ro-Ro Terminal	13,000	0.4	Year 12 Q4 – Year 13 Q1
Total Dredge Volume/Area	**1,259,000m^3**	**26.0ha**	

Volume not suitable for disposal at sea (top 1.0m at Maritime Village)	(70,000)		
Volume suitable for disposl at sea	**1,189,000m^3**		

SPAR Bridge (Downstream of Tom Clarke Bridge)

The proposed SPAR bridge is outlined in more detail in Chapter 5. The bridge will be similar in design to the Tom Clarke Bridge with the piers aligned to the Tom Clarke Bridge. The bridge will be placed on 5 stanchions, with a further six concrete dolphins placed adjacent to the bridge. The footprint of these stanchions and dolphins will directly impact the benthos.

SPAR Road

The SPAR road is designed as a bridge structure with 13 sets of five piles and four sets of ten piles. This will result in the placement of 105 piles into the soft sediment adjacent to the existing road. These piles will directly impact the soft sediment benthos due to habitat loss within their direct footprint.

Turning Circle

The creation of a new 325m diameter turning circle will require the dredging of the riverbed to a depth of -10.0m C.D. This will result in the dredging of 440,000m^3 (including an allowance for dredging tolerance) of mixed sediments and the demolition of the existing Sludge Jetty.

Maritime Village

This will require the reconfiguration of the Poolbeg Marina with new Finger Berths and a bunkering facility. The proposed development will result in the creation of 258 finger and mooring boom berths. This will require the placement of 100 number steel tubular marina restraints, 0.7m in diameter. In addition, it will require the dredging of sediment from the area of the new marina to a depth of -3.0m C.D. This will result in the dredging of 197,000m^3 (including an allowance for dredging tolerance) of muds and sandy muds. The top 1.0m of sediments (70,000m^3) contains widespread Class 2 material and is not suitable for disposal at sea. In addition, the placement of 3,879m^2 of rock armour scour protection below the MLWS mark running parallel to the SPAR Road will result in the replacement of this area of soft sediment habitat with hard benthos.

New Ro-Ro terminal (Area K)

Local dredging will be required to allow for local deepening to place scour protection at the base of the replacement quay at Berth 45. This will result in the dredging of circa 13,000 m^3 of muds and sandy muds.

New Lo-Lo terminal (Area N)

The proposed development at Area N will require the existing Poolbeg Oil Jetty to be demolished and the creation of a new wharf as a fully open piled structure which will require the placement of circa 2,500 circa 1.3m diameter steel pile structures over approximately 9.1ha of soft sediment benthic habitat. This will result in the loss of circa 3,300m^2 of habitat in the footprint of the proposed piles. The area under the proposed wharf to the east of Poolbeg Oil Jetty will also be dredged to -3.0m CD to enable the wharf to be constructed using marine plant. In addition, a berthing pocket for container vessels is proposed adjacent to the wharf, with the area dredged to a depth of -13.0m C.D. Overall, this will result in the dredging of 605,000m^3 (including an allowance for dredging tolerance) of muds and sandy muds.

Impact Assessment

SPAR Bridge (Downstream of Tom Clark Bridge)

The proposed 3FM Project will see the construction of a SPAR bridge, immediately seaward of the Tom Clarke Bridge. Its opening will be similar to that of the Tom Clarke Bridge and its piers will be aligned with it. This will result in the direct removal of the soft sediment benthic habitat from the immediate footprint of the new bridge supports and dolphins. Results from the present survey indicate that the communities present in this area are typical of enriched, muddy sediments, with a low diversity community dominated by large densities of opportunistic species such as *Capitella capitata*. The removal of these habitats, although locally severe and permanent, would be considered slight negative but not significant in view of the extensive nature of similar habitat within Dublin Harbour. A small area between the current bridge piers contains coarser material due to flow-associated scouring from the River Liffey. It should be noted that the creation of the additional bridge stanchions and pillars required is expected to cause an increase in sediment flow and could likely result in scouring of the seabed in these areas (See Chapter 13 of this EIAR). It is expected that the coarse habitats identified in the present survey adjacent to the existing bridge would establish themselves over time in these areas of increased water flow. In addition, placement of the stanchions and dolphins will create additional hard benthos habitats in the area which will gradually become coated in an epibiotic layer of encrusting fauna and algae, thereby increasing biodiversity in the area. These changes are assessed as slight positive and permanent.

SPAR Road

The construction of a new road between the SPAR Bridge and Poolbeg Marina will result in the permanent loss of soft sediment intertidal habitat only in areas where piles will be placed to allow for the construction of the road as a bridge structure. Although this is considered locally severe due to the permanent loss of the habitat within this small footprint, the impact is considered slight negative and not significant in view of the large amount of similar benthic habitat present in the area.

Turning Circle

The creation of a new 325m diameter turning circle will require the seabed to be dredged to a depth of -10m CD within the footprint of the circle. It will also require the removal of the existing sludge jetty. The area to be dredged consists of muds and sandy muds with pockets of bare gravel in areas where shipping activity causes scouring of the seabed. The faunal communities present in the muddy and sandy mud areas consist of highly opportunistic fauna, well adapted to episodic disturbance events. It is considered that the impact of the creation of the 325m diameter turning circle will be locally negative, but slight and temporary to short-term with recovery expected to occur within 12 to 24 months following cessation of dredging activities. In addition, the demolition of the existing sludge jetty will allow for the creation of a small amount of new soft-sediment benthic habitat in the footprint of the existing jetty, resulting in a slight positive and permanent impact.

Maritime Village

The proposed development allows for the removal of the existing Poolbeg Marina and replacing it with a new, larger marina stretching upstream, along the southern shore from the current location toward the Tom Clarke bridge. The construction of the Finger Berths will require the placement of piles along each of the berths, resulting in the permanent loss of the soft benthic habitat within the immediate footprint of the piles. The removal of this small footprint is locally severe and permanent. However, the impact is considered negative and slight as the loss of this habitat is considered negligible considering the extensive nature of similar habitat within Dublin Harbour.

In addition, the marina will require the dredging of the area to a depth of -3.0m CD, resulting in the removal of circa 197,000m^3 of muddy sediment from the area. This will result in the temporary disturbance of habitat from within this footprint. The faunal communities present in the area are typical of enriched muddy sediments, dominated by opportunistic species which would be expected to recover quickly. Therefore, this impact is considered slightly negative, locally severe but temporary, with recovery expected within 12 months following cessation of dredging activities.

It is proposed to reinforce the edges of the dredge basin with rock armour protection across an area of 3,879m^2 immediately below the MLWS mark. This will result in the permanent loss of the soft sediment community directly within the footprint of the rock armour protection. The loss of this habitat is considered permanent and locally severe. However, the effect is only considered slight negative, as the community that will be impacted consists of highly opportunistic fauna typical of upper and mid-estuarine mud communities and this habitat type is common throughout Dublin Harbour. It is also thought that the introduction of the hard-benthos habitat in this area will result in the creation of new habitat in the immediate footprint of the rock armour and add to the biodiversity in the area. Therefore, the impact associated with the placement of the rock armour protection is considered slightly positive and permanent.

New Ro-Ro terminal (Area K)

The proposed construction of the new Ro-Ro terminal will require the dredging of circa 13,000m^3 of soft sediment from the base of the terminal to place 3,658m^2 scour protection on-site. The impact of the dredging is considered slightly negative and temporary to short term with recovery expected to occur within 12 – 24 months following cessation of dredging activities at the site. The footprint of the scour protection will result in the permanent loss of the soft sediment benthos within its immediate footprint. However, this will create new, sub-tidal hard benthic habitat in the area, resulting in a potential increase in biodiversity. Considering the extensive nature of the soft-sediment communities present at the site, the creation of the hard benthos habitat is considered to be a slightly positive and permanent impact.

New Lo-Lo terminal adjacent (Area N)

The proposed construction of an Exports Lo-Lo Container Terminal requires the placement of 2,500 individual circa 1.3m diameter piles across an area of circa 9.1ha, with the removal of the existing ESB Jetty at the site also proposed. The area under the proposed wharf to the east of Poolbeg Oil Jetty will also be dredged to -3.0m CD to enable the wharf to be constructed using marine plant. The use of an open pile system at the site means the removal of 3,325m^2 of subtidal benthos from within the footprint of the proposed development resulting in the loss of only 3.7% of soft sediment subtidal from within the footprint of the wharf Results from the present survey indicate that the communities present in this area are typical of enriched, muddy sediments, with the area dominated by high densities of highly opportunistic species such as *Capitella capitata* and overall low species diversity. The loss of this relatively small area, just 3.7% of the total area of the wharf is considered permanent and slight negative, given the extensive nature of similar habitat within the wider Dublin Harbour area.

In addition, the proposed development will require the dredging of a berthing pocket adjacent to the wharf to a depth of -10.0m CD, resulting in the overall removal of circa 605,000m^3 of soft sediment. Results from the present benthic survey indicate that the communities present in this area are typical of enriched, muddy sediments, with the area dominated by high densities of highly opportunistic species such as *Capitella capitata* and overall, with a very low species diversity. The disturbance of this habitat is considered slight negative but temporary to short-term, with recovery expected within 12 to 24 months.

Burford Bank Disposal Area

Overview

The Burford Bank disposal site is 2.27km in area and located approximately 7km east of Poolbeg, in -12m to -24m C.D. of water immediately west of the Burford Bank (Figure 7.70). The site has been used since 1996 by Dublin Port to dispose of dredge soil from routine maintenance dredging and occasional capital dredging works e.g., for the ABR Project and MP2 Project. It is intended that the spoil generated by the 3FM Project which is suitable for disposal at sea (94%), will also be disposed of at the Burford site. Table 7.22 lists the total annual quantities disposed of at the site since 1996.

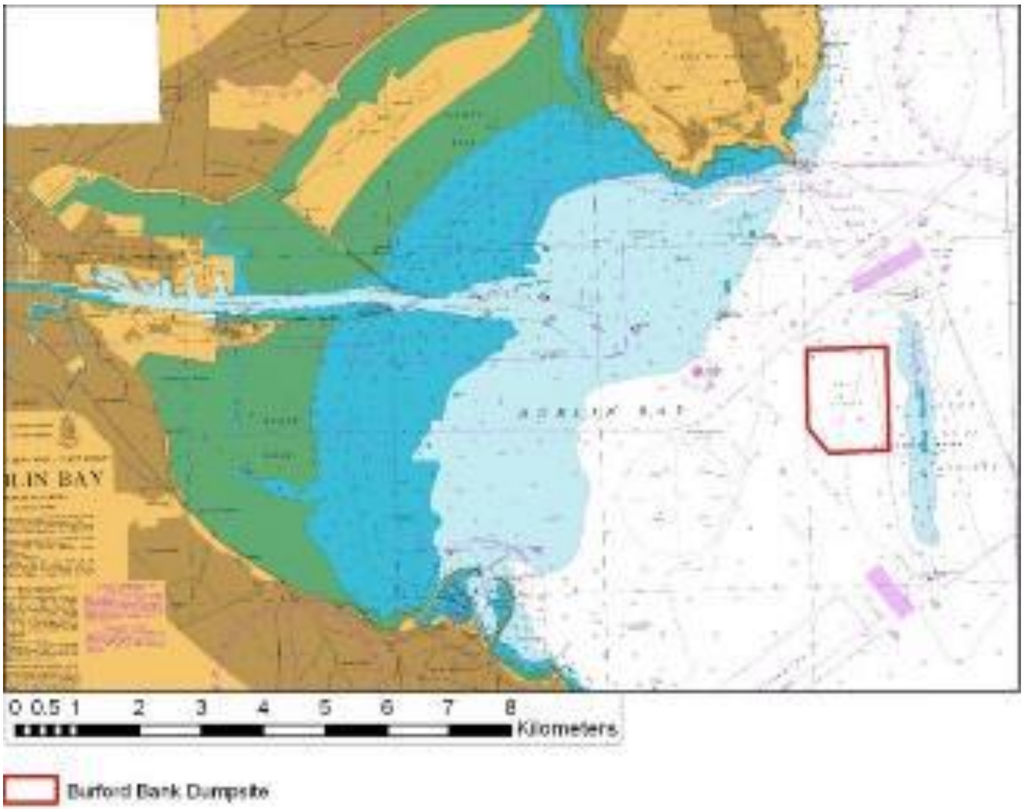

Figure 7.70 Burford Bank dumpsite location.

Geological surveys undertaken at the disposal site (INFOMAR, 2010) identify the site as being dominated by fine to medium sands, with pockets of coarser material also present in the area.

Previous biological surveys around the disposal site have recorded similar communities to those identified in the present survey. In 2007, a survey undertaken to assess the levels of recovery at the site from previous spoil disposal events (Kennedy, 2008) observed that all stations located within and immediately adjacent to the dumpsite were characterised by the presence of the polychaetes *Nephtys hombergii* and *Ophelia borealis* as well as the mollusc *Macoma balthica*. This assemblage conformed to the JNCC habitat SS.SMu.ISaMu.NhomMac (*Nephtys hombergii* and *Macoma balthica* in infralittoral sandy mud). The sampling stations located within 1km and 2 ½ km to the west and southwest respectively of the dumpsite contained fauna typical of the JNCC habitat SS.SMu.CSaMu.AfilMysAnit (*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud). In addition, the Infaunal Quality Index was assessed across all sampling locations and classifications of *'High*' were identified at all sites with reference to Water Framework Directive criteria, thereby concluding that the site had recovered well from previous dredging events. A benthic survey undertaken in 2011 (Dublin City Council, 2012) in the vicinity of the disposal site identified the dominant fauna in the area as the molluscs *Nucula* spp., *Abra* sp. and *Kurtiella* (*Mysella*) *bidentata* and the echinoderm *Amphiura filiformis*.

Table 7.22 Total licensed quantity for disposal at sea for the Burford Bank dumpsite location. *2001 and 2002 have been merged as the disposal activities overlapped across these years.

Year	Total Quantity Licensed (Tonnes)	Year	Total Quantity Licensed (Tonnes)
1996	540,000	2010	0
1997	1,170,000	2011	0
1998	610,000	2012	1,582,805
1999	660,000	2013	0
2000	250,000	2014	0
2001/2002*	3,427,200	2015	0
2003	175,000	2016	749,793
2004	254,450	2017	1,172,500
2005	0	2018	1,804,495
2006	251,128	2019	1,221,723
2007	253,643	2020	2,120,091
2008	251,128	2021	1,008,040
2009	6,400	2022	850,000

In 2016 and 2018, ASU undertook surveys of the disposal site using the same sampling locations and methodology as the current survey. The baseline survey in 2016 was undertaken following a fallow period where no disposal of sediment had taken place on the disposal site since 2012 and prior to the 2016 disposal event of 749,793 tonnes. Results from the 2016 survey identified the presence of two discrete faunal communities within and adjacent to the disposal area. One group, located in the sandier area along the eastern parts of the disposal site and survey area was characterised by the presence of *Nephtys* spp, *Ophelia borealis* and *Abra prismatica*. The other group, located to the east and south of the survey area was dominated by the echinoderm *Amphiura filiformis* and various polychaetes. A repeat survey in September 2018 was undertaken at the same locations, following the disposal of 2,964,153 tonnes of sediment from maintenance and capital dredging works and 5 months after the last disposal at the disposal site. Results from these surveys identified impacts associated with the dredge spoil disposal activities within the disposal area with changes in sediment grainsize and a reduction in biomass and faunal abundances noted at a number of sites within the disposal area 3 months following cessation of disposal at the site in 2018. However, a subsequent survey at the site 5 months after cessation of disposal activities identified partial recovery of biomass, species diversity and faunal abundances across the impacted area (ASU, 2019).

The faunal communities identified in these surveys from outer Dublin Bay are similar to those identified in the surveys of Walker & Rees (1980) from 1971 and 1972 indicating the stable nature of the benthic communities present in Dublin Bay. Results from the present survey are similar in nature to these previous surveys, following the same distribution patterns identified in surveys in 2016 and 2018, with similar species present within these groups.

The ecological impacts associated with dredge spoil disposal are site specific (Ware *et al.*, 2010), with factors such as disposal volume, frequency and timing of disposal, type of sediment to be disposed, hydrodynamic regime of the receiving environment and the habitat type of the receiving environment all playing an important role in the impacts and associated recovery.

The proposed development will require the dredging of approximately 1,259,000m^3 of mixed sediments, primarily sandy muds and gravels, from the dredge areas within Dublin Harbour of which 1,189,000m^3 will be disposed of at sea. The proposal allows for the dredging and disposal of these sediments over a period of 15 years. The dredging and disposal activities will be limited to a six-month period from October to March each year. The indicative dredging phasing plan presented in Table 7.2.2 shows that dredging is likely to take place over 10 winter seasons within the overall 15 year construction programme.

The sediments present along the inner part of the port area consists primarily of sandy muds, with areas of coarse gravels present within the main channel. Results from the hydrodynamic modelling of the disposal area are presented in Chapter 12, Coastal Processes. The behaviour of silt, sand and gravels at the site is markedly different, with sands and gravels expected to remain largely within the footprint of the disposal area and silts expected to disperse to the Irish Sea during normal tidal and hydrodynamic conditions. This is expected to occur more rapidly from storm events as the disposal activities will occur during winter months.

Impact Assessment

The main impact associated with dredge spoil disposal is the potential smothering of benthos associated with the deposition of large volumes of inert sediment on the seabed. As previously noted, the sediments to be dredged consist primarily of muddy sands and muds located along the inner port channel, with occasional areas of gravels from within the shipping channel. The deposition of muds and sandy muds from the port area could result in potential smothering of the native sediment and invertebrates from the existing community below the deposited spoil. Recovery of benthos will be limited to fauna that are able to burrow vertically through the deposited layers, thus potentially leading to a very significant drop in the diversity of species present and their density and biomass. Hydrodynamic factors associated with the disposal site will mean that the finer sediments will disperse away from the disposal site, due to a combination of tidal and wind-driven forces, leaving sands and coarser materials on the seabed. Once this occurs, it is expected that recovery of the benthic community to the native sand community will follow rapidly.

The Burford Bank is an active, dispersive disposal site, which has been extensively used for dredge spoil disposal since 2012, including the disposal of sediments from the ABR Project and MP2 Project. The depths at the disposal site range from -12m C.D. to -24 m C.D. The peak tidal flow recorded at the site is 0.82 m/s (1.59 knots). Surveys undertaken elsewhere in high dispersal sites and sites which are subjected to regular physical stress (such as sediment bed load movement, wave action, strong currents) indicate that the benthic communities present have a higher resilience to stress events such as dredge spoil disposal (Bolam & Rees 2003; Bolam *et al.,* 2011). In addition, it has been noted (Callaway *et* al., 2020) that ecosystems driven by a strong hydrodynamic regime can be relatively resistant to anthropogenic influences, such as dredge spoil disposal. The communities identified at the Dublin Bay disposal site contain species common throughout the bay. Dublin Bay is a shallow coastal environment with biological communities well adapted to frequent natural disturbances due to water and sediment movement. Results from previous surveys, highlights similarities in benthic habitats across the survey years including the present survey undertaken in 2022, indicating the stable nature of the biological communities throughout the embayment, including at the disposal site, and reflect the resilient nature of the benthic habitats present in Dublin Bay.

Recovery at a dredge spoil disposal site follows a typical pattern. After spoil deposition, macroinvertebrate species diversity, abundance and biomass is reduced. If the sediment deposited on the site is similar in nature to the native sediment, and the layer of deposition is thin (<15cm) then vertical migration through the sediment of existing fauna may occur (Wilbur et al., 2007; Fredette & French, 2004, Maurer *et al.,* 1981 (a), Maurer *et al.,* 1981 (b), Maurer *et al.,* 1982). This is complimented by lateral migration of mobile fauna from adjacent areas and through larval settlement from the plankton. On occasion where the dredge spoil contains finer sediments than the native sediment, then recovery occurs in a number of stages. In high dynamic areas, such as those identified at the Burford Bank disposal area, the silt fraction initially settles with the sand fraction. Vertical migration through predominantly mud sediments would be reduced and recolonisation of these sediments would be through lateral migration of mobile species and larval settlement from the plankton. Initial colonisation will be by small, fast growing, opportunistic species, especially small polychaete and oligochaete worms. Due to the dynamic nature of the site, the finer material will winnow away from the site in under a year leaving coarser sandier sediment behind which will gradually revert, through the process of recolonisation, to a community more closely resembling that which pertained prior to disposal, i.e., typical of the dominant substrate and the prevailing hydrodynamic regime.

The area has been subjected to regular deposition of sediment since opening in 1996. Kennedy (2008) recorded high IQI (Infaunal Quality Index) values for the site, indicating Good Status under the Water Framework Directive and reflecting the ability of the site to rapidly recover following dredge spoil disposal. In view of the dispersive nature of the site and findings from previous studies in the area, which recorded communities present being typical for the habitats present, despite regular spoil disposal, it is considered that the impacts associated with the deposition of 1,189,000m^3 of mixed sediment over a 10-year will be short-term and slightly negative in nature and only affect the direct footprint of the disposal site. Recovery is expected to commence rapidly at the site, with substantial recovery expected to occur within 12 – 24 months following cessation of disposal activities at the site and full recovery expected to occur between three – five years.

Modelling results for the disposal of dredged sediment from the 3FM Project indicates there will be no significant movement of sand material from the disposal site (See Chapter 13, Material Assets – Coastal Processes), and finer material will be carried away by tidal currents. No far-field impacts are expected from the disposal of the sediment from the 3FM Project within Dublin Bay. Previous surveys within the embayment highlight a stable benthic system across the wider bay, with no changes evident in the faunal communities across the years. This is reflected in the present survey, with similarities in the faunal composition and distribution of these communities from previous surveys undertaken in the wider Dublin Bay.

7.3.3.2 Inter-Tidal Benthos

Dublin Harbour Area

Habitat Alterations due to New Infrastructure

Over the centuries and decades, the intertidal habitats on both the north and south side of the Lower Liffey Estuary have undergone enormous alterations, designed to prevent the channel completely silting up due to migration of sands from the large shallow embayments to the north and south of the entrance to the lower estuary. In addition, a whole network of quays and berths have been constructed to facilitate the development of Dublin Port as the most important entrepôt on the island. These developments have effectively eliminated all the shallow, sloping intertidal areas which would have been present in the lower estuary prior to these infrastructural developments. What remains is a combination of vertical quay walls and berths comprised of steel piles, concrete or stone, and steep boulder and rock rubble revetments, with very confined pockets of lower intertidal soft sediment. Table 7.23 lists the lengths of the existing shoreline infrastructure within the 3FM Project study area i.e. from the Tom Clarke Bridge seaward to the end of the port hardstand on the north side of the Liffey, measured from Google Earth imagery.

It is clear from Table 7.23 that two thirds of the linear length of the intertidal/shoreline within the 3FM Project study area exists on the north side of the Liffey, which is due to the fact that most of the basins are present there, only one occurring on the southside (Pigeon House Harbour). It is also notable that more rip-rap revetments are present along the southern shore as well as more stone wall (granite block), principally the Great South Wall (GSW), which is regularly interrupted within the study area by other infrastructure, principally related to the power generation and wastewater treatment facilities on the southside. The least represented intertidal habitat within the Lower Liffey estuary is soft sediment intertidal and that which at present is mainly exposed only at low water of spring tides. What the figures in Table 7.23 do not convey is the quality of the habitats concerned, which is addressed in detail in Section 7.3.2.1.

Table 7.23 Total licensed quantity for disposal at sea for the Burford Bank dumpsite location. *2001 and 2002 have been merged as the disposal activities overlapped across these years.

NORTHSIDE	Length (m)	% Tot	% Northside	% Southside
Northside Berths (Steel Piles)	6,247	60.2	90.2	
Northside Rip-Rap Revetments	680	6.6	9.8	
SOUTHSIDE				
Southside Rip-Rap Revetments	1,289	12.4		37.3
Southside Berths (Steel Piles)	1,493	14.4		43.2
Stone Quays/Walls	473	4.6		13.7
Low Tide Soft Sediment	198	1.9		5.7
Total Length (m)	**10,380**			

The key point here is that shorelines comprising vertical steel walls either of sheet piles or a combination of sheet piles and circular piles are an extremely low diversity and poor intertidal habitat, and, based on personal observations, that may be even more so when they are regularly used as berths for large vessels. Accordingly, the vast majority of the intertidal on the north side of the port (~90%) is very poor quality and this is also the situation for a significant proportion of the south side shore (~43%). Slightly better in terms of diversity and naturalness is the granite block GSW which has developed a good cover of green, brown and red algae but is still devoid of or very low in faunal colonisation. The best quality habitat remaining with the study area and the closest to its natural equivalent, rocky intertidal, are the sections of rip-rap revetments which constitute a significantly greater linear extent on the southern shore. Within the Lower Liffey, this habitat is relatively sheltered from direct wave action and is therefore dominated by fucoid (brown) algae and the typical associated intertidal mobile and attached invertebrate fauna. There are variations, however, which relate to (i) the salinity, (ii) the degree of shelter and (iii) the size of the rock elements. The walkover surveys conducted for this assessment showed that the closer to SPAR Bridge the greater the freshwater influence and generally the lower the diversity within the revetment community, this is exemplified by the greater importance of species such as *Fucus ceranoides*. The greater the shelter, the higher the proportion of the brown alga species *Ascophyllum nodosum* in the mid to lower shore. What was also apparent was that in sections of the shore where the rock armour elements were massive, there tended to be fewer microhabitats for invertebrates such as juvenile crabs. The greater the presence of smaller rock rubble the greater the available microhabitats for juvenile crabs and gastropod molluscs, especially when these were present in the lower shore area.

Another feature of the entire shore, which differentiates it from most natural rocky shores, was the absence of rock pools which, if they are present especially if at several levels on the shore and of a varied structural complexity, can add very significantly to intertidal biodiversity. One unusual structure on the shore, a pile supported platform (one of the ESB intakes at Poolbeg) which cast near complete shade on the intertidal boulders beneath it, is jutting out from the GSW beside the power station. The shade arising resulted in a complete alteration in the usual intertidal community situated beneath it, in that all algae were absent, and the rock surface was covered by epilithic communities, comprised of encrusting bryozoa, sponges and barnacles (see Section 7.3.2.1). Finally, there were two other habitats within the study area, not mentioned above and these are (i) the steel piles supporting two open water jetties, specifically the Sludge Jetty and the ESB Oil Jetty, and (ii) the floats beneath the pontoon gangway and finger berths in the Poolbeg Yacht club marina, both elements providing surfaces which have been extensively colonised by algae and invertebrates, forming distinct epibiotic layers (see Section 7.3.2.1).

The following section will deal principally with the impact of the various 3FM Project components on the intertidal habitats and associated benthic floral and faunal communities. However, because it would be difficult to disentangle them, this section will also deal with the potential effects of these alterations on fish in each of the areas concerned, where relevant.

Relevant Characteristics of the Proposal - 3FM Project Infrastructure and associated alterations

The following are the <u>main</u> elements of the proposal which will impact intertidal habitats within the study area

- SPAR Bridge
- SPAR Viaduct
- New Marina
- Refronting of Part of Area K with a new combi-wall

- Removal of part of the intertidal to facilitate the creation of a new turning circle
- Construction of a new open-pile wharf (Area N)
- Demolition of the Sludge Jetty and the Poolbeg Oil Jetty

SPAR Bridge

The construction of the SPAR bridge will have effectively no negative impact on intertidal habitats.

SPAR Viaduct

The SPAR Viaduct will be about 620m in length and it will run parallel to and abut the south bank rip-rap revetment from just east of the Tom Clarke Bridge as far as the Poolbeg Yacht Club. This will result in complete shading of the revetment along about 540m of its length, the only section not being shaded is about 100m where the viaduct separates from the revetment where the latter curves slightly back from the edge, about a third of the way downstream from the SPAR bridge. The shading will result in the complete dieback of the heavy algal cover on the revetment, which will be also result in the absence of any associated invertebrates, in particular Littorinid molluscs. It may also reduce the attractiveness of parts of the mid to lower shore for juvenile green crab (*Carcinus maenas*) and mobile epibenthos such as amphipods which are currently very common under the algal cover during low tide. If juvenile mullet, bass or butter fish and other estuarine fish feed here during flooding and ebbing tides, this resource will probably be diminished as a result of this change.

Clearly, all these same algae and invertebrates are present abundantly on similar revetments, mainly downstream of this point, so while there will be a localised drop in diversity it will not result in the elimination or even significant loss of any particular species, neither will it prevent fish from feeding immediately sub tidally or downstream in similar habitats. Notwithstanding, these positive caveats, this impact can be described in isolation as significant, negative and permanent. However, this impact will be offset to a moderate degree at least by the provision of rock armour scour protection along much of the length of the revetment in order to provide scour protection for the dredged slope on the landward side of the new marina. This will be 3,879m^2 in area and extend out from the base of the existing revetment as far as the top of the new proposed natural dredge slope. This hard substrate area will be colonised by green, brown and red algae, especially toward its landward edge, and provide shelter for a range of mobile invertebrates and fish including green crab, shrimp, eel, migrating lamprey and resident species such as butterfish and gobies.

The impact of these combined changes cannot be fully evaluated without taking account of the new marina which will be installed along this shore also and these will be discussed below.

New Marina

The existing floating docks and berths of the current Poolbeg Yacht Club marina will be removed and replaced with a significantly more extensive marina. Gangways and finger berths of the new facility will be supported on floats, which will gradually become clothed in a cover of epibionts comprising a range of red, green and brown folios and filamentous algae along with attached and encrusting fauna such as mussels, barnacles, tube worms and hydroids like those covering the existing marina's floats (see Section 7.3.2.1). A similar, though not necessarily the same range of biota, will colonise the new piles used to anchor these pontoon structures. The floats under the proposed marina have greater lateral surface areas and may therefore provide a greater surface area for epibiota colonisation, than the floats at the existing marina.

Connell (2001), in a study in Australia, noted differences in the species composition and dominance of various epibiota, algae and attached invertebrates, between pontoon (i.e., floating structures) and piles and natural rock reefs (fixed structures), which they attributed in part to the fact that pontoons are always on the surface and therefore more exposed to light compared to both piles and natural rock which are submerged. Within this dense surface biofilm small mobile crustacea such as amphipods and juvenile crabs are also likely to be present as these were noted associated with the pontoons of the existing marina after an incidental search. These small crustacea will act a food source for fish and possibly shrimp as well. The new marina therefore will introduce an additional hard surface habitat into this section of the Liffey, i.e., between the Tom Clarke Bridge and the Poolbeg Yacht Club.

How these structures influence local fish populations does not appear to have been studied in great detail in the northern hemisphere. However, research elsewhere can provide clues about how they may influence the Liffey Estuary species. Several Australian studies report that marina structures, piles and pontoons, provide both refuge and food for a range of fish species (Waltham *et al.,* 2023) and that the abundance and diversity of fish can in some instances be strongly linked to the amount and types of epibiota on marina piles (Clynick *et al.,* 2007). In a similar study, also in Australia, Moreau *et al.,* (2008) concluded that although two fish associated with marina piles probably did source some of their diet from the epibiota on the piles, it was clear that their presence around the piles was not linked to availability of food because when the epibiota was removed experimentally, the fish still congregated around the piles and the authors speculate than in this instance the fish, while still availing of the food associated with the piles, were probably using them as a way of reducing predation risk from larger fish, e.g. by using the shade or the physical presence of the piles to avoid predation.

In the context of the Liffey, it is possible that juvenile mullet and perhaps juvenile bass might use the marina both for food (plant and animal) and as a means of avoiding predation by both birds and larger fish. It would seem unlikely that bottom dwelling species, such as flounder, butterfish or eel would forage among the pontoons although they might feed at the base of any of the piles associated with the new marina.

The presence of artificial structures in urban waterways, especially those associated with marinas, are considered susceptible to colonisation by invasive and nuisance species several of which are already known from Irish waters including the sea squirt *Styela clava* and more recently the red seaweed *Grateloupia turuturu* (Devils' Tongue Weed), and it has been suggested that a way of avoiding excess competition from invasive species would be to pre-seed surfaces with native species such as blue mussels (*Mytilus edulis*) (Paalvast *et al.,* 2012). However, as blue mussel are already prominent members of the epibiota community on the pontoon floats of the existing marina, it is reasonable to assume that they will also become prominent in time of the new marina's floats.

Overall, the new marina will add to the diversity both of habitat and species in this section of the River Liffey due to the provision of additional hard surface areas on pontoon floats and piles and, while acknowledging the increased risk of Invasive Alien Species availing of newly created habitat associated with any marina development, the provision of the new marina is assessed as being a positive, medium to long term impact both for fisheries and in terms of biodiversity. Taken together, the changes in this section of the Liffey, are expected to largely balance the negative impacts associated with the shading by the SPAR Viaduct by the introduction of additional hard surfaces in the form of scour protection and pontoon floats and piles for the new marina. The overall impact is therefore taken to be neutral or slight negative and medium to long-term in duration.

Area-K Re-Fronting

This entails adding a steel piled combi-wall to the existing berth along 225m of berth and adding 3,658m^2 of subtidal scour protection. The latter will add to the local habitat diversity, however, the movement of shipping at the berth will reduce its value as a habitat. Overall, these changes will have a negligible impact.

New Turning Circle

The proposed 325m diameter turning circle will see the removal of approximately 145m of rip-rap revetment and its replacement with a vertical steel combi-wall. This will result in the loss of all the intertidal algae and diverse range of typical intertidal hard benthos invertebrates including barnacles, limpets, a range of gastropod snails and mobile crustaceans, including amphipods and juvenile green crab (see Section 7.3.2.1). Again, all the same species will be present in other similar areas upstream and downstream, but it will see a significant reduction of this habitat in this part of the port, which is also used, at least intermittently, by fish both for feeding and temporary shelter when the tide is in. The replacement vertical piled shoreline will be of negligible ecological value. In addition, about 50% of the intertidal soft sediment habitat in this corner will also be removed by the turning circle. These changes constitute a localised moderate negative, permanent, impact.

Area N – Habitat Alterations

The construction of a new Lo-Lo terminal at Area N is the most significant aspect of the 3FM Project development entailing a structure which will be roughly 650m long and 128m wide set back 10m from the GSW for the western 145m, excluding the ESB intakes, and 6m back for the next 154m of the GSW. Over 2,400 piles will support the deck, mainly 1.219m diameter, with two rows of 1.626m diameter piles, one at the face of the new wharf and one set back by two rows of the smaller diameter piles (i.e., 18.3m from the face). The piles will be mainly 23 rows deep. The main impact of the wharf at Area N will be the shade it casts. This will impact the intertidal algae adhering to the GSW itself and the two sections of rock armour intertidal adjoining the eastern sides of the two ESB Intake structures along this stretch of shore. It will also impact the soft sediment habitat directly beneath the wharf, which is mainly shallow subtidal and a smaller section of intertidal comprising, sand, muddy sand and sandy mud. In the case of the two rocky intertidal sections, and the sections of the GSW immediately above them, both will lose virtually all their very extensive algae cover due to shading from the wharf. It is possible that a small portion of the upper section of the GSW and the first couple of meters of the rocky shore sections may receive some light during parts of the day, which will allow some algae to be retained, probably more so on the more westerly section of rock armour shore where the wharf is set back 10m as compared to the more eastern section, where the wharf is only set back 6m. In both cases, however, the greatest plant diversity and mobile epifaunal diversity will be in the middle to lower sections of these shore sections, and the latter will be entirely shaded by the wharf. The absence of seaweed will probably ensure that at least the lower section of this part of the shore might become more covered by encrusting fauna including, encrusting bryozoa, barnacles and sponges, like what are currently established on the angular boulders in the shade of the more western of the two ESB intakes (see Section 7.3.2.1). However, there is a layer of fine muddy silt currently adhering to some of the large boulders beneath the *Ascophyllum* cover currently, which when combined with the predicted reduced current speeds in this area after construction, may reduce somewhat the degree of cover of these organisms.

Area N – Potential Impacts on Fisheries

Research on the impact of shading on the growth of two bottom fish feeding species under jetties in New York showed that fish kept along a transect 20m and 40m under the jetty either lost weight or grew poorly compared to the same species along the same transect but 20m and 40m respectively out from the edge of the jetty. One of the species was a flounder the other a tautog, *Tautoga onitis* (a species of wrasse), both diurnal species (Duffy-Anderson and Able, 1999). The same paper quoted an earlier study in the same waterway, which showed that benthic infaunal invertebrates continued to grow normally even in total shade. The area which will lie beneath Area N is very productive of infauna due to the constant particulate organic inputs from the nearby WWTP, so it constitutes an important food source for both fish and other epibenthic predators such as crabs and brown shrimp. It is hard to know which if any fish or other species will feed within the total shade beneath the wharf. Species such as eel which are nocturnal may do so, but flounder and plaice which are visual feeders may not. Green crab (*Carcinus maenas*) one of the most common epibenthic species in the estuary are nocturnal, so they may feed there, while brown shrimp (*Crangon, crangon*), which are diurnal, may avoid it (see Gibson *et al.,* 1998) but see below. Bass are a species that are known to feed both during the day and at night, however, this is seasonal, with nocturnal feeding a winter phenomenon. American eel (*Anguilla rostrata*) was the only fish species which were collected more frequently under shaded piers in a US study compared to unshaded adjoining habitat (Able and Duffy-Anderson, 2005). The same study noted that several decapods (including crab and a *Crangon* sp. shrimp species) were also common beneath shaded piers and generally, that the prey supply for fish is not significantly impacted by shading in such habitats. Fish on the other hand, with few exceptions, appear to be, and the study concludes that under-pier areas are poor-quality habitats because they support low fish abundances, inhibit feeding, and suppress growth. The study speculates that fish which rely on vision for prey capture are likely to spend little time under such structures given the reduced reaction speeds and distances available to capture prey in heavy shade. Overall, it is not possible to quantify the impact of the heavy shading resulting from the Area N wharf on the Lower Liffey ecosystem. For example, reduced fish foraging under the ~9ha of decking may boost prey productivity which in turn may contribute to the production of mobile decapods such as green crab and shrimp, which, because of their importance as prey for fish, may contribute positively to the populations of these and other prey items beyond the shaded cover of the wharf. Tidal movement may displace these and other prey items beyond Area N and thereby expose them to predation by fish, so that at a population level, the impact of the shading may not be very significant. Moreover, if we take the subtidal (mainly) and limited soft sediment intertidal area as a whole within the 3FM Project study area (~1.3km^2), Area N wharf constitutes just about 7% of that area. However, these considerations notwithstanding, the heavy shade under the Area N deck is expected to have a moderate, negative, long-term impact on the nursery capacity of the Lower Liffey. In addition, the loss of the two pockets of rock-armour intertidal near the ESB outfalls, will reduce rocky shore biodiversity in that area, but this will not increase the overall level of impact assigned.

ESB Jetty

The demolition of the two jetties (Sludge and ESB Oil) will be adequately compensated for, like for like, by the construction of the new ESB jetty and the outer rows of Area N piles which will in time develop all the same attached faunal and algal communities. It is possible that some fish such as corkwing, ballan and other wrasse species, along with rocky shore species such as butterfish may be attracted to these piles, including the outer, non-shaded piles on the Area N wharf. These particular changes, i.e., those related to changes in non-shaded piles, taken together, are assessed as having a neutral to slightly positive, long-term impact for fish and the associated attached epibiotic communities in that part of the outer estuary.

Greater Dublin Bay

Impacts on Reefs in the Rockabill to Dalkey Island SAC

The Rockabill to Dalkey Island SAC includes intertidal reefs as one of its conservation objectives. Supporting documentation for the conservation objectives, specifically Marine Habitats and Species, Version 1 -April 2013, available on the NPWS website, refer to the:

"INTERTIDAL REEF COMMUNITY COMPLEX This reef community complex is recorded on the islands within this site and on the south coast of Howth. The exposure regime of the complex ranges from exposed to moderately exposed reef. Exposed reef is recorded on the east side of Dalkey Island, on the east and southern shores of Ireland's Eye and on all shores of Rockabill and the Muglins. Moderately exposed reef occurs on the western shores of Dalkey and at Howth and Ireland's Eye. The substrate here is that of flat and sloping bedrock; around Rockabill cobbles and boulders occur on bedrock. Vertical cliff faces are found on the north and northeast shores of Ireland's Eye; steep shorelines are a feature of Rockabill, Muglins and the eastern shore of Dalkey Island."

As part of the 3FM Project assessment the potential impacts of dredge spoil disposal at the licensed dump site in Dublin Bay, surveys were undertaken at the designated intertidal reefs on Howth Head and Ireland's Eye to see if there was any evidence that they were being negatively impacted by the spoil disposal. Two walk-over surveys were undertaken on the southern shore of Howth Head, which contains the nearest reefs to the dump site. The first survey was undertaken in February 2021 at a time when there was spoil from the ABR Project dredging being disposed of and again in August 2022, a little farther east along the shore from the 2021 survey. A third survey was undertaken, also in August 2022, on the south and southern eastern side of Ireland's Eye, again within the designated reef area and immediately adjoining. The 2022 surveys were undertaken at a time when spoil was not being disposed of at the dump site. Details of the findings of these surveys are presented in Appendix 7.3.1d,e and f.

The surveys revealed shorelines with a diverse range of species and habitats typical in the main of semi-exposed rocky intertidal areas, which showed no evidence that the species diversity or community composition was being negatively impacted by turbidity spreading from the dump site.

7.3.3.3 Fisheries

The 3FM Project will require extensive pile driving, capital dredging and dredge spoil disposal, and a range of infrastructural installations stretching from the Tom Clarke Bridge upstream to just east of the outfall from the

Ringsend Waste Water Treatment Plant outflow downstream, a distance of about 3km. Pile driving, dredging, and dredge spoil disposal are the most relevant characteristics of the Project with potential for impact on fisheries.

Pile Driving

The 3FM Project will require extensive pile driving along the 3km linear extent of the works from the new SPAR Bridge downstream to beyond the Poolbeg oil jetty. This includes piling along ~700m of the SPAR Viaduct, widely spaced piling along the new marina, a 225m long combi-wall of tubular piles and sheet piles re-fronting part of Area K, piling of four large tubular piles for the new Ro-Ro linkspan at Area K, a short combi-wall section in the south west and southern section of the new turning circle where it abuts the southern shore, a 650m x 150m open pile Lo-Lo wharf at Area N, which will entail the driving of 216 tubular piles of 1.626m diameter toward the outer face of the wharf and 2,275 tubular piles of 1.219m in diameter, forming the bulk of the support for this structure. This will be by far the largest piling operation of the 3FM Project. Lastly, a replacement for the existing ESB oil jetty which will be removed as part of the project; replacement facilities will be installed at the seaward end of the new Area N terminal; this is referred to as the Lo-Lo Terminal Dolphin and will utilise tubular piles of 1.02m diameter.

Potential Impacts of Pile Driving on Fisheries

The possibility that anthropogenic sound generated by pile driving, in particular impact pile driving, could negatively impact fish has been referenced in the peer reviewed and grey scientific literature for over 20 years. However, it is only in the past ten years or so that carefully controlled experimental studies have attempted to link the amount of sound energy emitted during pile driving with injury and potential mortality in fish. Of necessity the vast majority of this work has been undertaken in laboratory settings due to the need for accurate control of the sound levels that the fish are being challenged with. In all of these studies the sound challenge employed has derived from recordings of actual pile driving events in the field or been reproduced mechanically in the lab. Before, during and since this time, field experiments have also been undertaken where fish have been exposed in suspended cages placed at various distances from live piling operations in order to assess impacts, and while valuable, these studies tend to be less widely applicable, due to the diversity of site-specific factors associated with each piling project, along with the difficulty of measuring the sound energy that the test fish were exposed to etc. These factors make the results less widely applicable and the difficulty in controlling other aspects of experimental design, means that their results tend to be treated with a greater degree of caution.

The main thrust of all these studies is to assess the risk of fish injury causing immediate or delayed mortality or various degrees of recoverable injury, i.e. more or less measurable and quantifiable outcomes. In addition, many studies have examined the behaviour of fish and the degree to which that can be affected by sound generated by piledriving. Unlike impacts related to injury, however, the significance of behavioural reactions, which have been demonstrated in a wide range of species, is very difficult to quantify either at a local or population level.

In relation to injury risk, the studies undertaken have clearly demonstrated that varying degrees of injury occur in fish as a result of exposure to certain levels of sound energy generated by pile driving in water. Furthermore, the degree of injury is related to the degree of exposure with higher sound levels and longer durations of exposure likely to result in greater effects. As a general rule, injury leading to immediate death, tends to be confined in most cases to distances within a few to a few tens of metres of a sound source, with the recoverable injury pushed out to maybe 50 to 300m. Behavioural impacts, i.e. ones not associated with any form of injury, may extend to 1000m or sometimes much farther in the case of species such as cod and sprat which are very sensitive to underwater sound. In all of these examples, however, the type of species has a significant bearing on these effects. In broad terms, fish without swim bladders e.g. flat fish and lamprey, are far less susceptible to injury from pile driving than species that have swim bladders. In fact, none of the peer reviewed studies on the impact of pile driving sound on fish have demonstrated injuries in fish without swim bladders, strongly suggesting that these species are the least affected by direct impacts of anthropogenic sound, although behavioural effects have been demonstrated. Species with swim bladders can be broadly sub-divided into groups like salmonids which have a swim bladder that is not involved in hearing and species from the herring family for example whose swim bladder is connected to the inner ear and involved in hearing. These latter species are also known as hearing specialists because they can detect a very wide range of the underwater sound spectrum and these species tend to be the most susceptible to sound-related injury. An intermediate category such as cod have swim bladders, which although not directly connected to the middle ear have an indirect connection via auditory bones, which allow it to hear a broader range of sounds than say salmonids.

Research has shown that species such as lamprey and flatfish, which do not have a swim bladder rely on particle motion rather than sound pressure to detect sound.

This is also the case for species such as salmonids whose swim bladders are not involved in sound detection in fact salmon are not sensitive to sound pressure. This is an issue when it comes to assessing the influence of underwater sound on fish such as salmon because the vast majority of research has looked at the effects of sound pressure on fish and virtually all measurements of pile driving sound energy is measured in units of pressure. All pile driving generates both sound pressure and particle motion but particle motion attenuates much more rapidly than sound pressure with distance from the piling source, which means than fish such as salmon and eel, will only be able to detect sound generated by pile driving when they are relatively close to the pile being driven. However, because they possess a swim bladder, they are still susceptible to pressure-induced damage if the pressure levels are high enough.

Many factors affect the sound energy level output from piling including among others: the diameter of circular/tubular piles, the width of sheet piles, the depth of water, the nature of the bottom material (soft or hard), salinity, temperature etc. In terms of pile sizes, all other things being equal, the bigger the diameter of a tubular pile, the greater the sound energy output during piling. Table 7.24 lists the sizes of piles to be used in each of the areas within the 3FM Project, how they will be driven and the predicted single strike SEL (SEL_{ss}) for each (see Chapter 12, Noise and Vibration for more details).

Sound Level Regulations

There are currently no underwater sound-related legislative requirements for fish in Irish planning law. However, a set of guidelines developed by Popper *et al.,* (2014) is widely referred to in the literature and has been used to inform the assessment of the sound related risk for fish in various infrastructural projects internationally including the 3FM Project as reported in Chapter 12. Popper *et al.,* (2014) have taken the research on the impact of pile driving on fish and grouped the fish into three broad groups based on the susceptibility to injury i.e., (i) fish with no swim bladders, (ii) fish with a swim bladder not involved in hearing and (iii) fish with a swim bladder involved in hearing.

Against these three groups, they have defined sound metrics leading to several outcomes, three of which have relevance for the 3FM Project, namely (i) mortal and potential mortal injury (ii) recoverable injury and (iii) behaviour. For the first two categories of effect the guidelines use two sound metrics, namely sound pressure peak (dB peak) and cumulative sound energy level (SEL_{cum}), the latter derived by adding a series of single strike SEL levels (SEL_{ss}). These metrics are explained in detail in Chapter 12, Noise and Vibration. The guidelines are based on research which demonstrated a link between onset and degree of injury in fish to a quantifiable amount of sound energy received from pile driving.

Broadly speaking, the greater the amount of accumulated sound energy received by the fish due to exposure to successive pile strikes the greater the risk of injury. However, the accumulated energy (SEL_{cum}) would have to reach a certain threshold before (i) mortal or potentially mortal injury could occur or (ii) recoverable injury could occur. Moreover, these thresholds are different for each of the three categories of fish referred in the Popper *et al.*, (2014) guidelines, so for example fish without a swim bladder have a much higher threshold for both injury-related and behavioural effects than fish with a swim bladder involved in hearing. The guideline metrics have been reproduced in Chapter 12, Noise and Vibration.

Table 7.24 Pile types and sizes, the type of piling to be used and the sound output for each * Single strike SEL (impact piling), 1 second SEL (vibratory piling)

Location	Piling Required	Installation Piling method	*Sound Level
SPAR Bridge	1.02m dia. round	Impact	204dB SELss
SPAR Viaduct	1.2m dia. round	Vibratory	206dB SELss
Ro-Ro Terminal Area K	1.42m dia. round	Impact	206dB SELss
Ro-Ro Terminal Area K	1.4m wide sheet pile	Vibratory	207dB SPL
Marine Finger Berths	1.02 dia. round	Impact	204dB SELss
RO-RO Ramp	2.4m dia. round	Impact	210dB SELss
Area N (west)	1.63m dia. round	Impact	207dB SELss
Area N (east)	1.63m dia. round	Impact	207dB SELss

Using these guidelines, Chapter 12 Tables 12.2.11 to 12.2.25, gives the distances from the active pile in each 3FM Project piling location, within which (i) mortality or potential mortal injury (PM) or (ii) recoverably injury (RI) are expected to occur. In each case two scenarios were assessed, (i) the SEL output from a single strike of a piling hammer on a tubular pile and the SEL of a one second output from a vibratory piledriver on either a circular pile (e.g. at the SPAR Road or a sheet pile in the combi-wall for refronting part of Area K, both denoted as SELss and (ii) the cumulative SEL (SELcum) output of 1200 strikes (i.e. half an hour of continuous piling at 1.5 second per hammer strike) or in the case of vibratory piling, the output of one hour of continuous piling. In the case of Area N, which will require driving more than 2,500 piles, the analysis has computed the effect distances associated with the use of one piling rig alone, or two or five piling rigs operating at the same time. These distances are summarised from Chapter 12 Noise and Vibration in Table 7.25 below.

Chapter 12 also lists the effect distances of a single blow of an impact piler and one second operation of a vibratory piler. In virtually all cases, these never reached the level of effect for either Potential Mortality or Recoverable Injury, so they have been excluded. The only exception was in the case of Area N (east) if five piling rigs were operating at the same time, in which case the single blow SEL would potentially give rise to mortal or potentially mortal injury and to a recoverable injury within only 10m of the active piles. For this reason the single blow impact has been left out of this summary table.

Table 7.25 Pile types and sizes, the type of piling to be used and the sound output for each. *PM=Potential mortality or mortal injury. **RI=Recoverable injury.

Location	Activity	No of blows	PM* Risk Range (m)	RI** Risk Range (m)	Approximate Width of Channel at each piling operation (m)
SPAR Bridge	Impact piling	1200 blows	30	50	145
SPAR Viaduct	Vibro piling	1 hour	#N/A	20	170 (west), 225 (mid), 265 (east)
Marina	Impact piling	1200 blows	30	80	165 – 185
Areat K RoRo Linkspan	Impact piling	1200 blows	50	300	200
Area K, refronting	Impact piling	1200 blows	75	250	200-210
Area K, refronting	Vibro piling	1200 blows	#N/A	40	200-210
Area N West	Impact piling	1200 blows	75	150	350-500
Area N Mid	Impact piling	1200 blows	60	100	,,
Area N East	Impact piling	1200 blows	45	160	,,
Area N small W	Impact piling	1200 blows	35	80	,,
Area N small E	Impact piling	1200 blows	25	70	,,
Area N x2	Impact piling 2 rigs	1200 blows	50	180	,,
Area N x5	Impact piling 5 rigs	1200 blows	70	280	,,
Lo-Lo Terminal Dolphin	Impact piling	1200 blows	25	100	350

Table 7.24 shows that no single strike of an impact piling rig or no one second duration of a vibratory piling rig is expected to have any negative impact in terms of mortality or recoverable injury to fish, except in the case of Area N if five piling rigs are used at the same time, in which case, recoverable injury (RI) would extend for 10m from the pile. In the case of vibratory piling, none of the one hour continuous piling at any location is expected to cause fish mortality (PM) and recoverable injury (RI) is only expected to extend 20m-40m out from the active pile in the case of the SPAR Road and Area K re-fronting respectively. In contrast, every round pile driven for 1200 blows will potentially cause mortality (PM) or recoverable injury (RI) at a certain distance away from the active pile at each location. Potential mortality/mortal injury distance is estimated to range from 40m-150m out

from the piles, depending on the size of pile and the location, and in the case of Area N, whether one, two or five rigs will be piling simultaneously. For recoverable injury (RI), the distances are greater ranging from 40m to 300m, the longest effect distances associated with the Ro-Ro Ramp and Area N when 5 rigs are piling simultaneously.

Impacts of Piling Noise on Migratory Species (Salmon, Eel, Lampreys)

The impacts of the project on salmon is especially important given what appears to be a marked decline in the numbers of returning adults of this Annex II species to the Liffey since 2019. The risk of pile driving in the port area i.e. in the outer Liffey Estuary will depend to a significant degree on the behaviour of migrating salmon in estuaries, as well as the reaction of salmon to loud underwater noise. The movement of salmon through estuaries into rivers has been studied in many rivers in Europe and North America and there appears to be quite a degree of variability between sites which probably relates in part to the physical structure of the estuaries involved, and the volumes of freshwater flow from them (see Milner *et al.,* 2012). This notwithstanding, a number of trends appear to be common to several systems. A number of studies in Great Britain indicated that salmon mainly migrated through estuaries and enter rivers at night but that during high flows when waters are often more turbid, salmon may also migrate during the day (Hellawell, *et al.,* 1974, Potter, 1988, Smith and Smith, 1997).

Another study (Dunkley and Shearer, 1982) on a Scottish river, noted that later in the year when perhaps salmon are nearing the time for spawning, they will also enter rivers during daylight hours. In contrast, a study in a Norwegian fjord (Davidsen *et al.,* 2013) noted no preference for the daily timing of salmon entry from the fjord into a natal river. Currently, data on the timing of salmon entry into the Liffey at the head of the tide at Islandbridge is not available, although the pattern of several rivers in Great Britain would suggest that there would be a greater tendency for salmon moving through estuaries and into rivers at night. There is evidence that the tide can influence the movement of salmon into estuaries also.

Potter (1988) working on the River Fowey in Cornwall noted that while salmon entered and left the estuary at all stages of the tide they noted a slight tendency for them to enter the estuary one to three hours after low water, while on the Aberdeenshire Dee, Smith and Smith (1997) noted that upstream movement tended to occur during ebb tide. The relevance of these observations relates to the daily timing of piling. Given that piling is only permitted from 08:00 to 18:00, any salmon travelling through the project area during the night will not be at risk. Furthermore, if movement is more likely during the ebb tide and close to low tide, then this also carries some benefit in that piling noise attenuates over shorter distances in shallower water, thereby reducing the range of the main effect levels i.e. mortality or mortal injury and recoverable injury on a migrating salmon during such times.

The foregoing points to some of factors likely to influence the possibility and the degree of exposure of salmon to piling noise within the project area. If at least some salmon will be moving through the project area during piling, then their degree of exposure will be determined by their location within the channel relative to the active pile or piles and the rate at which they move through the area. Research has shown that the speed of migration of adult salmon can vary considerably among individual fish and in different sections of the transition from the sea to river entry, and while still bearing this variability in mind, an average speed in the literature tends towards

0.5 body lengths per second (Potter, 1988, Smith and Smith 1997, Davidsen *et al.,* 2017), which in the case of a grilse (1 SW salmon) would equate to about 0.3m per second or just over 1km per hour.

Combining this average speed with the distances within which mortality/mortality or recoverable injury could occur after 1200 piles strikes (i.e. 30minutes piling at 1.5sec per strike) and assuming that these distances are in effect radii emanating from the pile being driven, then Table 7.26 lists the time that a salmon travelling upstream at 0.3m per second would take to pass through these zones. It is important to note that such a fish would be passing very close to the pile and would swim through both zones, given that the higher impact zone is roughly centred within the lower impact zone. Note that the shape of these two zones will not be exactly circular given all the variability in the depth and other physical variables required in the sound propagation model. Nevertheless, for our purposes it is an acceptable simplification.

Table 7.26 Estimate the time a 1SW salmon (grilse) would take to travel through the sound impact zones around each pile travelling if it were travelling at roughly 0.3m/second.

Piling Areas	Minutes in Potential Mortal Injury Zone	Minutes in Recoverable Injury Zone
SPAR (Bridge)	3.3	5.6
SPAR road, west	0.0	2.2
SPAR road, east	0.0	2.2
Marina	3.3	5.6
RoRo Linkspan	5.6	27.8
Area K, refronting (sheet piles)	0.0	4.4
Area K, refronting	8.3	19.4
Area N West	6.7	10.0
Area N Mid	5.0	6.1
Area N East	5.0	12.8
Area N small W	3.9	5.0
Area N small E	2.8	5.0
Area N x2	5.6	14.4
Areat N x4	7.8	23.3
Lo-Lo Terminal Dolphin	2.8	8.3

Looking at the table we can see that there is considerable time overlap for an average salmon at the Ro-Ro Linkspan in Area K, for the driving of tubular piles at the new section of combi-wall at Area K and the driving of the larger piles toward the outer channel-side face the of Area N when 5-rigs are piling simultaneously. In terms of spatial distribution it is not possible to say where a migrating salmon is likely to be as it makes its way upstream toward the head of the tide. However, if we take it as being random, then the wider the channel, the lower the likelihood of a fish entering either of the injury-related zones. Toward the outer end of the project area the width of the channel is 450-500m, toward the centre i.e. near Area K it is 220-240m, between the Marina and the western end of the SPAR Viaduct it is roughly 175 to 250m and at the SPAR bridge it is around 170m wide. It follows that the areas where there would be least unaffected channel during piling would be the SPAR Bridge, the Marina, the Ro-Ro Linkspan, Area K piling of tubular piles in the combi-wall, and simultaneous piling of 5 rigs for the larger Area N piles. The likelihood of impact would also be lower if the migrating salmon avoided the areas where active piling was taking place. However, there is very little clear evidence that salmon avoid impact piling (Ruggerone *et. al.,* 2008 and Harding *et. al.,* 2016). This is because salmon are very insensitive to sound pressure because of a lack of connection between the swim bladder and the inner ear. They are predominantly sensitive to particle acceleration which is the only stimulus that has been successfully shown to deflect them from their migratory path (Knudsen *et al.,* 1994) and then only at very low frequency at very close distances to the sound source (0-3m) because particle acceleration attenuates at a much faster rate than sound pressure.

Bui *et al.,* (2013) also demonstrated that adult salmon in a cage tripled their swimming speed from roughly 0.5BLS (body lengths per second) to 1.5BLS, when exposed to infrasound of 12.5Hz. They also showed that the fish resumed normal swimming behaviour almost immediately after cessation of the stimulus. The sound modelling for the 3FM Project (see Chapter 12) indicates that sound at these very low frequencies will not propagate, because the depths are too shallow. Moreover, particle acceleration is also propagated through the bed of the estuary via shockwaves generated by the impacted pile, and salmon, because they migrate up in the water column rather than along the bottom will receive less of this benthic propagating particle acceleration, thereby reducing the likelihood or the strength of avoidance behaviour as well.

Carlson *et al.,* 2001, argues that even impact piling will be unable to impede salmon from migrating because the rapid attenuation of particle motion in the nearfield (few meters) is insufficient to deflect them. Thus, while the piling activity for the 3FM Project will almost certainly not prevent any inward or outward salmon migration, the research suggests that avoidance is unlikely to prevent salmon coming close to active piles, which would not be the case for more sound-sensitive species.

There are aspects to the process of pile driving which reduces its risk in terms of exposure and that is the fact that it can be quite stop-start. This can be illustrated by the piling of 88 tubular piles (76 x 0.81m diameter & 16 x 1.12m diameter) for the ABR Project Ro-Ro jetty, which on average required three drives per pile, lasting 30, 21 and 15 minutes respectively for each drive. However, each of the three drives was undertaken on a different day, spacing out the potential impact even more. In contrast, the final 5 to 6 metres of the 46m long x 1.42m diameter Berth 35 combi-wall tubular piles were each driven in virtually all cases with a single drive which lasted on average 27minutes per pile. However, several piles were generally driven each day, with an average gap between piles of just 12 minutes (median 7 minutes). The rapidity of this pile driving (undertaken in late October and early November 2020), was probably related to the fact that over 80% of the length of each pile had already been drivenby vibratory piling, and because they were all lined along an existing quay frontage and therefore easily accessible for the final driving to refusal.

In contrast, the Ro-Ro jetty entailed open water piling which would have required a more complicated and time consuming set-up, which explains the longer gap between drives. Despite these characteristics of the piling process which may reduce the risk to migrating salmon and indeed all migrating species, the fact that all the piling efforts are along the open river as opposed to being within basins, indicates that some salmon are nevertheless likely to be at risk. This is especially true where the channel is narrow e.g. at the SPAR Bridge and where larger diameter piles are been driven, as higher SELss have been shown to be associated with greater numbers of recoverable injuries in test fish (Casper *et al.,* 2012). It is worth noting that in the gaps between pile drives, even very short ones of just a few minutes, all the research conducted on a wide range of species suggests that fish disturbed by piling quickly revert to their pre-piling behaviour.

Eels

Eels have swim bladders but like salmon have a low sensitivity to sound pressure and mainly respond to particle acceleration as a means of hearing. Outward migrating silver eels move at night (Arrestrup *et al.,* 2010). They also tend to move in bursts depending on the river discharge, with the largest movements (in terms of numbers) tending to be synchronised with peaks in riverine discharge. In these situations, eels can cover large distances in a short timescale (Bultel *et al.,* 2014) and in this situation, when the bulk of silver eel exiting the Liffey are also likely to run, the chances of any being injured or killed as a result of piling is likely to be much reduced. This is further suggested by the fact that piling will not be undertaken after 18:00 each evening. During conditions of low flow, the average daily displacement of eels can be expected to be lower, averaging as little as 0.05m/s (Bultel *et al.*, 2014), However, directional swimming speeds would be higher (average 0.56m/s, range 0.03 – 1.14m/s) (Bultel *et al.,* 2014) which means that they could move through the inner, higher impact zones around an active pile on average faster than salmon. This is supported by observations in Arrestrup *et al.,* (2010) which showed that the closer to the open ocean that migrating silver eel in a fjord reached, the higher their speed on average. Work on the Loire in France has shown that silver eels tended to congregate toward the head of the estuary until discharge levels were suitable for downriver movement (Bultel *et al.,* 2014). Translated to the Liffey, that would mean that the majority of silver eels would tend to remain toward the Islandbridge end of the estuary several kilometres upstream of the port until the discharge conditions were favourable for estuarine descent, behaviour that would offer additional protection to the species in the circumstances. All of the above would indicate that out-migrating silver eel are at a significantly lower degree of risk than salmon from impact piling sound.

Glass eels

Glass eels arrive on our shores around November and continue until April. As inwardly migrating glass eels enter European estuaries, they gradually become pigmented and eventually at the head of the tide enter freshwaters where they tend to be referred to as elvers (although the two terms elver and glass eel are often used interchangeably). Glass eels are poor swimmers and rely on tidal transport to bring them progressively up through estuaries to the head of the tide. On flood tides they tend to be well distributed throughout the water column but particularly in the main tidal flow, whereas at early ebb they move toward the margins and during full ebb they move toward the bed of the estuary in order to bury into sediment or to remain in slacker flows in order to stem their seaward displacement (Harrison *et al.,* 2014). This oscillating cycle of a big step upstream on the flood and a shorter backward stem during ebb is the mechanism whereby glass eels eventually arrive at the tidal limits where they begin a more active swimming phase into freshwaters proper. Glass eel migration in the Lower Liffey is expected to follow a similar pattern. Although glass eels have swim bladders, in the case of the closely related American eel, the swim bladder does not become gas-filled until freshwater residence occurs (Hickman, 1981). Nevertheless, the possibility that some migrating glass eels may for a short period of each ebb be displaced into the higher impact zones of actively driven piles cannot be ruled out. If this occurs, then some at least of these eels will either suffer recoverable injury or if closer to the pile be killed or suffer mortal injury. It is likely however that the proportion of the glass eel population which will be negatively affected in this way is likely to be very small for a number of reasons as follows: (i) the majority of glass eels only migrate at night unless conditions are very turbid, (ii) if they migrate during the day they will be most exposed to piling noise for those periods when piling will be occurring, which based on the experience of the ABR project will last at most for just a few hours in any given day and (iii) they are only likely to be concentrated toward the southern side of the estuary i.e. the active piling side during the early part of the ebb tide. Outside of this period they will either be close to or buried in the bottom to stem their seaward displacement during full ebb or distributed throughout the water column during flood tide periods during which time far fewer are likely to be present in the higher impact zones.

Implications of Pile Driving for migratory eel at a population level

The European eel throughout its entire range from Scandinavia to North Africa and the Mediterranean basin is considered to be a single, panmictic stock, whose spawning adults collect in the Saragossa Sea to spawn and whose progeny then drift on the Gulf Stream currents back to various parts of Europe. This means in effect that the glass eel progeny of a silver eel from the Liffey could end up entering any Irish or European river and vice versa, as eel do not home to the rivers where they grew to maturity. In other words, the glass eels running into the Liffey each year are not directly dependent on the number of eels that have previously migrated from the river. Furthermore, the number of eels running into the Liffey each year is likely to be tiny when compared to systems such as the Erne and the Shannon (see Figure 7.29), so that a marginal reduction in recruitment caused by piling-associated mortality in the Liffey will be so small compared to the regional recruitment as to have effectively no negative impact on either the Liffey or European populations. Furthermore, once within freshwater habitats glass eels/elvers take anywhere between six to 18 years or more to mature, with males reaching maturity several years earlier than the larger females. The likelihood therefore is that within the Liffey River and estuary there could be at least ten to 20 years of eel cohorts and that the glass eels and elvers from any given year's recruitment would contribute to several years' recruitment of silver eels thereby dampening the effect that interannual variation in glass/elver supply would have on migrating silver eels. In summary, therefore, it is expected that the pile driving in the 3FM Project will have no impact on the eel populations at a national or European scale and a negligible impact on the Liffey populations in the absence of mitigation.

Lamprey

The time at which river lamprey migrate upriver to spawn is variously reported, with Hardisty and Potter (1971) quoted in Igoe *et al.,* (2004) giving the period as long as September to June in the UK, Kelly and King (2001) quote Pickering (1993) as indicating that it begins generally in late summer and autumn of the year before spawning, while Maitland (2003) indicates mainly from October to December. In the case of sea lamprey, the spawning migration tends to be in spring and early summer with Igoe *et al.*, (2004) referring to observations of sea lamprey migration on the Shannon at Ardnacrusha in May and June through the Borland weir in 1992. In every case, water temperature, river discharge and time of day are all likely to be influential in the detailed timing. It is generally accepted that lamprey of both species migrate at night waiting up during the day in suitable refugia. There are very few observations of lamprey movements in the estuarine part of the Liffey, except for an observation of three river lamprey being taken in a fyke net in the upper Liffey estuary in a WFD fish monitoring survey undertaken during October 2010 by IFI (Kelly *et al.,* 2011) and a report of sea lamprey spawning below Islandbridge Weir in summer 2015. Since then, details of river lamprey migrations into the Liffey have greatly increased due to information gathered mainly since 2017/2018 at the Islandbridge elver trap operated by the Marine Institute, which was modified around that time such that lamprey started entering the trap as well as eels. These data (see Figure 7.30) show a bimodal pattern of immigration in the Liffey, the first in autumn/winter from September to December peaking in November and the second in winter/spring from January to April, peaking in March.

In the context of potential negative impacts from sound, the key point to note about inwardly migrating adults and outwardly migrating transformed young lamprey is that they do not have swim bladders, and this means that they are far less susceptible to suffering injuries as a result of pile driving. This means the zone of higher effect of mortality and potential mortal injury and the lower effect zone of recoverable injury, are much narrower than for salmon, indicating that they would be at significantly lower risk of suffering injury from piling than that species. Lampreys tend to migrate at night and during the day seek refuge under stones or behind log piles where they are protected from strong currents and predators. The fact that they mainly migrate at night further reduces their risk from piling. However, the fact that they are present in the estuary during the day means in theory at least that they could rest up close to an actively driving pile, although it would seem unlikely that they would choose such a location in a situation where they could move to any other non-sound-impacted location. In any case it must be borne in mind, that the length of the estuary between the ESB jetty and the SPAR bridge is about 3km, so the chances of a lamprey resting up beside a single active large diameter pile or one of the less sound intensive sheet piles is likely to be very low. For these reasons, it is believed that inwardly or outwardly migrating lamprey will not suffer any significant negative impacts from piling noise, which will be undertaken as much as possible in consecutive rather that overlapping phases and only occur concurrently at Area N.

At the population level the bulk of the Liffey river lamprey reside within the river catchment itself as it takes 3-5 years for the immature stages (ammocoetes) to grow sufficiently before transforming to the adult migratory stage. Therefore, any marginal increase in mortality related to pile driving noise is unlikely to be felt at the population level.

Overall Impact on Migratory Species in the Liffey

In terms of impact significance, the impact on eel is predicted to be imperceptible, while that on river lamprey will be slight, negative to neutral and short-term at worst. In the case of eel this is based on the likelihood that the Liffey population is relatively minor in an Irish context, the fact that returning glass eel do not home to the river of their progenitors, and because of the general robustness of the species itself. In the case of river lamprey, the assessment is based on the fact that the species is without a swim bladder, tends to migrate at night and contains the bulk of its population within the freshwater reaches of the river, thereby conferring significant buffering to minor fluctuations in recruitment. Quantifying the likely impact on salmon in the Liffey, is more difficult, mainly because of the apparent sharp decline in numbers recorded in the Islandbridge and Leixlip salmon counters since 2019, which may be pointing to a significant decline in the Liffey population, which if it is the actual situation means that there is very little spare capacity within the population which could buffer it from additional mortalities or a decrease in fitness which might lead to poorer reproductive outcomes among some returning fish. That notwithstanding, there is a great deal of uncertainty when it comes to assessing the potential impacts on migrating salmon from pile driving noise, mainly because of a lack of field data on avoidance responses of wild adult fish, coupled with the fact that they are very insensitive to sound pressure, which may see them come closer to active piles than might be expected. Accordingly, taking a precautionary approach, the impact on salmon from pile driving is determined to be potentially significant, negative and long-term, in the absence of mitigation.

Marine / Estuarine Resident/Migratory Species

Surveys by IFI in the estuarine part of the Liffey recorded 22 species across three surveys (2008, 2010, 2022) using phyke nets, beach seines and beam trawls (Table 7.13). As part of baseline surveys for the ABR Project and MP2 Project EIAR's and a dredging application, beam trawl surveys were undertaken in 2013, 2018, and 2020 within the port area and ten species were recorded (Table 7.14). A species absent from both lists but frequently reported by anglers from the project area is bass.

Knowledge of the sound sensitivity of fish species inhabiting the lower Liffey Estuary and their reaction to increased sound is confined to just a few well studied species namely eel, bass, cod and sprat, with somewhat limited or no knowledge on the sound sensitivity of several others. In terms of mortality or recoverable injury all species which enter into the two effect zones (PM or RI) around each pile during active piling will be susceptible to greater or lesser injury depending on how long they remain within these zones and how close to the piles they are while they are being driven.

The species at the least risk of direct injury from piling noise are flounder, plaice, dragonet and pogge, none of which has a swim bladder and at similar but slightly higher risk would be 5-bearded rockling and sand goby, both with very small swim bladders. This condition lessens their susceptibility to barotrauma which is the principal mechanism of injury due to impact piling and the associated individual and cumulative pressure wave energy. We can make the assumption that all the remaining species, because they have swim bladders, will generally be more susceptible to pressure-induced injury. Again, however, it will depend on how close these species will get to active piles. However, the natural behaviour of a species might be an important factor affecting the degree of risk involved. For example, yellow eel, which are resident in the Liffey Estuary, will be less susceptible to piling noise because they only tend to move around their home ranges between sunset and sunrise (Walker *et al.,* 2014).

In the case of sprat and cod, which are known to be very sensitive to sound, even at distances greater than at least 1km, it seems unlikely that they, or the related gadoids, pollack and whiting, would come close enough to these impact zones to be directly impacted. Note, however, that assumptions about reactions to sound between related species or even within the same species in differing contexts should only be made with caution (Kastelein, *et al.,* 2008). It is known from several studies that bass, which have a wider hearing range than salmon (Kastelein *et al.,* 2008) and are sensitive to increased sound, both ship noise and impulsive sounds associated with pile driving. Buscaino *et al*., (2010) demonstrated increased movement and increase blood lactate levels in sub-adult bass exposed to shipping noise in a laboratory based experiment, while Neo *et al.,* (2014) demonstrated increased swimming speed and an initial startle response, a dive response and greater physical cohesion in a test group of sub adult bass in a large tank experiment exposed to continuous sound of

SPL of 162dB re 1μPa² and intermittent sound up to SPL of 172dB re 1μPa². Taken together, these studies suggest that bass would certainly react to the level of sound that will be induced by both vibratory and impact piledriving for the current project but the degree to which they might avoid an active pile is not certain. However, Kastelein, *et al.,* (2008) in their sound experiments which included bass noted that in almost all cases when the test fish exhibited a startle response they swam away from the sound source, suggesting that bass would be more likely than not to avoid an active pile.

Mullet were seen to have a similar reaction (startle response) to elevated sound levels over the same sound frequency range tested as bass (100-400Hz) but were judged to require a higher SPL in the lower part of that range than bass to evoke a startle response. This might suggest that mullet are somewhat less sensitive than bass to sound. Most studies which have looked at the reaction of fish to elevated sound levels have also noted that the fish generally recover to their pre-exposure behaviour very soon after exposure, often in a matter of minutes or less. These studies have also noted a degree of habituation following repeated exposure to sounds, although this may not persist after extended gaps (hours) between stimulus bouts. The significance of transient, sublethal effects in fish such as increased ventilation rates, increased swimming speed and elevated levels of certain metabolites in the blood as a result of increased anthropogenic sound is not known but if they reduce the fitness of individual it might negatively affect their ability to reproduce or affect their survival in other ways.

Bruintjes *et al*., (2016) found, that eel exposed to shipping noise had a 6% slower reaction response (startle) to a simulated predator stimulation. Subtle behavioural changes like these might have survival consequences for any resident fish. It must be borne in mind, however, that a busy port will always have elevated ambient noise levels and that an existing fish community will be adapted to that acoustic environment even if it is suboptimal. If the addition of impact piling is intermittently overlaid on this elevated ambient sound level during piling operations it is likely to constitute an additional stress on the resident population which, regardless of the sound environment will be fluctuating constantly as a result of seasonal migrations to offshore and in and out of the estuary. It is unlikely however, that this additional stress will be seriously decremental to any of the resident species because most of them spawn offshore and are linked to wider populations, such that a temporary reduction in the success of some individuals is thought very unlikely to lead to more than a slight, short-term negative impact at a population level, in the absence of mitigation.

Dredging and Dredge Spoil Disposal

The greater part of the material from the Area N berthing pocket, the new turning circle and the new marina area will be dredged using Trailer Suction Hopper Dredger (TSHD), while lesser but significant volumes of material will be dredged using a back-hoe dredger, mainly for the side slopes in each area and probably also for the small volumes to be removed for scour protection in front of the new Area K combi-wall. It is proposed to undertake the dredging and dumping over 10 winter seasons (October to March). This will avoid the period of outmigration of salmon smolts and the upriver migration of the majority of adult salmon. It will also avoid overlap with the port’s maintenance dredging schedule which usually takes place within an April-September window in years when it occurs.

Potential Impacts of Dredging on fisheries

The two main impacts associated with dredging relate to the increase in suspended solids during dredging and the possibility of entrainment of fish by the dredger, both of which are discussed below.

Increased Turbidity and Suspended Solids

Channel dredging gives rise to increased turbidity levels associated with the disturbance of fine bottom sediments which results in an increase in suspended solids in the water column. Increased suspended solids is also associated with overspill from barges used to hold back-hoe dredge spoil and hoppers used in TSHD dredging on occasions when overflow is practiced. This occurs when barges and hopper are overfilled in an attempt to increase the amount of spoil they can contain. In general, suspended solids concentrations are highest within the first 50 to 100m of a dredger (up to several hundred milligrams per litre and more) and with the highest levels concentrated in the middle and bottom layers of the water column. As the distance from the dredger increases the suspended solids load drops off very rapidly, and although a turbidity plume of the finest material may still be visible for up to a kilometre or more down current from the dredger, the actual amounts of solids in suspension tend to be very low beyond the first 100-200m. These levels are potentially much higher if overspilling occurs. As part of the 3FM Project, the concentrations of suspended solids arising during dredging at each of the project areas have been modelled for different stages of the tide and the projected figures, presented in Chapter 13 are broadly in keeping or better than the overview of concentrations that can arise during dredging outlined above. Note that no overspilling will be permitted for the 3FM Project capital dredging campaigns and the models in Chapter 13 have taken that into account.

A review of the literature on the subject indicates that fish mortality due to dredge plumes is extremely unlikely because the concentrations generated are generally much lower than those shown in experiments to give rise to mortality in the vast majority of species including salmonids and that includes larvae, juvenile and adults (see Wilber and Clarke, 2001). In general, fish are more likely to undergo sublethal stress from suspended sediments rather than lethality because of their ability to move away from or out of an area of higher concentration to one of lower concentrations. Outward migrating salmonids for example have been shown to move away from dredge plumes (Johnson, 2018) and inward-migrating salmon in Ireland often have to travel through high turbidity zones in estuaries such as the River Suir, downstream of Fiddown Bridge, where the suspended solids at some stages of the tide can be several hundreds of milligrams per litre. When given a choice between clear and more turbid water salmonids will choose less turbid conditions (Johnson, 2018).

Sub-lethal effects such as gill abrasion and associated gill hyperplasia has been noted in cod exposed for extended periods (up to 10 days) to 500mg/l suspended sediment (Humborstad *et al.,* 2006) and it is likely that other species would have similar type responses under similarly extended exposure at high suspended solids concentrations. Other effects include increased stress, which might lead to reduced growth or reduced egg production etc. Behavioural impacts include reduced foraging success by visual predators due to increased turbidity and reduced light (Wenger *et al.,* 2017). This might also benefit certain prey fish as they would be less likely to be captured by larger predator fish and perhaps be less susceptible to capture by piscivorous birds also. How these impacts play out at a community level is very difficult to predict and would probably depend to some extent on a combination of the sensitivity of the species or life stage present and the importance of any habitats affected for fish.

In relation to Dublin Port, we know that it is a transit area for migrating salmon, eel and lamprey, none of which will be significantly impacted by the turbidity. We also know that the resident fish populations will be exposed to periodic increased in turbidity associated with storm surges, high river flows and more frequently by vessel manoeuvring within the port, which has been shown elsewhere to generate locally elevated suspended solids levels. Most of the benthic species including gobies, flounder, plaice, pogge, butterfish and dragonet are much less likely to be negatively affected by increased turbidity given that they are more likely to encounter elevated conditions on a fairly regular basis, given their bentho-demersal habitat. In all cases dredging will be intermittent, confined mainly to the southern side of the channel and include regular gaps in the cycle while the TSHD dredger or dredge spoil barge steams the 10km to and from dumpsite, during which time the dredge plume will significantly drop in suspended solids concentration. Moreover, the dredging operations will be split over 10 winter seasons within the 15 year construction programme so their impacts will not be additive.

Within the port area itself there are no known concentrations of fish spawning, with most of the species using the port being offshore midwater spawners, e.g., mullet, bass, plaice, flounder, sprat etc. It is possible that sand gobies (*Pomatoschistus minutus*) and butterfish (*Pholis gunnellus*) both of which are benthic spawners which also guard their eggs while they develop, may spawn in more shallow inshore waters than the other species mentioned and therefore may be more vulnerable to deposition of sediment from dredger plumes. Pogge have demersal eggs but their larvae and settled juveniles are widely dispersed within the Irish Sea (van der Molen *et al*., 2007), like most of the fish recorded within the Lower Liffey Estuary (Bunn & Fox, 2004). If this effect does occur it is likely to be localised to the area around the dredging footprint. Furthermore, certainly in the case of gobies, which can have more than one cohort per annum in temperate waters and are likely to be present all-around Dublin Bay, they will not be significantly impacted at a population level, and the same is thought likely for butterfish. Overall, the resident estuarine and marine migrant fish population will experience some degree of sub-lethal stress and temporary and localised community disruption associated with elevated turbidity levels during the dredging process but that stress will be in line with a constant lower level of stress associated with turbidity generated by ship movements, storm surges from the east and high river flows, along with periodic higher stress associated with maintenance dredging within the port. Accordingly, turbidity-associated impacts on the resident estuarine/marine species in the project area is expected to be slight, negative and temporary to short-term in duration in the absence of mitigation.

Entrainment

Resident Marine/Estuarine Fish and Invertebrates

Reine *et al.,* (1998) undertook a review of the literature examining entrainment, which they define as: *the direct uptake of aquatic organisms by the suction field generated at the draghead or cutter head of a dredger*. They go on to point out that entrainment-related restrictions are commonly requested to protect life history stages of many commercially or recreationally important species as well as species listed as threatened/endangered. Different species have different susceptibilities to being entrained, and while the data they draw on is entirely North American based, the life histories of many of the species involved have many equivalents in European temperate waters. The species with the greatest propensity to be entrained were Dungeness crabs (*Metacarcinus magister*) and shrimps (*Crangon* sp.). In the context of Dublin, the equivalents would be green crab (*Carcinus maenas*) and brown shrimp (*Crangon crangon*), both of which are widespread in the Lower Liffey estuary (ASU, 2020). In terms of fish, demersal species were more susceptible than pelagic species, even though pelagic species could also be entrained. The demersal species Reine *et al.,* (1998) were referring to included Pacific sand lance (*Ammodytes hexapterus*), Pacific sanddab (*Citharichthys sordidus*) and staghorn sculpin (*Leptocottus armatus*) and the Lower Liffey equivalents would be sandeel, plaice and flounder, and Long-spined sea scorpion, respectively. Other species living on and close to the bottom likely to be entrained during dredging include sand gobies, pogge and dragonet. The degree to which other demersal species which are less benthic in their habits including grey mullet, bass and gadoids such as cod, whiting and pollock, or truly pelagic species such as sprat, will be entrained will depend a lot on their presence within the dredge area during dredging, as well as their sensitivity to sound and turbidity plumes which could also affect their susceptibility to entrainment. The review also notes that hopper dredgers (i.e., TSHD) entrained higher numbers of fish per unit of dredged volume compared to clam shell dredgers, the latter likely to be similar to back hoe dredgers in the 3FM Project, where they are expected to be used to excavate the side slopes of the dredge areas. Another consideration for the potential impact on the resident estuarine and marine migrant populations in the Lower Liffey, is the fact that the areas to be dredged in both the proposed dredging campaigns amount to just under 7% of the subtidal area within the Lower Liffey Estuary from Tom Clarke Bridge to the outer end of proposed ESB jetty in the case of the Area N dredging campaign, and just under 14% of the area in the case of the other campaign, comprising principally the new marina and the turning circle dredge areas. The fact that the density of fish and certain mobile invertebrates will be at their lowest annually, at least during part of the proposed October-March dredging campaign, with several species moving to deeper and warmer offshore waters either to preserve condition or to prepare for spawning, will reduce the overall exposure at a community level to dredging-related impacts.

Migratory Species

In the context of anadromous fish, Reine *et al.,* (1998) quote studies which show that salmonids can be entrained in significant numbers in narrow river channels. For the 3FM Project, the areas with the highest risk could be said to be toward the western end of the project area i.e., toward the Tom Clarke bridge where the channel is at its narrowest. However, in the context of a single active dredger, with a draghead of 2-3m wide plus another ~1m either side with sufficient suction velocity to draw in fish and mobile epibenthos, there is some but perhaps not that much more risk in terms of channel width between the upriver and seaward ends of the project area. Despite this however, dredging upstream of Berth 49 (narrowest section of the Liffey) will not take place from mid-March to May inclusive thereby avoiding the bulk of outward migrating salmon smolts from the Liffey. The fact that the dredging will take place in the October-March campaign, instead, means that the vast bulk of the inwardly migrating adult salmon will also be avoided. The only anadromous species which will potentially be most exposed to entrainment will be river lamprey, which migrate from late September to May on the Liffey with peaks in November/December and March/April, and to a lesser extent, outward migrating silver eel in late autumn and early winter. However, dredging will be confined to the southern half of the channel and lamprey and eel tend to mainly migrate at night, factors which will both reduce exposure of a significant portion of the population at any one time. Furthermore, the splitting of the operations into two separate years and the fact that dredging will not occupy the full six-month period in either, will also reduce the risk of exposure. Finally, the fact that the active draghead will likely constitute no more than 2% to 3% of the width of the channel at any location means that the opportunities for entrainment will also be relatively low. In the case of lamprey, as mentioned previously, the fact that much of the Liffey population in any given year remains within the catchment for three to five years as ammocoetes, combined with the fact that lamprey are believed to only be weakly homing i.e. may not return to their river of spawning (Bergstedt and Seeley, 2004 quoted in Kimmo, 2015), means that any entrainment-related mortalities are unlikely to have a significant negative impact on the Liffey population. The same can be said of the likely impacts on the Liffey eel population, for more or less similar reasons.

The consensus in the Reine *et al.,* (1998) review is that entrainment is unlikely to pose a population level risk to any species and that is also likely to be the case for the 3FM Project. In terms of mitigation, Drabble, (2012, and Reine *et al.,* (1998) noted that when the drag head was off the bottom and still pumping water through the intake that the rate of entrainment of mobile epibenthos increased markedly, so in addition to the non-dredge window of mid-March to May referred to above, it is also proposed that to reduce the rate of entrainment, the pumps should be turned off while the dredger drag head is off the bottom, e.g. while the dredger is switching between dredge lines.

Overall, therefore, it is expected that the dredging operation associated with the 3FM Project, will have a localised, slight negative, temporary to short-term, impact on the estuarine/marine resident fish and invertebrate community in the Lower Liffey estuary, in the absence of mitigation, and a negligible impact on the anadromous (salmon and lampreys) and catadromous (eels) fish populations of the River Liffey.

Potential Impacts of dredge spoil disposal on fisheries

A review of the turbidity generated in open water dredge spoil disposal sites (Truitt, 1988) showed that significantly elevated turbidity levels are generally confined to the lower 15-20% of the water column depth, declining by orders of magnitude toward the surface. Turbidity levels at all depths decline rapidly, approaching background levels within a matter of minutes to tens of minutes, with the bottom levels declining slowest. In view of the rapid dissipation of water column turbidity after each disposal event, it is not expected that this aspect of the operation will give rise to any significant impacts on fish species in the area, due to the very short period of exposure to elevated turbidity. In the case of the Dublin Bay dump site, based on the Truitt (1988) review, one would expect high concentrations up to several thousands of milligrams near the dredger during disposal with levels dropping rapidly within the plume toward the edge of the disposal site to the low hundreds of milligrams or less. Thus, each dumping event will be associated with a unique and rapidly dissipating suspended solids plume.

In Chapter 13 the site-specific dispersion for the Dublin dump site produced predicted suspended solids concentrations which broadly concur with this overview. Specifically, when modelled over a full month of disposal, the maximum spatial envelope within the maximum concentration contour of 200mg/l, which due to the general tidal flow at the site forms a roughly north-south oriented lens shape, extended no more than 750m north and south of the dump site. he central area of the envelope contains higher maxima as, this is where the dumping will take place. It is important to note, that these are maximum concentrations, and the equivalent envelope for average concentrations, is fully confined to the dump site itself occupying less than half of its area and with an average concentration of less than 50mg/l throughout (see Chapter 13). Fish living on or very close to the bottom, e.g., small dab, plaice, dragonet, lesser weever fish and gobies etc., immediately beneath the dredger hopper during a disposal event may be buried, killed or injured by the descending bulk spoil, whereas others within the water column in and adjacent to the plume are likely to avoid the area. Such effects are expected to be largely localised to the dump site area.

A reduction in the biomass of benthic infauna (worms, bivalves, crustacean etc), as well as mobile epibenthos e.g., shrimps and crabs as a result of the dredge spoil disposal would be expected to temporarily reduce the available food for fish in the area. Again, this effect will be mainly confined to the disposal area and diminish with time. This does not mean however that bottom dwelling fish will be absent from the site following the spoil disposal. Desprez (2000) commenting on sites recovering from marine aggregate extraction, indicated that while sites are still in their recovery phase, they are also likely to be used by fish if prey suitable for them is present. In one of the few studies in which fish were surveyed before and after a dredge spoil disposal campaign, Pezy *et al.,* (2017) recorded an increase in sole, plaice and dab at a site where large volumes silty sand were disposed of off the mouth of the Seine Estuary, suggesting that the dumping may have increased certain benthic prey species attractive to the fish. This is in keeping with the observation that the benthic community which initially colonises dredge spoil disposal sites is often dominated by rapidly growing, small-bodied infauna, situated close to the sediment surface, especially if the material being disposed of is high in organic matter such as the sediments around the Area N dredge area are likely to be. The high density of these invertebrates can significantly increase the secondary production of disposal sites providing an increase in food for benthic feeding fish, especially juveniles (see Lunz 1983 quoted in LaSalle *et al.,* 1991).

Again, however, the key point to emphasise is that the site and its immediate adjoining ground is being used by a wide variety of fish, a fact reiterated by a recent trawl survey on the site (June 2023) using the same trawl lines as the July 2022 survey which returned 114 individual, from 13 species, which included most of the most abundant and frequently occurring species, along with three not previously recorded (brill, *Scophthalamus rhombus*, rockling, *Ciliata mustela* and solonette, *Buglossidium luteum*). On this basis, given the small size of the site within the Dublin Bay as a whole, it is expected that the disposal of the 1,189,000m^3 of dredge spoil at the dump across two separate campaigns will have at most a localised, time limited impact on the fish community in the area. This impact is categorised as slight, negative and temporary to short-term because of the widespread adjacent availability of comparable fish feeding habitat in that area.

7.3.4 Remedial & Mitigation Measures

The following key mitigation measures shall apply to Capital Dredging to minimise the impact of the proposed works on marine ecology:

- No over-spilling at the surface of the dredger for all dredging activities within the inner Liffey Channel will be permitted. This includes all proposed capital dredging required for the 3FM Project;
- The dredger will work on one half of the channel at a time within the inner Liffey channel to prevent the formation of a silt curtain across the River Liffey;
- A schedule of no-dredging windows has been prepared and will apply to specified locations in the navigation channel. The capital dredging of sediments within the navigation channel will be carried out during the winter months (October – March) to negate any potential impact on salmonid migration (particularly smolts) and summer bird feeding, notably terns, in the vicinity of the dredging operations. In addition, upstream of Berth 49 the no-dredging period will be extended to include the period from 15th March to 31st March.

- A trailing suction hopper dredger (TSHD) or back-hoe dredger will be used for the capital dredging works. When operating in the River Liffey Channel, the TSHD pumps will be switched off when the drag head is being lifted and returned from the bottom as the dredger turns between successive lines of dredging to minimise the risk of fish entrainment.
- A maximum of 4,100m³ of sediment and entrained water will be loaded into the dredger's hopper for each loading/dumping cycle.

The following key mitigation measures shall apply to impact piling activities to minimise the impact of the proposed works on fisheries:

- No impact piling for construction activities for the SPAR Bridge, SPAR Viaduct, the Maritime Village and Ro-Ro Terminal will take place during March to May inclusive, the three months of the year when vulnerable smolts are likely to run in their highest numbers.
- Due to the greatly reduced number of adult salmon returning in recent years, down to circa 250 individual salmon, an additional no-piling window will apply to July and August for impact piling at the Ro-Ro Terminal.
- The July-August closed period for piling also applies to impact piling at the Turning Circle boundary wall and temporary works piling.
- The July-August closed period for piling also applies to the Lo-Lo Terminal (Area N outer piles and dolphins).

Mitigation by avoidance has also been used, where possible. A summary of the Closed Periods identified by the mitigation measures are set out below:

<u>Capital Dredging</u>

Mitigation by avoidance includes restricting capital dredging to the winter seasons (October to March) to avoid disturbance of nesting terns. The proposed capital dredging Closed Periods are set out in Figure 7.71.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
All Capital Dredging												
Upstream of Berth 49 includes the period 15th to 31st March												

Figure 7.71 Capital Dredging Closed Periods (denoted by orange coloured cells)

<u>Piling Activity</u>

Riverside impact piling activity is also restricted to avoid disturbance of migrating salmon. The proposed Closed Periods for riverside impact piling are set out in Figure 7.72.

- The period March to May represents the peak smolt run (river to sea)
- The period July to August represents the peak adult salmon return (sea to river).

Vibratory piling is allowable during these periods.

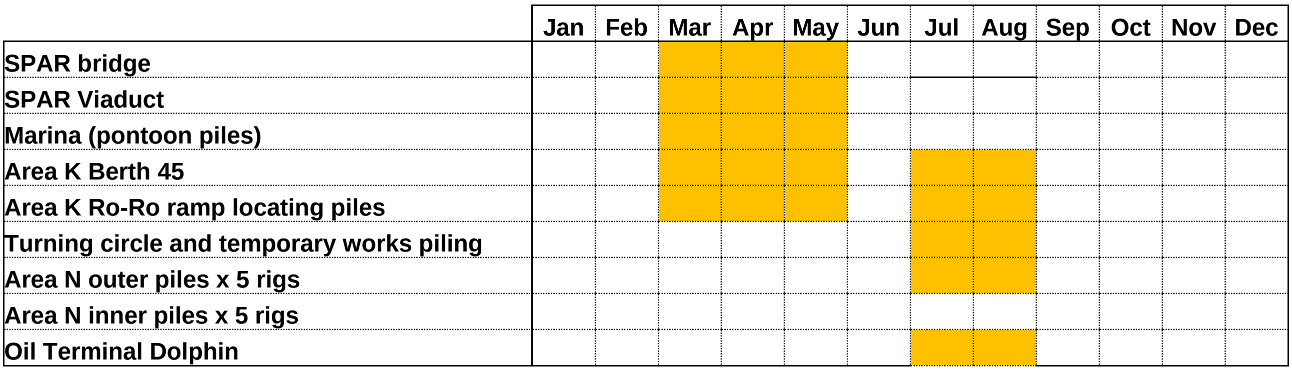

Figure 7.72 Impact Piling Closed Periods (denoted by orange coloured cells)

7.3.4.1 Cumulative Impact

Chapter 5 of the EIAR identifies and describes other related projects in proximity to, or whose zone of influence might overlap with the proposed 3FM Project. This section considers the potential for cumulative impacts specifically in relation to benthic biodiversity and fisheries of the proposed 3FM Project in combination with other existing and/or approved projects, and projects which, at the time of assessment, were yet to be approved but for which a decision is likely during the consenting and construction period anticipated for the 3FM Project. It should be noted that cumulative effects of the 3FM project and other projects on the European sites and their Qualifying Interests are appraised in the Natura Impact Statement submitted with the application for permission.

The projects that could potentially have cumulative impacts on benthic biodiversity and fisheries in conjunction with the 3FM Project have been identified from the list of projects in Chapter 20 by considering their potential for cumulative effects on benthos and fisheries, the location, scale and nature of the projects, the zone of influence of individual projects, and the likelihood of temporal overlap. Pressure sources and pathways were also considered in assessing the potential for cumulative effects in relation to benthos and fisheries. The following assessments address the potential cumulative effects in a proportionate manner to ensure that all main sources of potential impact are considered.

Alexandra Basin Redevelopment (ABR) – ABP Reg. Ref. PL29N.PA0034

The proposed ABR development works comprise the following main elements:

- Capital dredging of the navigation channel to -10m CD, from 50m downstream of East Link Bridge to Dublin Bay Buoy over a six year period.
- Refurbishment and construction of quay walls in Alexandra Basin West. This includes installation of Ro-Ro ramps and construction of a Ro-Ro jetty. The basin is to be dredged to -10.0m CD and the contaminated dredged material is to be treated for re-use as infill on site.
- The Bulk Jetty is to be demolished and ore concentrates loading operations are to relocate o Alexandra Quay West Extension.
- Excavation and restoration of Graving Dock No.1 and Infilling of Graving Dock No. 2 with treated dredged material will facilitate development of a Cultural Heritage interpretative space

- Existing Berth 52/53 is to be infilled with treated dredged material, and existing surface levels raised by approximately 1.4m. This includes quay wall construction, mooring jetty construction and installation of Ro-Ro ramp

The ABR Project is currently in late construction stage having been granted permission by An Bord Pleanála (ABP) in July 2015 (ABP Ref. 29N.PA0034). Capital Dredging was completed in 2021. The remaining construction works with potential to impact benthos and fisheries are completed, or at an advanced stage and will be completed before the commencement of the 3FM Project. No significant ABR operational impacts are envisaged. Therefore no cumulative impacts are likely.

MP2 Project – ABP Reg. Ref. ABP-304888-19

The MP2 Project was granted planning permission by ABP on 1 July 2020 and must be completed within 15 years of that date. The project is located mainly within the northern lands of Dublin Port, and the project also includes capital dredging works within Dublin Port Harbour.

The works proposed as part of the MP2 Project are summarised as follows:

- Construction of a new Ro-Ro jetty (Berth 53) for ferries up to 240m in length. This requires dredging of a berth pocket and installation of slope stabilisation mattresses, installation of piles for jetty and dolphins, and vertical piles for a wash protection structure.
- A reorientation of the already consented Berth 52 (ABP Ref. 29N.PA0034) and modification to Berth 49. These works include Infilling of the old berth 52 basin, using a rock armour causeway to initially seal the basin, and construction of a new quay wall.
- A lengthening of an existing river berth (50A). This will comprise the construction of a new sheet pile to the west end of Berth 50A, and excavation of Pier Head at the Eastern Breakwater and the south end of the existing Oil Berth 3/4 jetty. Sheet pile combi-walls walls will be installed and the void between existing wall at Oil Berth 3 and the proposed new wall will be filled with engineering fill. Dredging in front of existing Berth 50A will be completed over one month.
- The redevelopment of Oil Berth 3, and infill of Oil berth 4, as a future deep-water container berth for the Container Freight Terminal. This will entail installation of sheet pile combi-walls, dredging of Berth 3 and infilling of Oil Berth 4.
- Channel widening works will comprise dredging over one season (October to March).
- Redevelopment of the ferry terminal yard including consolidation of passenger terminal buildings, demolition of redundant structures and buildings, and removal of connecting roads to increase the area of land for the transit storage of Ro-Ro freight units as a Unified Ferry Terminal (UFT)
- Installation of a heritage zone adjacent to Berth 53 and the Unified Ferry Terminal set down area.

Of these, the final two bullets entail landside works and will not impact benthos and fisheries. They are not considered further. The works will be phased throughout the life of the MP2 Project and are scheduled for completion in 2032. The main pressures of concern that could give rise to cumulative impacts are dredging operations and piling noise.

The first capital dredging campaign as part of the MP2 Project took place between October and December 2022. The localised widening of the channel and majority of dredging at Berth 53 was completed. Berth 52 and 53 construction is expected to commence in 2024 and will be completed before the commencement of the 3FM Project. Dredging activity for the 3FM Project has been programmed to ensure that there will be no overlap with either the MP2 Project capital dredging programme or DPC maintenance dredging campaigns.

Both MP2 Project and 3FM Project dredging impacts on benthos habitats are considered to be minor, negative and temporary, with recovery expected to occur rapidly once dredging has been completed. Some small amount of permanent habitat loss is expected to occur but will have minor impact considered in the context of the large area of similar habitat present within the Dublin Port area. DPC will ensure that dredging works for MP2 Project and 3FM Project occur over separate winter periods. The phased nature of dredging elements, the small spatial extent of areas affected, and the lack of overlap between MP2 Project and 3FM Project dredging campaigns will allow benthos habitat and biodiversity to recover rapidly, both in the dredged areas in the harbour and at the dump site, and will avoid any significant cumulative impacts.

Impacts of suspended solids due to dredging during both MP2 Project and 3FM Project on fisheries are expected to be just slight negative and temporary. No fish species should be negatively impacted at the population level due to the dredging proposed in these projects. Therefore cumulative impacts on benthos and fish is expected to be negligible.

Underwater noise from pile driving during construction could negatively impact fish. Significant mitigation is being implemented for both the MP2 Project and 3FM Project in relation to underwater noise due to piling. This includes observing a soft start to percussive piling, and a progressive ramp up to maximum percussive piling energy. DPC will also ensure that piling operations at Area K as part of the 3FM Project, which is on the south side of the channel opposite MP2 construction locations to the north of the channel, will not take place simultaneously. This will ensure there will be no cumulative piling impacts on fish.

All potential piling impacts are confined to the inner harbour and significant impacts by either project are not likely in Dublin Bay. Piling in the River Liffey Channel upstream of Berth 49 will not take place between March and May in order to avoid the main salmon smolt run. Neither will piling take place in July and August upstream of Berth 49 or driving of the outer piles at Area N in order to avoid the peak of the adult salmon run to spawning grounds. This will mitigate the risk to migratory salmon. Provided the suggested mitigation measures as listed in the environmental chapters are employed during construction and/or operation the overall impact to the environment, even considered in combination, is considered negligible. As a result there will be no significant impact on benthos and fisheries by either project and no cumulative effects.

Dublin Port Maintenance Dredging Programme 2022–2029 – Foreshore Licence FS007132 / DAS Permit S0004-03

DPC has permission to carry out regular maintenance dredging over an eight-year period, 2022 to 2029, with an annual maximum permissible dredging volume of 300,000m^3. Maintenance dredging is confined to the period April to September with a closed period operating between 01 April to 14 May in the inner Liffey channel upstream of Berth 49 (including the main channel and side berths but not including basins). Maintenance dredging will not overlap with the 3FM Project capital dredging project which will be restricted to winter months

(October to March). The loading of dredged material will be restricted to those areas of the navigation channel, basins and berthing pockets which contain sediments which are suitable for disposal at sea (Class 1: uncontaminated, no biological effects likely).

Dredging impacts on benthos and fisheries are considered to be short-term and minor negative, with recovery expected to occur rapidly once dredging has been completed. The phased nature of maintenance and capital dredging elements, and their separation into discrete periods will allow benthos habitat and biodiversity to recover rapidly, both in the dredged areas in the harbour and at the dump site, and will avoid any significant cumulative impacts on benthic biodiversity or fish species.

Dublin Harbour Capital Dredging Project – Foreshore Application FS007164/DAS Application S0033-01

DPC is currently seeking permission to undertake capital dredging within Dublin Harbour to deepen areas of the navigation channel and basins that were not dredged by the ABR Project to -10m CD (excluding Alexandra Basin West). The total volume to be removed is circa 500,000m^3. The loading of dredged material will be restricted to those areas of the navigation channel, basins and berthing pockets which contain sediments which are suitable for disposal at sea (Class 1: uncontaminated, no biological effects likely).

Capital dredging under the Dublin Harbour Capital Dredging Project has the potential to overlap temporally with the 3FM Project, however DPC will programme these works to ensure they occur over separate winter periods, resulting in no cumulative impacts on bentic biodiversity and fisheries.

Irish Water – Ringsend WwTP –Upgrade Project BP Ref. PL29S.301798

Irish Water has submitted a planning application for strategic infrastructure development to An Bord Pleanála (Ref. PL29S.301798) seeking permission to further progress the upgrade of the Ringsend Wastewater Treatment Plant (WwTP). The application seeks permission for works required to facilitate the use of Aerobic Granular Sludge (AGS) technology, to omit the previously permitted long sea outfall tunnel and to upgrade the sludge treatment facilities at Ringsend, Dublin 4, and to provide for a Regional Biosolids Storage Facility in Newtown, Dublin 11. The proposed development at Ringsend is on the south bank of the River Liffey. The application was granted permission in April 2019. Construction works will largely be land based and unlikely to have any significant impact on benthic biodiversity and fisheries.

The NIS assessment concluded that the operational phase of the proposed upgrade will result in water quality improvement in Inner Dublin Bay because of a reduction in nutrient load, and that there will be no negative effect on the integrity of any European site as a result. Cumulative impacts on benthic biodiversity and fisheries in conjunction with the 3FM Project are therefore unlikely.

The Howth Yacht Club Marina Extension - DAS Permit Reg. No. S0010-01

Howth Yacht Club (HYC) is proposing to extend the marina at Howth within the confines of the existing breakwater. A Dumping at Sea Permit was granted in August 2011 (Reg No. S0010-01) for the disposal of 120,000 tonnes of dredged material at the licensed offshore spoil grounds located to the west of the Burford Bank, the same offshore site for the dredge spoil from the 3FM Project.

HYC estimated a maximum daily quantity for dumping of 1,200 tonnes, and 800 tonnes in each load. It also suggested a spring or winter commencement and campaign duration of six months. This volume of material is equivalent to approximately 6% of the annual quantity of material permitted under Dumping at Sea Permit S0024-01 for the ABR Project.

No dumping at sea under the HYC permit has taken place since it was granted in 2011. In the unlikely event that this work was to proceed during the construction phase of the 3FM Project, all dumping will be subject to the approval of the Dublin Port Harbourmaster and dumping activity will not be permitted by the Harbourmaster for DPC and HYC operations simultaneously. Given this, and the relatively small volumes for disposal no cumulative impact on benthic biodiversity and fisheries is expected.

ESB / Uisce Éireann Discharge Channel - ESB Poolbeg Cooling Water Channel Sheet-Pile Repairs

The works to repair and upgrade the UWWT plant discharge channel adjacent to the ESB Poolbeg Generating Station are expected to be completed prior to the commencement of the 3FM Project. ESB's repair and upgrade works are likely to result in scour and redistribution of soft, organic rich sediments that have accumulated in recent years at the damaged outfall weir. This will result in some loss of muddy habitat and replacement with habitats of coarser sediments. Given the extent of soft muddy benthic habitat within harbour area, the cumulative impacts are likely to be minor negative and not significant.

7.3.5 Residual Impact

Impacts to intertidal habitats are principally related to reductions in the amount of intertidal hard substrate or alterations to its community composition due to increased shading. Introductions of new hard substrates in the shallow subtidal in the form of scour protection, at the new marina and turning circle, as well as new hard surfaces associated with the new marina pontoons and piles will together partially offset the other impacts in these areas. Shading is also likely to reduce the quality of the intertidal and subtidal soft sediment habitat for fish beneath the Lo-Lo wharf in Area N and this remains a moderate, negative impact of medium to long-term duration for the nursery function of the Lower Liffey estuary. Impacts on resident and migratory fish communities within the port and on the dump site associated with dredging and dredge spoil disposal are expected to be minor, negative and temporary to short-term in duration.

Impacts to subtidal benthic habitats within Dublin Port will be limited to a number of activities from the proposed development. Areas to be dredged will result in the temporary disturbance of soft sediment habitats within the immediate footprint of the dredge area. The impacts associated with the dredging are expected to be minor, negative and temporary, with recovery expected to occur within 12 months following the completion of the dredging in these areas. Permanent habitat loss is expected to occur within the footprint of the piles and stanchion structures that will be placed to accommodate the creation of the SPAR Bridge, SPAR Viaduct, Poolbeg Marina and the proposed Wharf at Area N. The impacts associated with this habitat loss is considered to be negative and permanent, but minor considered in the context of the large area of similar habitat present within the Dublin Port area. Increased water flow in the vicinity of the new bridge structure will likely result in the establishment of coarse benthic communities – similar to the existing community identified at B_02 in the present survey.

A number of locations within the areas to be dredged will be re-enforced with scour protection in the form of rock armouring placed onto the seabed immediately below MLWS. This will result in the permanent loss of the soft sediment communities within these footprints. However, the placement of the rock armouring will result in the creation of new hard-benthos habitat, potentially increasing biodiversity in the area. As a result, the impact is considered neutral.

The disposal of 1,189,000 m^3 of mixed sediments at the dump site is not expected to have any impact on the benthos outside the footprint of the disposal area. Impacts will occur within the immediate footprint of the disposal area, but these are expected to be temporary, with partial recovery reached within 12 months, and full recovery expected within three to five years post cessation of disposal activities.

7.3.5.1 Conclusion

The infrastructural changes associated with the 3FM Project are significant and complex and will give rise to a range of positive and negative impacts. Temporary habitat disturbance from the dredging activities is not expected to result in any long-term impact, with recovery occurring rapidly on cessation of dredging activities. Loss of sub-tidal habitats associated with the installation of piles in particular are deemed minor due to the large amount of similar habitat present in Dublin Port. On the other hand, however, the introduction of extensive areas of shade by the SPAR Viaduct and the wharf at Area N will have negative effects on the habitats affected. However, all these changes need to be viewed in the context of the Lower Liffey Estuary as a busy port and a busy recreational boating and angling area, whose natural intertidal habitats have been dramatically altered and largely degraded down the decades. And, despite the proposed changes, the importance of the Lower Liffey as a locally important nursery ground for estuarine/marine residents and migrants will remain substantially intact and fully functional and its role as a conduit for inwardly and outwardly migrating anadromous and catadromous species for the wider River Liffey catchment will remain fully intact.

7.4 Marine Mammals

This section assesses the potential impacts of the 3FM Project on marine mammals and their habitats and any resulting implications for marine mammal biodiversity in the zone of influence of the 3FM Project. Baseline data in relation to marine mammals and relevant environmental information in the Dublin Bay region relevant to the 3FM Project is described. Potential project impacts are identified and their significance assessed, and mitigation measures are presented where relevant.

7.4.1 Methodology

Dublin Bay and the adjacent marine areas are an important site for marine mammals. Grey and harbour (common) seals occur all year round within this area, and a Special Area of Conservation (SAC) for harbour porpoise and reefs extends from Rockabill to Dalkey Islands off the Dublin coastline. Only three sites have been formally designated in Ireland for the protection of harbour porpoise. Bottlenose dolphin, common dolphin, and minke whale occur regularly, while humpback whales and Risso's dolphins are occasionally recorded adjacent to Dublin Bay. All cetaceans are strictly protected under EU legislation (Annex IV of the EU Habitats Directive).

In 1981, United Nations Educational, Scientific and Cultural Organisation (UNESCO) recognised the importance of Dublin Bay by designating North Bull Island as a Biosphere because of its rare and internationally important habitats and species of wildlife. To support sustainable development, UNESCO's concept of a Biosphere has evolved to include not just areas of ecological value but also the areas around them and the communities that live and work within these areas. In 2015, the Biosphere was expanded to cover Dublin Bay, extending over 300 km^2. Biospheres are places where nature and culture connect. They are internationally recognised for their biological diversity yet also actively managed to promote a balanced relationship between people and nature. A biosphere is a special designation awarded by UNESCO but managed in partnership by communities, NGOs and local and national governments. The biosphere designation brings no new regulations; its aims are achieved by people working together.

Fair Seas, a coalition of Irish environmental non-governmental organisations (eNGOs) and environmental networks, has identified the east coast of Ireland as a high biodiversity "Area of Interest" for potential Marine Protected Area (MPA) designation in their report "Revitalising Our Seas (2022)". Ireland's east coast is an extremely rich area for sea birds, is one of only two cod spawning grounds in Irish Waters, home to *Nephrops* (Dublin Bay Prawns) and boasts 37% of Ireland's harbour porpoise sightings.

7.4.1.1 Cetacean Surveys: Dublin Coastal Area

The Irish Whale and Dolphin Group (IWDG) has been operating a Cetacean Sighting Scheme since 1991, which validates and logs all cetacean sightings, including casual sightings reported. The data is accessible online and has been reviewed (Berrow *et al*. 2010; Wall *et al*. 2013). The IWDG database was accessed in March 2023 to prepare marine mammal distribution maps. Records from the last 10 years (2013-2023) are presented for the four main species frequently recorded in Figure 7.73.

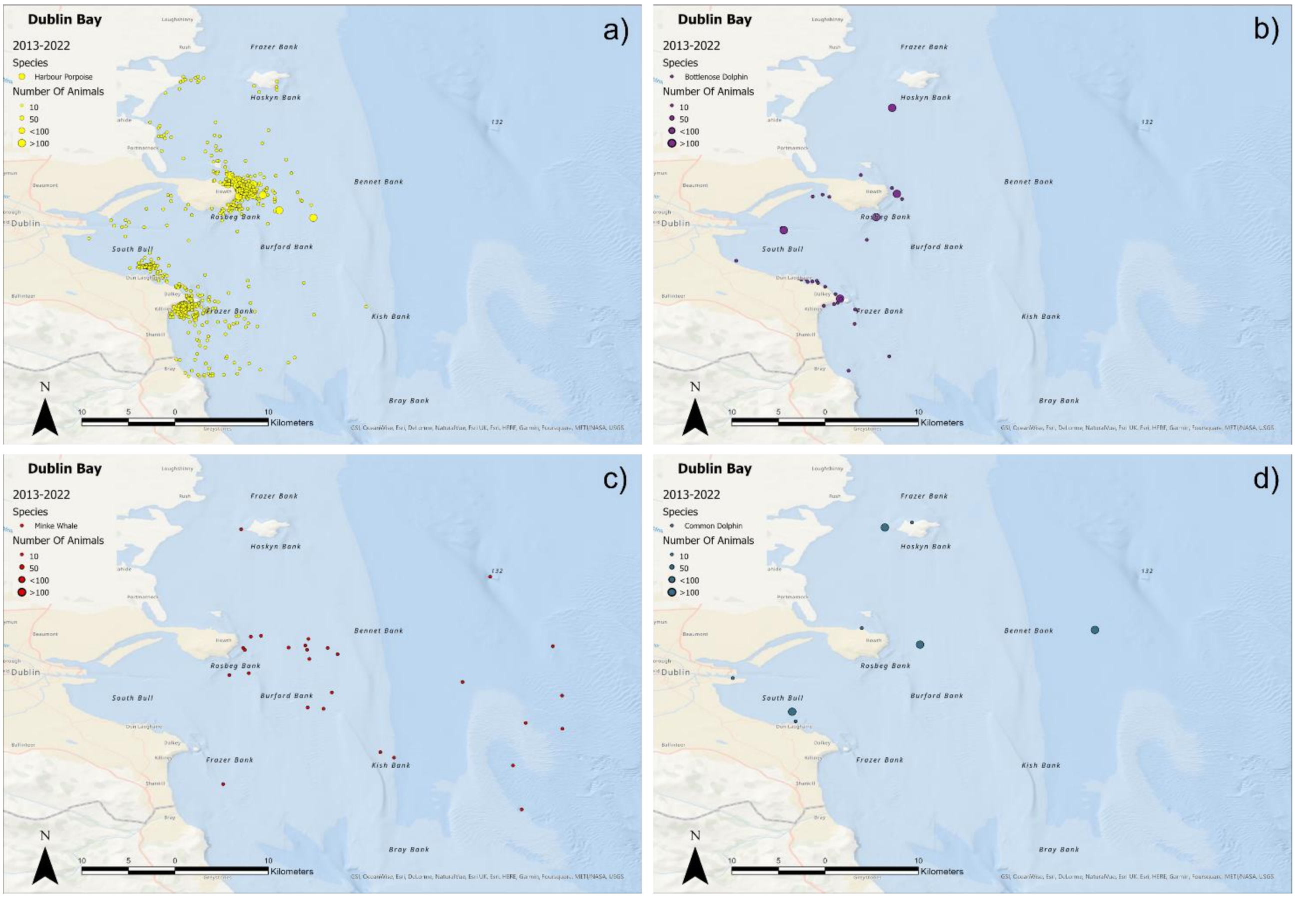

Figure 7.73 IWDG sighting records from 2013 - 2022. a) harbour porpoise, b) bottlenose dolphins, c) minke whale and d) common dolphins recorded in Dublin Bay © IWDG

Dedicated surveys of harbour porpoises in the Dublin coastal area were first carried out in 2008, when distance sampling was used to calculate density and abundance estimates of porpoises off the North County Dublin coastline and Dublin Bay (Berrow *et al*. 2008; 2014). The Rockabill to Dalkey Island SAC, with harbour porpoise as a qualifying interest, was subsequently designated in 2011. IWDG, on behalf of NPWS, assessed porpoise numbers in the SAC using single platform line transect surveys in 2013, 2016 and 2021 (Berrow and O'Brien 2013; O'Brien and Berrow 2016; Berrow *et al.* 2021). Since 2008 these successive surveys have confirmed the importance of the area for harbour porpoise, and they now provide some measure of inter-annual trends in density and the status of harbour porpoise. However, little is known about their general ecology. The only studies on the diet of harbour porpoise in Ireland were carried out by Rogan and Berrow (1996) and Rogan (2008) but there is little data from the east coast.

Dublin Port's Alexandra Basin Redevelopment (ABR) Project began in 2016. This was the first phase of the Dublin Port Masterplan 2040, reviewed 2018 to be brought forward to construction. The project included a wide range of field studies and extensive monitoring of marine mammals which has led to a significant increase in our knowledge of harbour porpoise in Dublin Harbour, Dublin Bay and in the surrounding area. Monitoring included records of sightings during maintenance and capital dredging campaigns (2017-2022) and acoustic monitoring using an array of sensors deployed in Dublin Harbour and Dublin Bay. These long-term monitoring programmes are continuing and are also a requirement of the ongoing MP2 Project which is the second phase of the Dublin Port Masterplan 2040, reviewed 2018.

Under the ABR Project, a Static Acoustic Monitoring (SAM) programme using C-POD hydrophone devices was initiated to better inform on how harbour porpoise use the licensed dredge spoil grounds prior to, and during, the ABR capital dredging programme and to determine if any displacement occurred. Four locations were monitored in the period from September 2017 to May 2021, and one location monitored from May 2021 to January 2022. As part of the MP2 Project, three locations have been monitored since January 2022 using a combination of C-PODs and F-PODs (the latter is a recent upgraded hydrophone device). SAM is independent of weather conditions once deployed and thus ensures high quality data is collected, but only at a small spatial scale. SAM using C-POD/F-PODs can identify porpoise acoustic feeding buzzes which can provide information of feeding rates. Results show that all sites monitored are important for harbour porpoise, and porpoises were detected on more than 90% of days on average since monitoring commenced. Data collected during acoustic monitoring as part of the ABR and MP2 Projects provides information on seasonal, diel and tidal patterns of porpoise occurrence at individual sites.

7.4.1.2 Seal Surveys: Dublin Coastal Area

Both grey and common seals were surveyed in the Dublin Bay area in 1997 and 1998 by Kiely *et al*. (2000) and also during all-Ireland seal surveys in 2003 (Cronin *et al*. 2004, 2005) (O'Cadhla *et al*. 2007), between 2009-2012 (O'Cadhla *et al*. 2013) and in 2012 (Duck and Morris, 2013).

Little is known of the ecology and foraging behaviour of common and grey seals in the Dublin coastal area. Kiely *et al*. (2000) carried out some photo-identification of grey seals between Skerries and Ireland's Eye to explore the movements of individual seals and their fidelity to particular sites. The diet of common seals off southwest Ireland was described by Kavanagh *et al*. (2007), but similar studies are lacking from the east coast.

Monitoring carried out during the ABR Project and the subsequent MP2 Project has led to a significant increase in knowledge of seals in Dublin Harbour, Dublin Bay and in the surrounding area. Marine mammal sightings, including seals, were recorded during maintenance dredging campaigns in 2016-2018, 2020 and 2021, and during capital dredging in 2017-2021 as part of the ABR Project, and since 2022 as part of the MP2 Project. Monthly seal counts at a haul out site on Bull Island have been carried out since May 2016, with up to 63 individuals recorded during the summer months.

In order to estimate the wider seal populations, a survey of the area of Dublin Bay and the adjacent Dublin coastal areas between Skerries and Dalkey Island, covering important haul-out and pupping sites, was carried out between July 2023 and January 2024. This survey identified a new important haul-out site for harbour seals at Rush Head, and confirmed that both seal species are widespread and numbers are consistent with previous surveys. The survey confirmed North Bull Island as an important haul-out site for grey seals in particular. It also documented an increase in harbour seals using North Bull Island as a haul-out site. Grey seals were much more abundant than harbour seals with maximum counts of 326 in October and 300 in July and a minimum of 167 in November. Harbour seal numbers ranged from 117 to 5, with a peak in July. Pup production was as high as previous estimates suggesting that populations of both seal species are healthy.

7.4.2 Receiving Environment

Dublin Bay extends about 10km north to south along a line from Howth Head to Dalkey Island, and 7km east to west from this outer margin to Dublin Port. The Burford Bank lies along the outer margin of the bay, and the licensed spoil dumping site lies to the west of the Burford Bank.

Amongst the Natura 2000 network of sites in the Dublin Bay area, two SACs are of relevance in terms of marine mammals. The Rockabill to Dalkey Island SAC, which includes harbour porpoise as a qualifying interest, extends southwards from Rockabill for approximately 40km in a strip about 7km wide. It crosses the mouth of Dublin Bay and extends a short distance into the bay. The SAC is 273km^2 in area. The spoil ground for dredged material occurs within this SAC but comprises less than 1% of the SAC area. To the north of Dublin Bay is the Lambay Island SAC which includes both harbour and grey seals as qualifying interests. Although Lambay Island SAC is greater than 15km from Dublin Port, seals are highly mobile and seals from Lambay Island are likely to forage in Dublin Bay and Harbour.

These SACs are designated for three species of marine mammals that are qualifying interests (Table 7.27). It should be noted that the likely significant effects of the project on the European sites and their Qualifying Interests are appraised in detail in the Natura Impact Statement submitted with the application for permission.

Table 7.27 Marine Mammals listed as Qualifying Interests of Special Areas of Conservation in the vicinity of Dublin Bay

Qualifying Interest Species	Rockabill to Dalkey Island SAC	Lambay IslandSAC
Harbour porpoise *(Phocoena phocoena)*	Yes	No
Grey seal *(Halichoerus grypus)*	No	Yes
Common seal *(Phoca vitulina)*	No	Yes

7.4.2.1 Cetaceans, other than harbour porpoise

Bottlenose dolphin and minke whale are frequently recorded in, or adjacent to, Dublin Bay. Bottlenose dolphins have been reported throughout the year, though mainly in the summer and mainly off Howth Head and especially from Dún Laoghaire and south to County Wicklow. Most sightings are of small groups though occasionally large groups of greater than 20 dolphins occur, but usually only for short periods. A small group of three individual bottlenose dolphins frequented Killiney Bay from August 2010 to August 2012 but have not been recorded since. Bottlenose dolphins off County Dublin are part of the highly mobile coastal population which has been recorded all around the Irish coast and some individuals reported off Scotland (O'Brien *et al.* 2009; Robinson *et al.* 2012). In May 2019, a group of Scottish dolphins including an individual known as "Spirtle" was sighted between Dalkey and County Wicklow. Two months later in July the group were observed in Tralee Bay, County Kerry and by December were recorded back in the Moray Firth, Scotland. This demonstrates not only the large movements of bottlenose dolphins, but also the connectivity between apparently distant sites. Surprisingly, there has been no evidence of movement between the east coast of Ireland and Wales, which holds a large number of semi-resident bottlenose dolphins. This highly mobile Irish coastal population is thought to number between 200-400 individuals.

Minke whales occur seasonally, especially off north County Dublin from Howth Head to Lambay Island and on the Kish Bank. They are usually solitary but up to five have been seen foraging in the same area at any one time.

Common dolphins have also been recorded in Dublin Bay and are thought to be more abundant in the Irish Sea in the summer and tend to occur further offshore than bottlenose or Risso's dolphins. They have been recorded from Rockabill to Dun Laoghaire, and two were recorded in the River Liffey in November 2018 upstream as far as Butt Bridge, and also at Poolbeg in March 2022.

Risso's dolphin were regularly recorded to the south of Dublin Bay in the spring and early summer for several consecutive years from 1999 to 2006 but have only been recorded once off County Wicklow over the past 10 years. They were likely part of a wider Irish Sea population whose occurrence is associated with the presence of squid, which may be an unpredictable food source off the east coast.

Humpback whales were recorded in July for two consecutive years in 2010 and 2011 off north County Dublin. Killer whales were observed twice in 2011, off the Kish Bank and Irelands Eye and off Rockabill in November 2018. In October 2019, a juvenile fin whale was recorded off Howth Head and in the River Liffey.

Although not a cetacean, basking sharks are now legally protected since October 2022 under the Irish Wildlife Act (Section 23). IWDG collaborate with the Irish Basking Shark Group and collate and validate basking shark sighting records from Irish waters. Basking shark sightings are rare in Dublin Bay with only one recent validated sighting in 2020.

7.4.2.2 Harbour porpoise

Dedicated porpoise surveys off County Dublin were first carried out in 2008, prior to designation of the Rockabill to Dalkey SAC. At that time two discrete areas were surveyed: off North County Dublin; and in Dublin Bay. Surveys were conducted on six days from July to September 2008, but two of these days gave unusable data (zero or low counts). Although an overall density of 2.03 porpoises per km^2 was reported based on surveys for four of the six days, density estimates ranged from 0.54 to 6.93 per km^2 and three of the four days produced density estimates of 1.06 per km^2 or less. Porpoise densities estimated in Dublin Bay were based on monitoring on four separate days, also from July to September 2008. Overall density was estimated at 1.19 porpoises per km^2 and ranged from 0.48 to 2.05 per km^2 (Berrow *et al.* 2008). The densities off North County Dublin were the highest recorded at any of the eight sites surveyed by Berrow *et al.* (2014), including two candidate SACs (cSACs) off the southwest coast of Ireland which were designated to protect harbour porpoise.

A survey of the newly designated Rockabill to Dalkey Island SAC was carried out in 2013 (Berrow and O'Brien, 2013). Density estimates based on monitoring on five days from July to September ranged from 1.13-2.61 per km^2, with an overall density of 1.44 porpoises per km^2. The combined area of the 2008 surveys (North County Dublin and Dublin Bay) is $220km^2$ and approximates in location and areal coverage to the subsequently designated Rockabill to Dalkey SAC ($273km^2$). An average overall porpoise density for the combined areas in the 2008 surveys is computed at 1.61 per km^2. This value was similar to the 2013 estimated density of 1.44 per km^2.

A further survey of the SAC was carried out on four days from June to September in 2016 which reported densities between 1.37 and 1.87 porpoises per km^2 and with an overall density of 1.55 porpoises per km^2. Again, these density estimates are consistent with previous surveys above, and are high compared to other sites in Ireland supporting the conclusion that Dublin Bay, and especially North County Dublin, provide some of the most important habitats for harbour porpoise in Ireland (O'Brien and Berrow, 2016). Calves consistently accounted for around 7% of the porpoises sighted during surveys and porpoise are thought to move offshore to calve in April-May before moving back inshore.

The Rockabill to Dalkey SAC was surveyed most recently on six days during July and August, 2021. Overall porpoise density was estimated at 0.83±0.14 porpoises per km^2 and ranged from 0.50 to 0.98 per km^2. Overall porpoise density was used to estimate a harbour porpoise abundance of 227±39 individuals for the Rockabill to Dalkey SAC (Berrow *et al*. 2021).

The trend in estimated harbour porpoise density from 2008 to 2021 is shown in (Figure 7.74) (from Berrow *et al*., 2021). The estimated 2021 overall density shows a 46% decline compared to that reported in 2016 and a 42% decline on that reported in 2013. Surveys during 2021 were carried out in very favourable sea conditions and the authors are confident that the density estimates reported are robust and represent a real decline within the Rockabill to Dalkey Island SAC, and a significant decline since monitoring started in 2008. A widespread decline in harbour porpoise density has been observed in Irish waters, and is not restricted to Dublin.

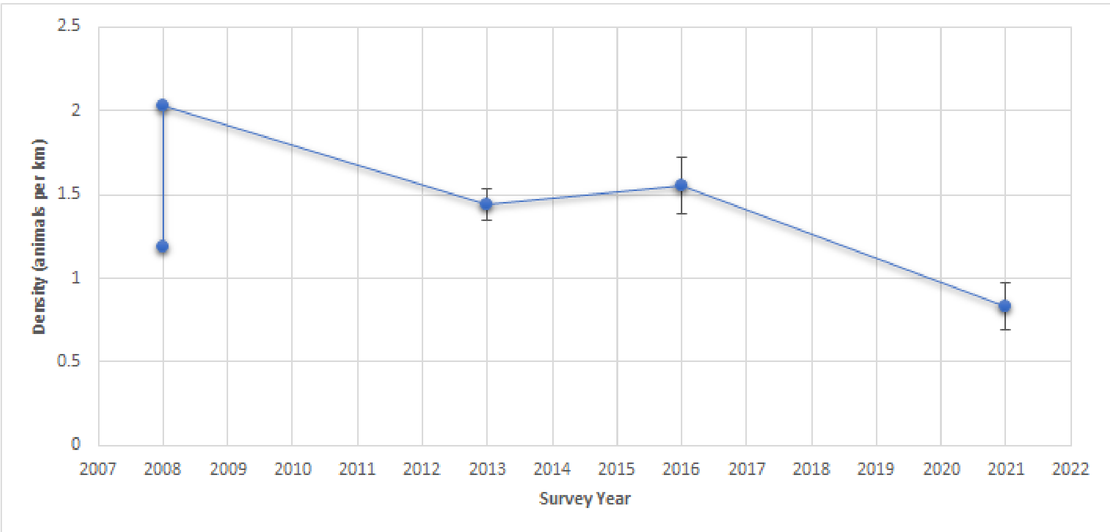

Figure 7.74 Changes in the estimated density of harbour porpoises in Rockabill to Dalkey SAC from 2008 to 2021 (from Berrow *et al*., 2021). Data for 2008 are the North County Dublin and Dublin Bay surveys pre-SAC designation.

This recent decrease in harbour porpoise densities in the Rockabill to Dalkey Island SAC is also reflected in the other two Irish SACs with harbour porpoise as qualifying interests, namely Roaringwater Bay and Islands SAC in County Cork and Blasket Islands SAC in County Kerry. O'Brien and Berrow (2020) reported a 70% decline in porpoise densities in the Roaringwater Bay and Islands SAC between 2016 and 2020 and a 53% decline between 2013 and 2020. O'Brien and Berrow (2018) reported a 56% decline in harbour porpoise densities between 2014 and 2018 in the Blasket Islands SAC.

This suggests that the drivers of the decline in harbour porpoise densities are widespread in Irish coastal waters. It does not necessarily imply a decline in overall population size but perhaps changes in distribution and habitat use at a local scale. It is more likely that the reduced density estimated for 2021 reflects a change in the local distribution of porpoises adjacent to the Rockabill to Dalkey Island SAC rather than a real change in population. More recent evidence (Paradell *et al*., 2023) suggested this decline is not restricted to coastal waters but is more widespread. Small changes in local porpoise distribution, driven by the distribution of their preferred prey can have profound effects on density estimates within a relatively small SAC compared to an individual's home range (Berrow *et al*. 2021). The diet of harbour porpoise in Irish waters is poorly known but is thought to consist of small benthic or demersal fish such as gobies, sandeels, whiting and other gadoids and pelagic species such as herring and sprat when available (Rogan, 2008).

A better understanding of the ecology of harbour porpoise in this region, including their diet and foraging ecology, is required in order to interpret this apparent decline in abundance between survey years. Information on harbour porpoise distribution in the Dublin Bay area is also available through marine mammal monitoring associated with dredging programmes and works carried out by Dublin Port Company. Harbour porpoise was the most consistently reported cetacean species observed during the maintenance and capital dredging programmes associated with Dublin Port since 2017.

During the first season of capital dredging of the ABR Project between 2017 and 2018, there were 77 harbour porpoise sightings (26% of total marine mammal sightings including seals) and one sighting of a single bottlenose dolphin. During 2018-2019, there were 44 porpoise sightings (33% of total marine mammal sightings), 84 (27%) during 2019-2020, 51 (32%) during 2020-2021, and 26 (12%) during the 2022 capital dredging programme (Table 7.28). The great majority of sightings were outside Dublin Harbour with increased number of sightings further east, closer to the dredge spoil grounds (Figure 7.75), although interestingly in 2022 there were five sightings of harbour porpoise within the breakwater walls of Dublin Harbour (Figure 7.76). Some of these were duplicate sightings as Marine Mammal Observers (MMOs) on two dredging vessels operating simultaneously observed the same individual.

Table 7.28 Summary of cetacean sightings recorded for each capital dredging programme (2017-2022) (U/I: unidentified)

Species	2017-2018	2018-2019	2019-2020	2020-2021	2022
Harbour porpoise	77	44	84	51	26
Bottlenose dolphin	1	0	0	0	0
U/I cetacean species	0	0	0	0	1

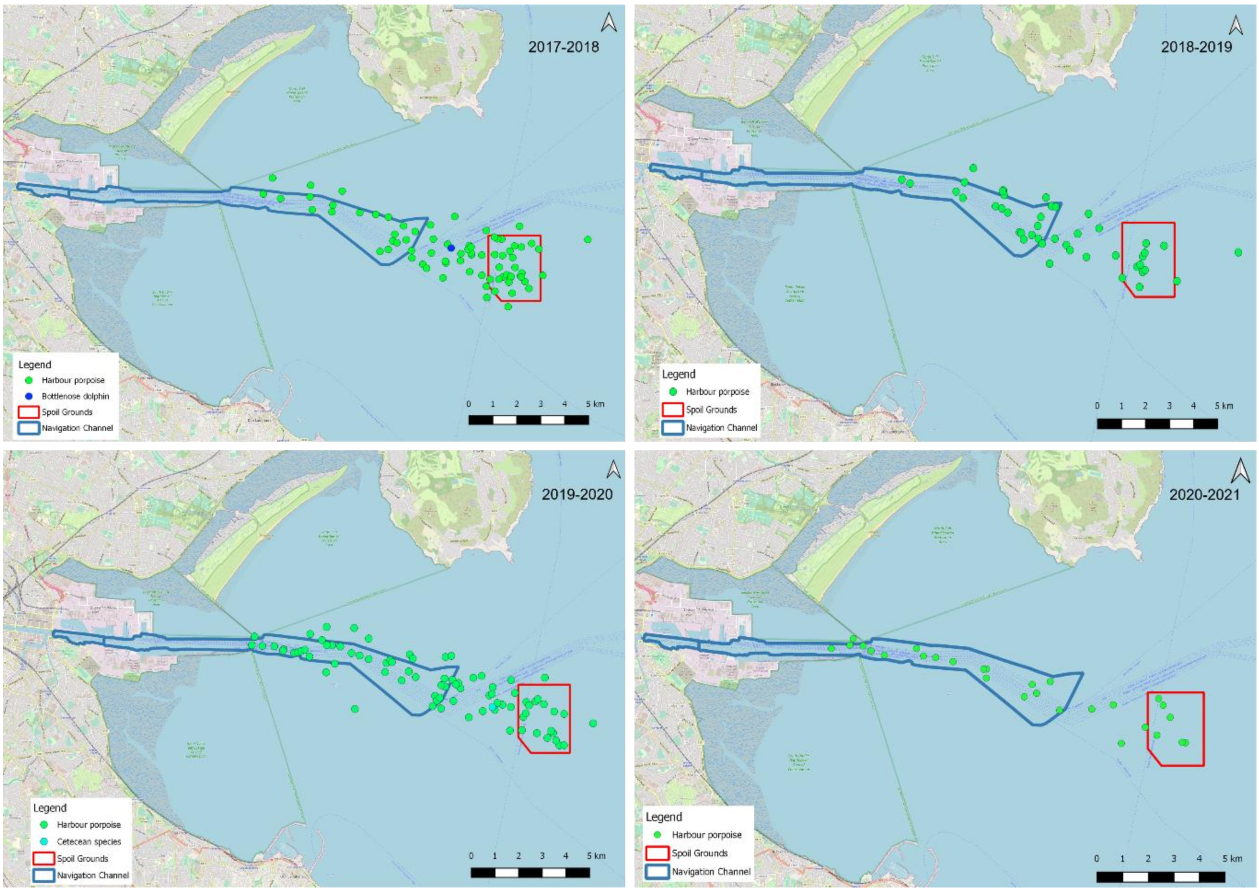

Figure 7.75 Cetacean sightings - capital dredging programme (2017-2021) as part of the ABR Project

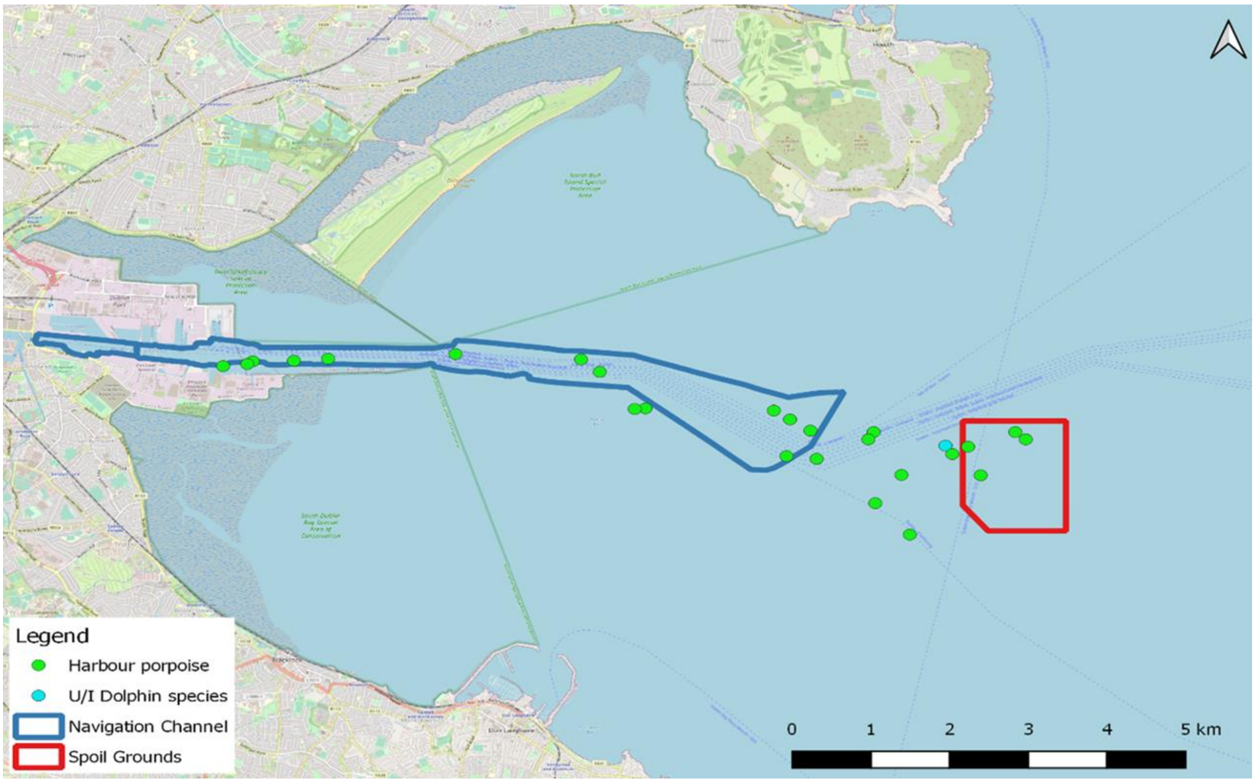

Figure 7.76 Cetacean sightings - capital dredging campaign (2022) as part of the MP2 Project

During maintenance dredging in 2017, there were 29 sightings of harbour porpoise (16% of total marine mammal sightings). In 2018, there were 35 harbour porpoise sightings (32%), 37 (53%) during 2020, and three (38%) during the 2021 maintenance dredging programme (Table 7.29). The majority of harbour porpoise sightings were outside Dublin Harbour, however harbour porpoise were observed within the breakwater walls on a few occasions (Figure 7.77).

Of 386 sightings of harbour porpoise during capital and maintenance dredging campaigns since the ABR Project commenced in 2016, 21 sightings have been within the breakwater walls of Dublin Port (Table 7.30)

Table 7.29 Summary of cetacean sightings recorded for each maintenance dredging programme (2017-2021)

Species	2017	2018	2020	2021
Harbour porpoise	29	35	37	3

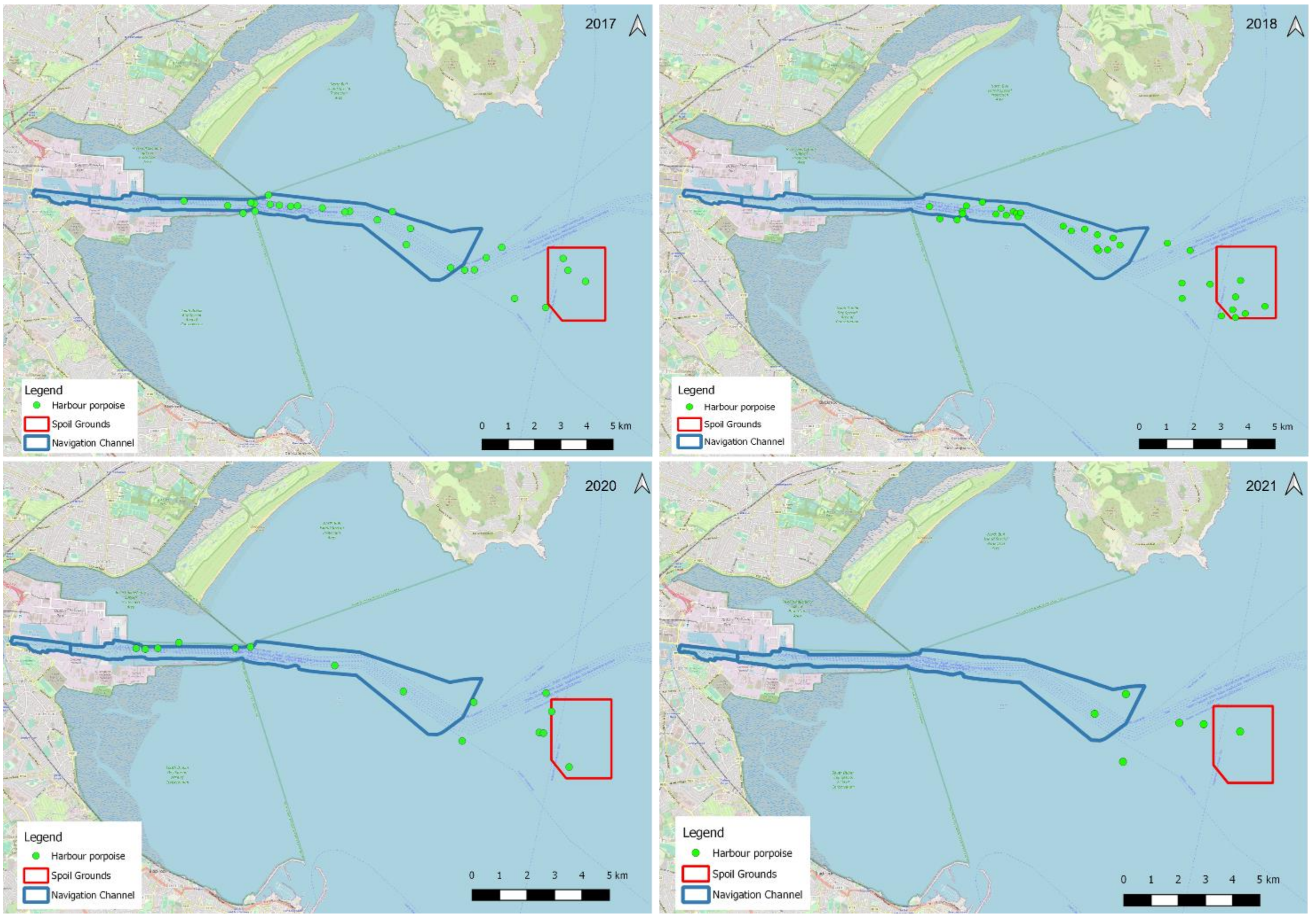

Figure 7.77 Harbour porpoise sightings during the maintenance dredging programme (2017-2021)

Table 7.30 Harbour porpoise sightings within the breakwater walls of Dublin Port since the ABR Project, 2016-2022

Species	Date	Latitude	Longitude
Harbour porpoise	25/08/2016	53.34367	-06.15088
Harbour porpoise	13/09/2016	53.34274	-06.15229
Harbour porpoise	16/09/2017	53.34345	-6.15108
Harbour porpoise	22/09/2017	53.34332	-6.15420
Harbour porpoise	27/09/2017	53.34408	-6.17507
Harbour porpoise	27/09/2017	53.34372	-6.15207
Harbour porpoise	29/09/2017	53.34298	-6.13837
Harbour porpoise	10/09/2020	53.34423	-6.17886
Harbour porpoise	11/09/2020	53.34407	-6.18294
Harbour porpoise	12/09/2020	53.34423	-6.18594
Harbour porpoise	12/09/2020	53.34531	-6.17194
Harbour porpoise	14/09/2020	53.34423	-6.15343
Harbour porpoise	11/10/2020	53.344	-6.154
Harbour porpoise	13/10/2020	53.343	-6.161
Harbour porpoise	14/10/2020	53.343	-6.176
Harbour porpoise	18/10/2020	53.344	-6.162
Harbour porpoise	16/10/2022	53.343	-6.171
Harbour porpoise	16/10/2022	53.342	-6.185
Harbour porpoise	20/11/2022	53.342	-6.177
Harbour porpoise	28/11/2022	53.342	-6.191
Harbour porpoise	28/11/2022	53.342	-6.186

Acoustic Monitoring

Static Acoustic Monitoring

Static Acoustic Monitoring (SAM) has been carried out in Dublin Bay as part of the ABR and MP2 Projects since 2017 using three different types of devices: C-PODs, F-PODs (the latest upgrade of the C-POD); and SoundTraps as part of a PhD based at the Atlantic Technological University (ATU). The C-POD and F-POD are fully automated, static, passive acoustic monitoring systems which can detect porpoises, dolphins, and other toothed whales by recognising the trains of echolocation clicks these species make in order to detect their prey, orientate themselves and interact with one another.

Four stations were monitored during the ABR Project (2017-2021) (SAM1, SAM2 and SAM3 at the spoil grounds; SAM4 at a control site in Scotsman's Bay) (Figure 7.78). Monitoring has continued at three sites (SAM1, SAM2 and SAM4) as part of the MP2 Project since 2022 (Figure 7.79).

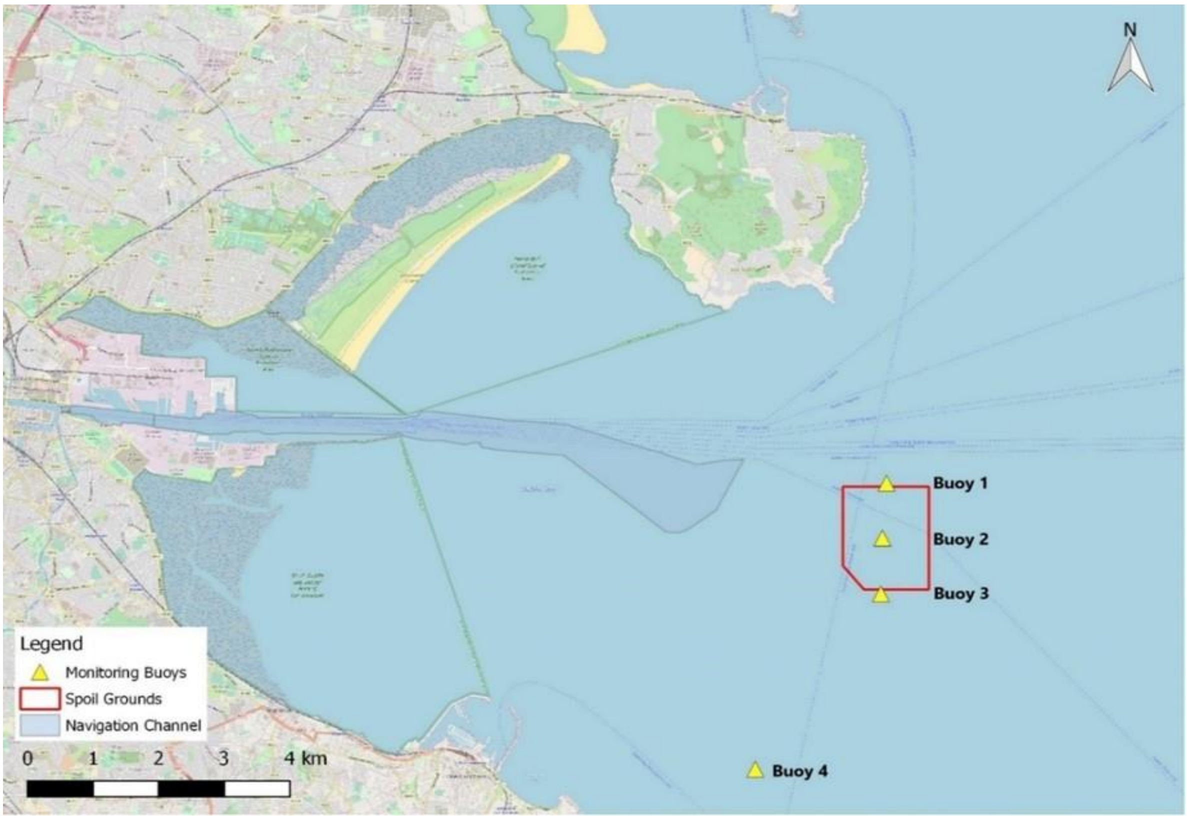

Figure 7.78 SAM stations on monitoring buoy positions within the spoil grounds and Dublin Bay (Buoy 1: SAM1, Buoy 2: SAM2, Buoy 3: SAM3 and Buoy 4: SAM4) as part of the ABR Project, 2017-2021

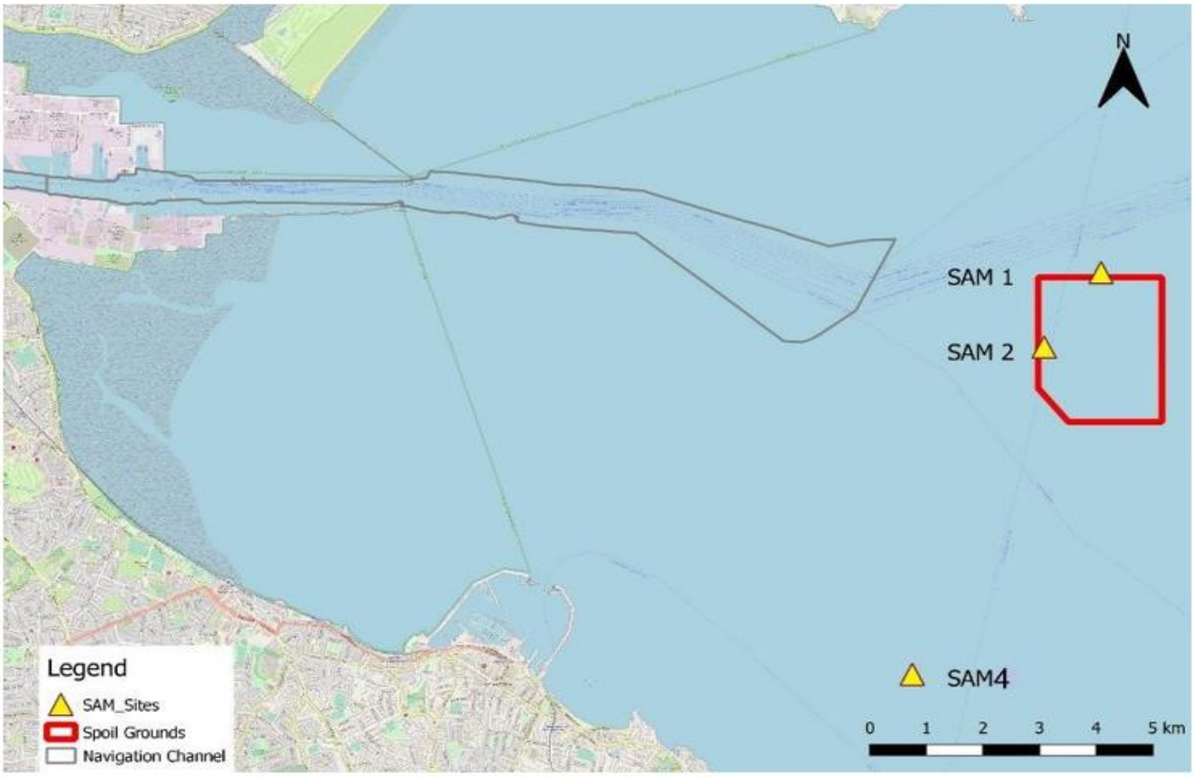

Figure 7.79 SAM stations currently being monitored as part of the MP2 Project, since 2022

SAM monitoring using C-PODs and F-PODs provides information on porpoise use of the spoil grounds both outside and during maintenance and capital dredging programmes and monitors if any displacement from the site occurs. SAM is effective in assessing habitat use by cetaceans and is particularly useful in studying behaviours such as feeding strategies. Significant effects of diel patterns have been described in the foraging behaviour of harbour porpoise (Carlström, 2005, Todd *et al*., 2009). Harbour porpoise echolocation clicks are very distinct and differ from most dolphin echolocation clicks (Au, 1993), and therefore they can be easily distinguished and monitored with C-PODs and F-POD's. SAM does not provide robust information on density and abundance of cetaceans in the area but gives valuable information on spatial and temporal trends.

SAM data is presented as number of porpoise detections per day to generate an acoustic index of activity at sites. This enables changes in activity to be identified at high resolutions for seasonal, diel and tidal periods. A BACI (before, after, control, impact) type analysis similar to Carstensen *et al*. (2006) will provide opportunities for adaptive project management through regular feedback to environmental managers and contractors.

The number of porpoise detections per day at each monitoring station over the period of record (2017-2023) is shown in Figure 7.80. The blue and green bars mark periods when maintenance (MD) and capital dredging (CD) programmes were ongoing. The curves are annotated with the station label (SAM1 to SAM4). F-POD monitoring commenced in January 2022. When C-PODs and F-PODs were deployed simultaneously at monitoring stations, the labels also include suffixes to indicate whether the data derived from C-PODs or F-PODs, (C) or (F) respectively. The data show a greater number of detections by F-POD compared to C-POD in all instances at the same station, however this is due to superior performance of the upgraded F-POD devices in detecting porpoises. Both C-POD and F-POD data show similar trends in site usage.

SAM does not provide information on the numbers of animals using the site but has given an insight into habitat use across temporal trends which could not be determined from visual monitoring alone. Clearly, the area east of Dublin Port is an important habitat for the harbour porpoise with their almost daily presence. Their presence is influenced by season, diel and tidal factors, and presence was significantly greater during the winter months, during hours of darkness and at slack high tides. The long-term monitoring data indicates displacement is not occurring during dredging periods, nor have there been any significant changes since monitoring began in September 2017. Trends in detections have remained consistent over the duration of monitoring during the ABR and MP2 Projects.

Cummins (2019) analysed the SAM data to identify trends in porpoise activity in the monitored area and found significant increases in harbour porpoise acoustic activity during dredging operations (2017-2019) at Dublin Port. Increased harbour porpoise acoustic activity at the spoil grounds during dredging programmes is evident in a number of instances (Figure 7.80) and has been explained by a limited increase in foraging activity. The variability in the strength of the foraging response to dumping activity across the three sites at the spoil grounds, suggests that other acoustic behavioural changes are also being exhibited by harbour porpoise during dumping periods (Cummins, 2019). The reason for these increases are currently unknown, but are not thought to be due to increased echolocation for navigation due to increased turbidity. There was no relationship found between turbidity levels and dredging periods at the spoil grounds, and turbidity at the spoil grounds was consistently similar to turbidity levels at the control site (DPC, 2018).

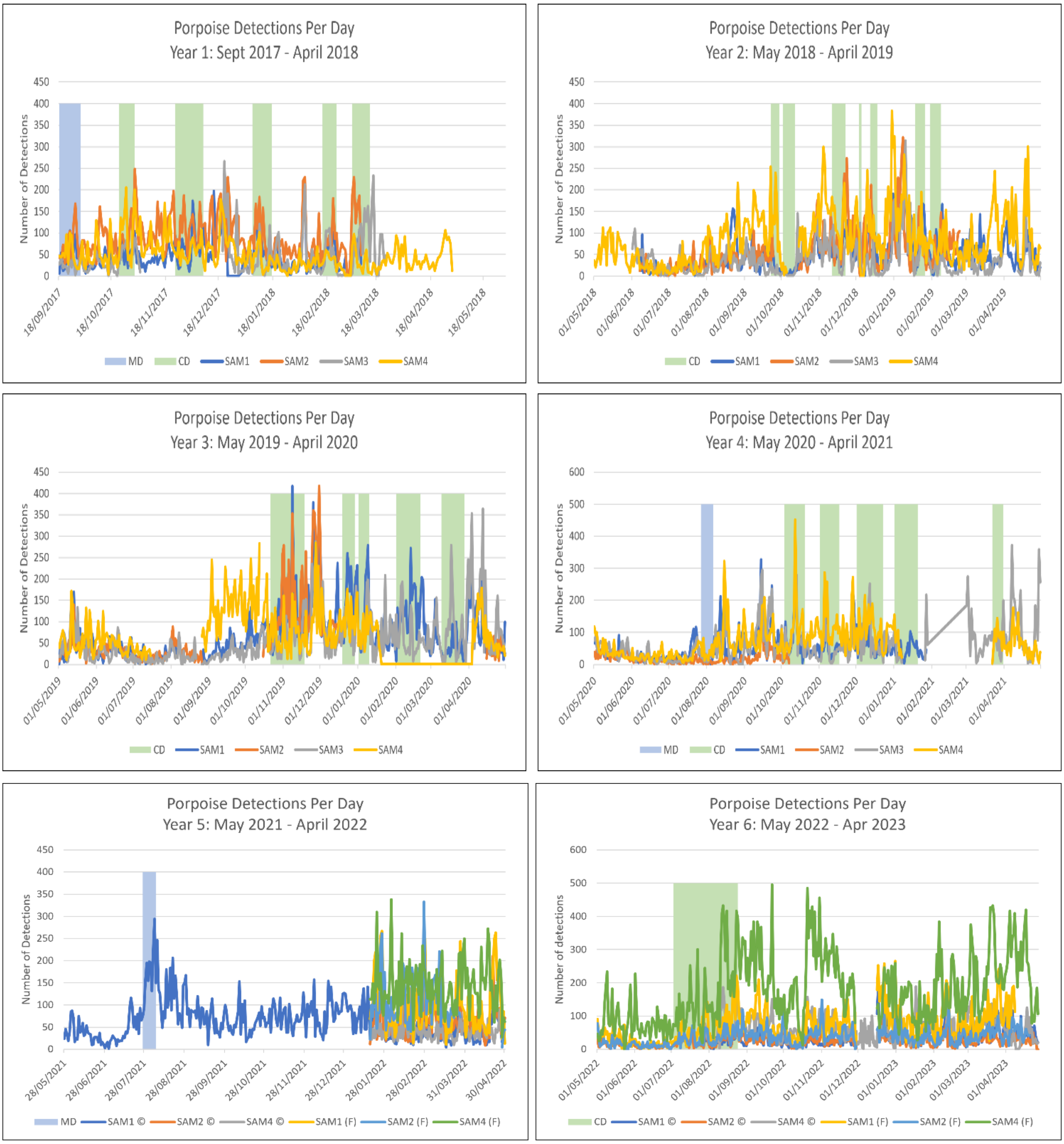

Figure 7.80 Porpoise detections per day since 2017. Data for Years 1 to 5 was collected as part of the ABR Project Year 6 data is from MP2 Project monitoring. *MD: Maintenance dredging, CD: Capital dredging periods.

Harbour porpoises and other cetaceans do not change their echolocation behaviour in conditions with decreased visibility (Goodson *et al*. 1995, Barrett-Lenard *et al*. 1996, Verfuss 2005). Cummins (2019) highlighted the need for continued monitoring and mitigation effort in Dublin Bay. Further analysis of this data set as part of a PhD dissertation at ATU is ongoing (due to be completed in 2026) and will explore different temporal scales and investigate whether harbour porpoise acoustic behaviour can be distinguished even further, and potentially incorporate this into modelling acoustic behaviour in relation to dredging activity.

Passive Acoustic Monitoring

Since July 2022, a second type of passive acoustic monitoring (PAM) device (Listen to the Deep - LIDO) has been deployed at the North Bank Lighthouse in the navigation channel of Dublin Port (Figure 7.81). The LIDO system consists of a hydrophone, powered remotely by solar panels, and connects to LIDO's server where software allows processing of real-time data streams. The software contains several modules for noise assessment, detection and classification of cetaceans, and localisation of cetaceans and other acoustic events.

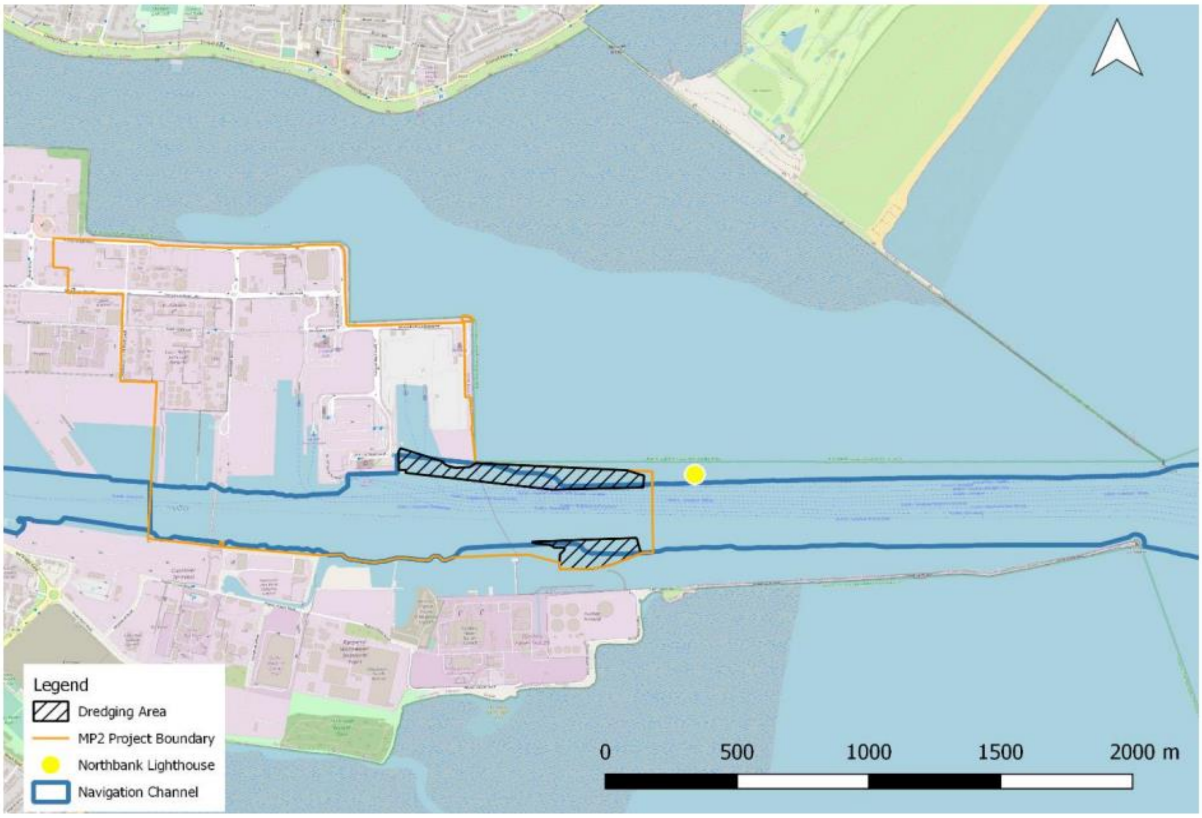

Figure 7.81 Yellow dot shows the LIDO system location at the North Bank Lighthouse in Dublin Harbour. Black shaded areas are the MP2 capital dredging areas for 2022.

The noise measurement module computes statistics for fixed length intervals in line with recommendations on criteria and methodological standards in relation to Noise/Energy to achieve Good Environmental Status as set out in the European Marine Strategy Framework Directive (2008/56/EC) and assesses noise trends over large time series.

The LIDO system is capable of detecting harbour porpoise within a range of approximately 200m, and bottlenose dolphins at distances of approximately 500m. Harbour porpoise are the only toothed whale species to produce narrow band high frequency (NBHF) clicks. For harbour porpoise detections, a train of impulsive signals, somewhat irregular, and limited to high frequencies can be observed on a spectrogram. Dolphins produce echolocation clicks to navigate and locate food (Au, 1993) and social sounds such as whistles, when communicating with each other (Jones *et al.*, 2019). Whistles can be observed around 12 kHz. Some dolphin clicks can be seen (around 35 kHz) that are much lower in frequency than the harbour porpoise.

7.4.2.3 Seals

Between 1997 and 1998, Kiely *et al.* (2000) identified six islands off North Dublin as grey seal haul out and/or breeding sites. Lambay Island and St Patrick's Island off Skerries were the most important haul out sites for immature and adult seals while Colt and Shenick Islands off Skerries the least important with an average count of 1.5 seals hauled out over the monitoring period. Rockabill and Ireland's Eye both held around nine seals on average. The distribution of seals was found to vary significantly with season, though they were present throughout the year. Cronin *et al.* (2004) also recorded 16 grey seals hauled out in Dublin Bay in 2003 and 131 between the Baily Lighthouse and Knocknagin and a further 64 were recorded hauled out on Lambay Island. In 2005, two grey seal pups were recorded on St Patrick's Island off Skerries, three on Islands Eye and two on Dalkey Island with a further 49 pups on Lambay Island (O'Cadhla *et al*. 2007). Further surveys conducted in 2009 recorded 58 pups on Lambay Island and Ireland's Eye resulting in a minimum pup production of 77 pups between 2009 and 2012, which provides an all-age population size of between 270-347 individuals (O'Cadhla *et al*. 2013). In 2017, Morris and Duck (2019) recorded 211 grey seals off the islands off Dublin in 2003, 172 in 2011/12 and 335 in 2017.

Only three common seals were observed between the Baily Lighthouse, on the north side of Dublin Bay and Knocknagin, Co Meath during a national aerial census in 2003 (Cronin *et al*. 2004) and six in Dublin Bay in 2012 (Duck and Morris 2013). The same surveys recorded 31 and 23 common seals on Lambay Island. Morris and Duck (2019) observed lower numbers of harbour seals off the islands off the Dublin coastline with 34 in 2003, 29 in 2011/12 and 70 in 2017.

The ecology and foraging behaviour of common and grey seals off Dublin is not known though seals on the east coast do range widely. Kiely *et al*. (2000) carried out some photo-identification of grey seals between Skerries and Ireland's Eye and showed individual seals did show a degree of site faithfulness, but some individuals were recorded moving between these sites and to sites off southwest Wales. The first satellite telemetry of a seal in Ireland was carried out by the Irish Seal Sanctuary, which tracked a young grey seal post-release from Co Dublin to Co Wexford, and onto County Down over a period of 20 days in June 1999.

Harbour seals off southwest Ireland are considered opportunistic, generalist feeders, and probably consume prey in relation to its availability. Eighteen prey species were identified, with sandeels constituting 55% of the prey by number. Sole, sandeels and *Trisopterus* species were found to be the most important species by weight (Kavanagh *et al*. 2007). Jones *et al*. (2015) found grey seals use offshore areas connected to their haul-out sites by prominent corridors, and harbour seals primarily stay within 50km of the coastline. Gosch *et al.* (2019) showed grey seals foraging in comparatively shallow waters off north Co Wexford in the south Irish Sea, had a greater contribution of demersal and groundfish species such as cephalopods and flatfish in their diet.

Within the island of Ireland, genetic analyses revealed the presence of three genetically distinct local populations of harbour seals, characterized by high genetic diversity, hereby defined as: Eastern Ireland (EI), North-western and Northern Ireland (NWNI), and South-western Ireland (SWI) (Steinmetz *et al*. 2022). Using previously published and newly generated data, a subsequent wider scale analysis revealed that the EI and SWI local populations were genetically distinct from neighbouring UK/European areas, whereas seals from the NWNI area could not be distinguished from a previously identified Northern UK metapopulation. Migration rate estimates showed that NWNI receives migrants from North-west Scotland, with NWNI acting as a genetic source for both SWI and EI (Steinmetz *et al*. 2022).

Seals using Bull Island as a haul out site

Bull Island has been surveyed for the presence of hauled out seals each month since May 2016 under the ABR and MP2 Projects Marine Mammal Monitoring Programme.

Grey seals were recorded hauled out on 53% of survey days with highest numbers of individuals recorded in June 2022, with 36 grey seals present (Figure 7.82). Each year, grey seals return to North Bull Island in late April to early May. Their abundance peaks from June to August, with low numbers from September to October, and with no grey seals present from November until April, which corresponds with their breeding and moulting seasons. Grey seals may move to known breeding sites at Lambay Island or Ireland's Eye to pup.

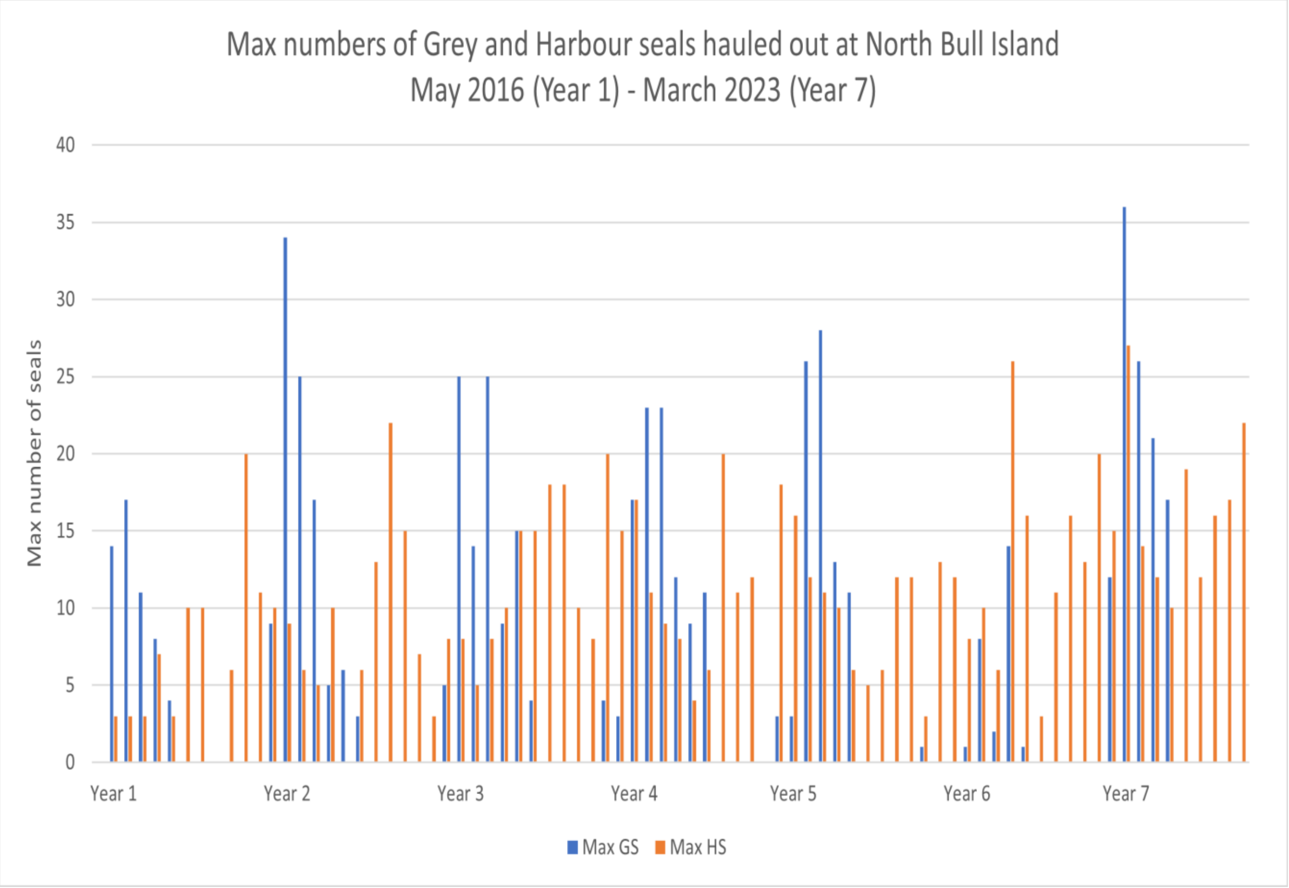

Figure 7.82 Max numbers of grey seals (GS) and harbour seals (HS) hauled out at North Bull Island (2016-2023). Year 1 starts off in May 2016, with each new year starting the following May.

Harbour (common) seals are present year-round on North Bull Island and were recorded on 91% of survey days although there appears to be a seasonal trend with numbers declining in the summer months and peaking in the winter months (Figure 7.83). Harbour seal breeding season occurs from approximately May to June and their annual moult takes place in August to September when they spend a significant time resting on offshore islands including Irelands Eye and Lambay Island. The highest abundance of harbour seals was also recorded in June 2022 with 27 seals present.

Seal numbers have remained consistent each year since monitoring commenced in 2016, including during periods of piling, demolition and dredging operations associated with the ABR and MP2 Projects with no displacement being observed. Seasonal trends observed at North Bull Island for both species, coincide with their moulting and breeding periods.

Figure 7.83 Top: Grey and harbour seals hauled out at The Point at the northern end of Bull Island, Bottom: Grey and harbour seals resting on the sandbank, which is visible at low tide, opposite Sutton Dinghy Club (Image: C Russell/IWDG)

Seals in Dublin Port and Dublin Bay

Both grey and harbour seals were observed regularly and year-round within Dublin Port. The number of seal sightings each year during capital dredging campaigns from 2017 to 2022 are shown in Table 7.31. Grey seal was the most frequently observed marine mammal from 2017 to 2020, accounting for 59% to 70% of the total number of marine mammal sightings, including cetaceans, during this period. Harbour seals were recorded in higher numbers between 2020-2021 and 2022 and accounted for 47% and 55% of all marine mammal sightings.

Table 7.31 also shows unassigned 'seal species' when specific identification was not possible due to distance from observer. Figure 7.84 and Figure 7.85 show the spatial distribution of seal sightings for each year.

Table 7.31 Summary of seal sightings recorded for each capital dredging programme (2017-2022)

Species	2017-2018	2018-2019	2019-2020	2020-2021	2022
Grey seal	209	80	202	29	49
Harbour seal	12	0	0	76	118
Seal species	0	11	26	5	20

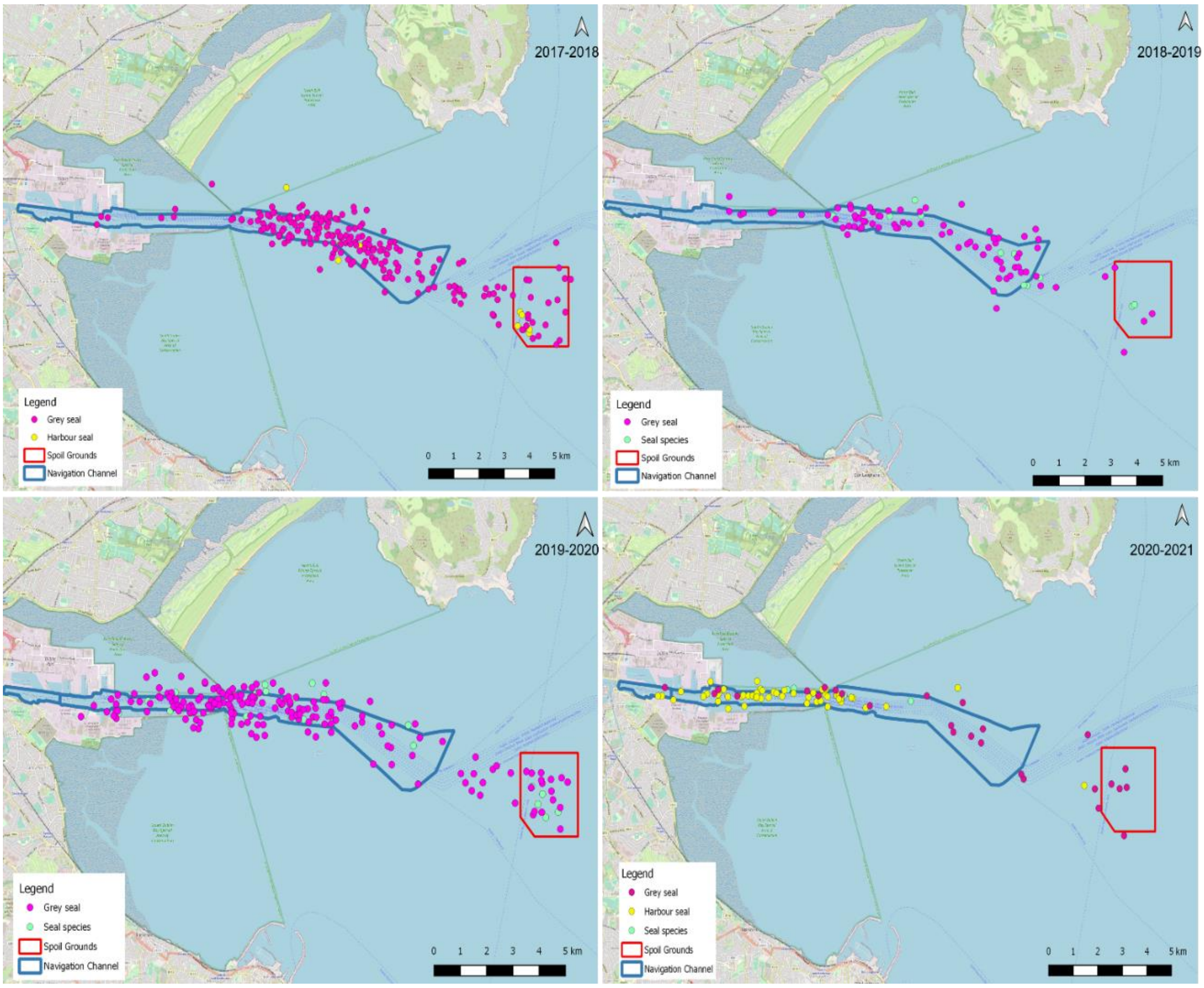

Figure 7.84 Seal sightings during the ABR Project capital dredging programme (2017-2021)

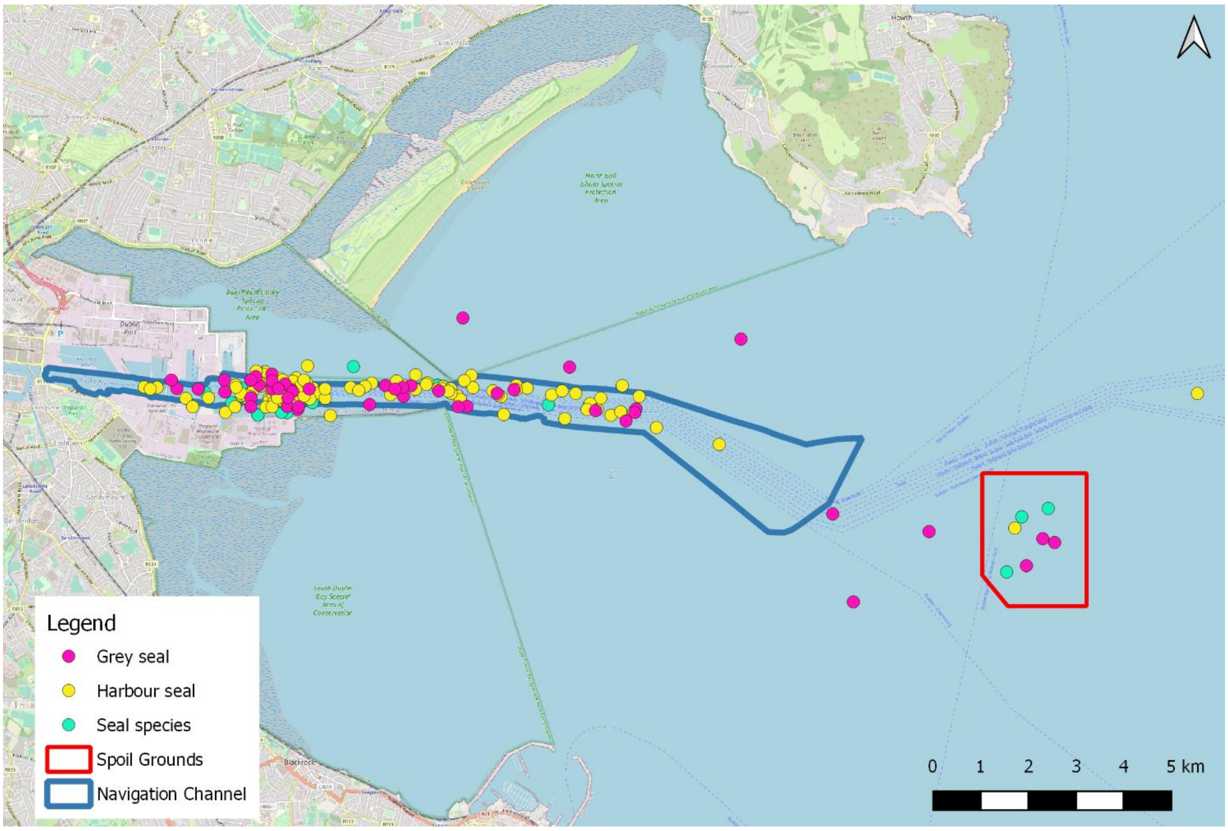

Figure 7.85 Seal sightings during the capital dredging programme (2022) as part of the MP2 Project

The grey seal was also the most frequently observed seal species during the maintenance dredging campaigns from 2017 to 2020, accounting for 23% to 76% of all marine mammal sightings. No grey seals were observed during the 2021 maintenance dredging programme. Harbour seal sightings during maintenance dredging campaigns accounted for 6% to 11% of total marine mammal sightings from 2017 to 2020, and for 63% of all marine mammal sightings in 2021 when no grey seals were observed. Table 7.32 also shows unassigned 'seal species' when specific identification is not possible due to distance.

Table 7.32 Summary of seal sightings recorded for each maintenance dredging programme (2017-2021)

Species	2017	2018	2020	2021
Grey seal	143	65	16	0
Harbour seal	12	11	8	4
Seal species	3	0	9	0

In order to estimate the wider seal populations, a survey of the area of Dublin Bay and the adjacent Dublin coastal areas between Skerries and Dalkey Island, covering important haul-out and pupping sites, was carried out between July 2023 and January 2024. This survey identified a new important haul-out site for harbour seals at Rush Head, and confirmed that both seal species are widespread and numbers are consistent with previous surveys. The survey confirmed North Bull Island as an important haul-out site for grey seals in particular. It also documented an increase in harbour seals using North Bull Island as a haul-out site. Grey seals were much more abundant than harbour seals with maximum counts of 326 in October and 300 in July and a minimum of 167 in November. Harbour seal numbers ranged from 117 to 5, with a peak in July. Pup production was as high as previous estimates suggesting that populations of both seal species are healthy.

7.4.3 Impact Assessment

The impact assessment for marine mammals has been undertaken following the methodology set out in the Chartered Institute of Ecology and Environmental Management's *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal* and Marine (CIEEM, 2018). Impacts (both positive and negative) are characterised through consideration of their magnitude and/or extent, the pathway through which they occur (whether direct, indirect, secondary or cumulative), their duration and their reversibility.

The key potential impacts on marine mammals resulting from the 3FM Project are likely to be due primarily to underwater noise generated from piling and dredging operations (Chapter 12.2 of this document) during the project construction phase. However, increased vessel noise post-project completion during the operational phase is also considered. Other pressures with potential for impact include generation of sediment plumes and elevated turbidity, risk of collision with vessels, indirect effects through impact on prey species, and release of pollutants.

Noise disturbance during activities such as piling, demolition, dredging and dumping could potentially lead to disturbance and displacement of marine mammals. Negative impacts from anthropogenic noise can include physical discomfort, pain or death (Parsons, 2017), PTS and TTS in hearing sensitivity (Finneran, 2015), increased stress (Houser *et al*. 2020), changes in behaviour that may affect individual fitness (Southall *et al*. 2009) and auditory masking (Erbe *et al*. 2016).

If an animal is in very close proximity to a high energy sound source, the received energy may be of a sufficient level to cause death or serious injury. With increasing distance from the sound source, where it is audible by the animal, the effect is expected to diminish through identifiable stages (e.g., TTS) in hearing, avoidance, masking, reduced vocalisation or PTS to a point at which no significant response occurs (NPWS, 2014).

Below is a summary of the possible direct effects of underwater sound on marine mammals (IACMST, 2006):

- Physical (Non-auditory)
    - Damage to body tissue (e.g., tissue rupture, internal haemorrhage)
    - Induction of gas embolism or decompression sickness
- Physical (Auditory)
    - Gross damage to ears
    - Permanent threshold shift (PTS) in hearing
    - Temporary threshold shift (TTS) in hearing
- Perceptual
    - Masking of communication with conspecifics
    - Masking of other biologically important sounds
    - Interference with the ability to acoustically interpret the environment
    - Adaptive shifting of vocalisations (with efficiency and energetic effects)
    -
- Behavioural
    - Gross interruption of normal behaviour (i.e., temporarily changed)
    - Behaviour modified (i.e., behaviour becomes less effective/efficient)

  - Displacement from an area (short or long-term)
  - Disruption of social bonds, including mother-young associations
- Chronic/Stress
  - Decreased viability of an individual
  - Increased vulnerability to disease
  - Increased potential for impacts from negative cumulative effects
  - Sensitisation to sound (or other stresses) – exacerbating other effects
  - Habituation to sound – causing animals to remain within damage range

There are two fundamental discrete sound types, impulsive and non-impulsive sounds which may have differing potential to cause physical effects on the hearing of marine mammals. Table 7.33 briefly summaries impulsive (single and multiple) and non-impulsive sounds with some features and examples of anthropogenic sounds of each type (Southall et al. 2007).

Table 7.33 Description and examples of impulsive and non-impulsive sounds

Sound Type	Acoustic characteristic (at source)	Examples
Impulsive: Single Pulse	Single sound event Rapid rise time to maximum pressure followed by decay that may include oscillating maximum-minimum pressures	Impact pile strike
Impulsive: Multiple Pulse	Multiple discrete pulse sound events Rapid rise time to maximum pressure in each pulse followed by decay that may include oscillating maximum-minimum pressures	Impact pile strikes
Non-impulsive	Single or multiple discrete sound events Intermittent or continuous sound event, tonal and/or broadband, but without rapid rise time of pulse type	Shipping, dredging, drilling

Substantial progress has been made in quantifying marine mammal hearing and the effects of noise on hearing for a range of taxa since the review provided by Southall et al. 2007. The updated scientific recommendations for residual hearing effects on marine mammals was published in 2019 (Southall et al. 2019), and presented modified noise criteria for onset of Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS). The frequency-weighted sound exposure level (SEL), and the unweighted peak sound pressure level (SPL) that, if exceeded, may result in TTS or PTS in the marine mammal groups that occur in Dublin Port and Bay are presented in

Table 7.34 and Table 7.35. SEL is a measure of sound energy of exposure accumulated over time and over multiple exposures, whereas SPL is a measure of absolute maximum exposure.

The onset metrics presented in

Table 7.34 and Table 7.35 are used to assess potential temporary or permanent impact on marine mammal hearing due to the 3FM Project.

Table 7.34 TTS- and PTS-onset thresholds for marine mammals exposed to non-impulsive noise: SEL thresholds in dB re 1 µPa2s under water and dB re (20 µPa)2 s in air (groups PCA and OCA only) (Southall *et al*. 2019)

Marine Mammal Hearing Group	TTS onset: SEL (weighted)	PTS onset: SEL (weighted)
High Frequency cetaceans (dolphin species)	178	198
Very High Frequency cetaceans (harbour porpoise)	153	173
Phocid carnivores in water (PCW) (harbour and grey seal)	181	201
Phocid carnivores in air (PCA) (harbour and grey seal)	134	154

Table 7.35 TTS- and PTS-onset thresholds for marine mammals exposed to impulsive noise: SEL thresholds in dB re 1 µPa2s under water and dB re (20 µPa)2s in air (group PCA) and peak SPL thresholds in dB re 1 µPa under water and dB re 20 µPa in air (group PCA) (Southall *et al*. 2019)

Marine Mammal Hearing Group	TTS onset: SEL (weighted)	TTS onset; Peak SPL (unweighted)	PTS onset: SEL (weighted)	PTS onset: Peak SPL (unweighted)
High Frequency cetaceans (dolphin species)	170	224	185	230
Very High Frequency cetaceans (harbour porpoise)	140	196	155	202
PCW (harbour and grey seal)	170	212	185	218
PCA (harbour and grey seal)	123	138	138	144

7.4.3.1 Construction Phase Impacts

Piling Noise and Dredging Noise

Piling Noise

Underwater noise from piling has the potential to have significant impacts on marine mammals.

Pile driving strikes have generally been reported to produce low frequency pulse sounds of several tens of Hz to several thousand Hz (and up to approximately 20 kHz). This presents the possibility of permanent hearing injury (i.e., Permanent Threshold Shift PTS), temporary hearing loss (i.e., Temporary Threshold Shift (TTS)) or other injury for some marine mammals in close proximity to such operations. The multiple pulses of some pile driving works can also be detected at received levels well exceeding ambient sound (>120dB re: 1 µPa) in deep water at more than 10km from the operating source (Richardson *et al.* 1995). They are sufficiently high therefore to potentially cause significant behavioural disturbance to marine mammals at distances of several kilometres. However piling in shallow water, such as ports and harbours, attenuates much more quickly and areas exposed to increased ambient noise levels are much reduced.

The 3FM Project includes piling operations for the following riverside elements:

- A new Southern Port Access Route (SPAR) Bridge and Viaduct;
- The development of a Maritime Village including a significant expansion of the marina;
- The refunctioning of the existing Lo-Lo Terminal operated by MTL to a new Ro-Ro Terminal requiring the re-fronting of Berth 44/45 and the contruction of new ramps;
- A new Turning Circle which will be bounded by a new quay wall along its sorth-western and southern boundary;
- The construction of a new Lo-Lo container terminal (Area N) immediately north of the ESB Poolbeg Generating Station. Area N will comprise a new open-piled wharf requiring circa 2,500 piles. Its construction will require up to five piling rigs operating simultaneously; and
- An additional Tern colony in the vicinity of the Great South Wall.

Pile driving is a static activity that tends to take place in a fixed area for a prolonged period of days or weeks, depending on the required scale of development. Therefore, this activity, has the potential to introduce persistent anthropogenic sound at levels that may impact upon marine mammal individuals. Piling operations can cause disturbance and serious hearing impact or injury to marine mammals in the vicinity, in the absence of mitigation.

Underwater noise measurements were made during pile driving activities at Alexandra Basin East in June 2014 to determine the acoustic noise generated during piling operations (McKeown, 2014), and again over three days during different piling activities at Berth 35 (riverside berth), Dublin Port in November 2020 (McKeown, 2021). Peak sound energy occurred at below 1 kHz, with substantial energy up to 10 kHz, and high frequencies rapidly attenuated. Results confirmed that noise due to impact piling attenuated rapidly in the shallow confines of the inner Liffey Channel and reached background levels at 500m from source.

However, recent revision of guidance in relation to onset thresholds for hearing impact in marine mammals and further modelling (Chapter 12) indicates that sound exposure arising from piling operations associated with the 3FM Project has the potential to result in significant impacts to harbour porpoise and seals, in the absence of mitigation. The likely significant hearing impacts include temporary threshold shift (TTS) during impact piling in the Port, and permanent threshold shift (PTS) injury if individuals are very close to the piling site at start-up.

Significant impacts are most likely to arise during:

- Impact piling at the proposed Ro-Ro ramps at Area K using 2.4m diameter guide piles.
- Impact piling at Area N, with the potential use of five piling rigs working simultaneously.
- Impact piling at the Lo-Lo Terminal Dolphin, given its close proximity to the dredged channel.

Noise propagation and sound exposure levels during the 3FM Project have been modelled for Dublin Port and exposure maps for piling activities at different sites within the port area are presented in Chapter 12 of this EIAR.

Models considered two noise generating scenarios:-

- short duration which includes a single blow in impact piling, or a one-second exposure (dredging, sheet piling and vessel noise);
- long duration reflecting one hour's activity i.e. 1200 blows for impact piling (= 1 blow every 3 seconds) and 3600 seconds for dredging, sheet piling and vessel noise.

The modelled risk ranges, that is, the distance from the noise source within which temporary (TTS) or permanent (PTS) injury may occur are summarised in Table 7.36.

While there is large variation in modelled risk ranges, modelling indicates that the TTS risk range for harbour porpoise during short duration impact piling activities (single blow) is typically 1,400m to 2,000m. For seals the TTS risk range is reduced and extends from 140m to 300m from the source. In the case of short duration sheet piling, the TTS risk range for seals was less than 20m, and for harbour porpoise less than 180m.

In the case of long duration impact piling activity (one hour or equivalent to 1,200 blows), modelling indicates that the TTS risk range for seals and harbour porpoise extends throughout the harbour area inside the bull walls. In the case of long duration sheet piling seals have a modelled TTS risk range of 2200-2400m, while the TTS risk range for porpoise extends throughout the Port area inside the bull walls.

Table 7.36 The modelled TTS and PTS risk ranges from noise sources for short duration and long duration activities are shown for relevant marine mammals. 'All Harbour Area' indicates that the risk range extends throughout the harbour area within the bull walls.

Activity (Duration)	TTS Risk Range (m)		PTS Risk Range (m)	
	Harbour Porpoise	Seals	Harbour Porpoise	Seals
Impact Piling (Short)	1400-2000	140-300	250-500	30
Sheet Piling (Short)	<180	<20	<5	<5
Dredging (Short)	<5	<5	<5	<5
Vessels (Short)	<5	<5	<5	<5
Impact Piling (Long)	All Harbour Area	All Harbour Area	All Harbour Area	1200-1600
Sheet Piling (Long)	2200-2400	All Harbour Area	<1200	<250
Dredging (Long)	90	30	<5	<5
Vessels (Long)	<5	<5	<5	<5

Noise exposure maps for piling activities at different sites within the port area are presented in Chapter 12 of this document and key plots are reproduced here for consideration of marine mammal exposure (Figure 7.86 to Figure 7.89).

Figure 7.86 Model outputs for impact piling for 1200 blows in one hour (one blow every 3 seconds) including PTS (red) and TTS (brown) exposure for seals (PCW) and harbour porpoise (VHF) (from Chapter 12: Noise and Vibration) at SPAR Bridge.

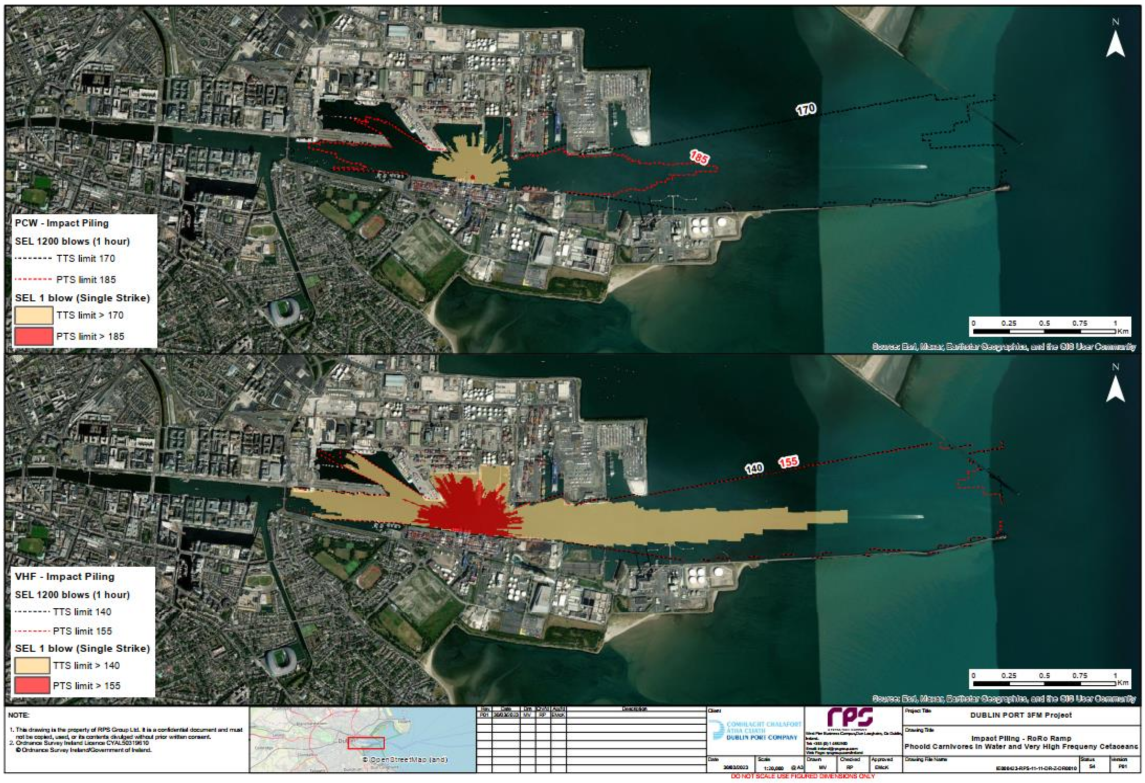

Figure 7.87 Model outputs for impact piling for 1200 blows in one hour (one blow every 3 seconds) including PTS (red) and TTS (brown) exposure for seals (PCW) and harbour porpoise (VHF) (from Chapter 12: Noise and Vibration) at Ro-Ro ramps.

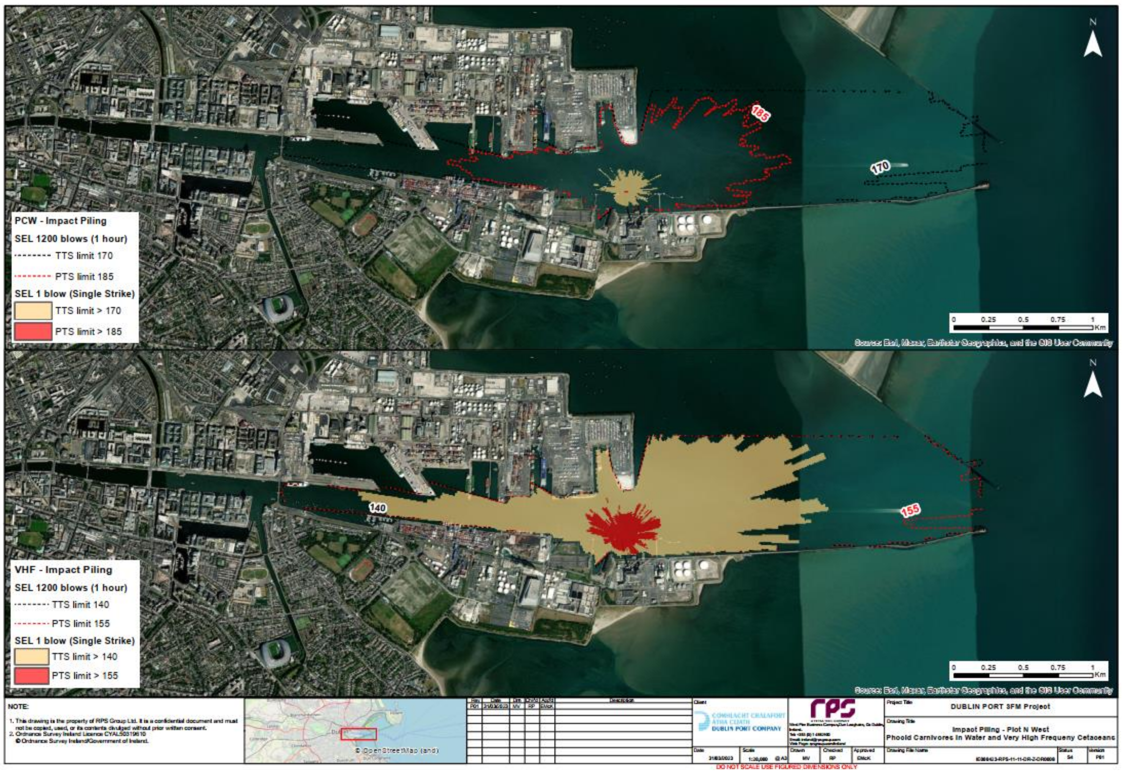

Figure 7.88 Model outputs for impact piling for 1200 blows in one hour (one blow every 3 seconds) including PTS (red) and TTS (brown) exposure for seals (PCW) and harbour porpoise (VHF) (from Chapter 12: Noise and Vibration) at Area N (crane rails).

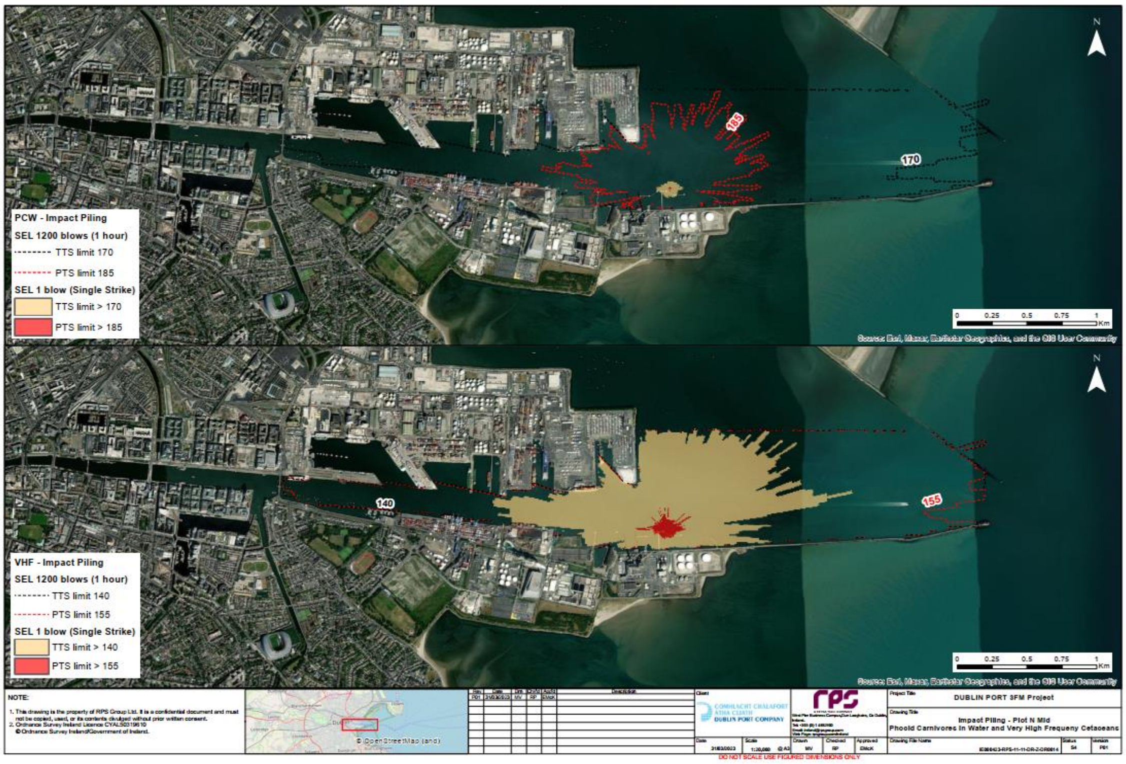

Figure 7.89 Model outputs for impact piling for 1200 blows in one hour (one blow every 3 seconds) including PTS (red) and TTS (brown) exposure for seals (PCW) and harbour porpoise (VHF) (from Chapter 12: Noise and Vibration) at Area N (deck slab).

Results from modelling show that the in-combination effect of more than one rig piling at the same time is minimal and did not increase the sound exposure levels significantly.

Modelling assessments of underwater noise suggests that all of the port area should be free of harbour porpoises before impact piling starts as even a single impact piling strike may result in hearing temporary threshold shift. In the case of vibro-piling of sheet piles, one hour’s activity also generates TTS risk ranges that extend throughout the port area. The potential effects on marine mammals of underwater noise due to piling is therefore considered to be moderate to major negative in the absence of mitigation measures.

Modelling also suggests that TTS risk ranges for seals are moderate during short duration impact piling events, but they will be at risk of TTS if present within the inner harbour area during long duration impact piling. Therefore a large area should also be free of seals before impact piling starts.

Dredging Noise

Trailing Suction Hopper Dredgers (TSHD) produce broadband sound between 20-1000 Hz and the highest noise levels occur during loading. Evans (2000) suggested dredging activities produce sounds varying from 172-185dB re 1 ųPa at 1 metre over the broadband range 45 Hz to 7 kHz. Dredging has been shown to displace bottlenose dolphins from a busy shipping port in Scotland during a prolonged dredging campaign over three years (Pirotta *et al.* 2013). Diederichs *et al.* (2010), through the use of acoustic monitoring with click detectors, showed that harbour porpoises temporarily avoided an area where sand extraction took place off the Island of

Sylt, Germany. When the dredger was within 600m of the monitoring location the interval between porpoise detections increased threefold.

A guidance document by the World Organisation of Dredging Associations (WODA, 2013) suggested that sound produced from dredging has the potential to impact on aquatic life and it is assumed that most of these impacts would concern disruption of communication due to masking or alteration of behaviour patterns. However, cumulative or long-term exposure leading to TTS has to be considered for marine mammals (Kastelein *et al.* 2012), but PTS or other auditory injuries are extremely unlikely. Studies on the impact of dredging on odontocetes (toothed whales including porpoises and dolphins), have mainly focused on short term impacts and show varying results, from short-term avoidance (Diederichs *et al*., 2010; Pirotta *et al*., 2013) to no apparent (Hoffman, 2010) or inconclusive effects (Marley *et al*., 2017). Bossley *et al*. (2022) found no long-term effect of dredging on dolphin sightings in South Australia over a 29-year period but short-term behavioural effects of dredging activity on dolphins, such as fine-scale changes in habitat use, were not examined. Future research, particularly in the case of dredging activities, would benefit from exploring finer spatial and temporal scales to investigate short-term changes in habitat use and behaviour.

The extent of dredging and disposal operations for the 3FM Project will be less than that carried out during the ABR Project. An estimated 1,259,000m^3 of sediment is to be dredged during the entire 3FM Project, of which 1,189,000m^3 (circa 94%) is suitable for disposal at sea (see Chapter 8). The remaining 70,000m^3 (6%) of material which is not suitable for disposal at sea will be brought ashore for treatment and subsequent re-use. The dredging will be divided over several campaigns in separate years. Dredging of material which is suitable for disposal at sea will be carried out using a combination of a back-hoe dredger and TSHD. Dredging of the material which is not suitable for disposal at sea will be carried out by a back-hoe dredger and brought ashore. A study on the sound produced by seven TSHDs during construction of a 2,000ha harbour extension of the Port of Rotterdam in silt/mud substrates found that maximum noise levels from the various activities associated with TSHD dredging (including the dredging process, placement, pumping and rainbowing) were no louder than those produced by the dredger during transit (De Jong *et al*., 2010). Robinson *et al*. (2011), found that emitted sound levels from TSHDs at frequencies below 500Hz, were similar to a deep-draft cargo ship travelling at a moderate speed.

Underwater noise levels were measured during maintenance dredging at Dublin Port in July 2016 to determine the noise generated during the dredging and dumping operations by a TSHD (RPS, 2016). Underwater noise recorders were moored less than 300m from the dredging activity, and approximately 90m from the dumping activity. Tonal components between 200Hz and 2kHz were attributed to the pump, while dredging generated higher-frequency noise than the dumping operation, but both showed a significant drop in energy at frequencies above 2kHz. The sound levels for the dredging operations at ranges of 213m and 268m from source were below the disturbance threshold for harbour porpoise of 140dB re 1µPa. The sound level for the dumping operation at a range of 90m was very slightly above the disturbance threshold for harbour porpoise (Table 7.37), but this level was still below the general behavioural threshold for marine mammals of 160dB re 1µPa SPL_{RMS} (Root Mean Square) adopted by National Oceanic and Atmospheric Administration (NOAA). This study confirms that noise emitted from dredging operations involving a TSHD does not significantly impact harbour porpoise at ranges of 213m, but the noise emitted from dumping operations may impact harbour porpoise at close ranges of less than 100m. However, dumping operations are completed in as little as 15 minutes, and the likelihood of impact is negligible.

Table 7.37 Source levels of dredging and dumping noise in Dublin Port and at the Dublin Bay dump site

Activity	Range (m)	dB re 1 μPa SPL_{PEAK}	dB re 1 $\mu Pa^2 s$ SEL	dB re 1 μPa SPL_{RMS}	Reference
Dredging	268m	146.03	133.6	133.8	RPS, 2016
Dredging	213m	151.65	138.0	138.8	RPS, 2016
Dumping	90m	153.03	124.7	142.7	RPS, 2016

Underwater noise modelling of 3FM Project impacts presented in Chapter 12 of this EIAR indicates that for one second exposure in the case of dredging or vessel noise the TTS risk range does not extend beyond 5m from source for any of the marine mammals considered (Table 7.36). In the case of continuous vessel noise none of the marine mammals show a measurable TTS risk range. Seals and harbour porpoise show a TTS risk range of 30m and 90m respectively for one hour's exposure to dredging. Vessel and dredging noise was not a significant risk of PTS in any of the marine mammals.

Sound Pressure Level (SPL) has been measured by LIDO at the North Bank Lighthouse over 5 months from August 2022 to December 2022, Sound level measurements (dB re 1µPa) were made over the broadband range, from 0 to 192kHz, using a 10-second time observation window. In addition, decidecade (one-third octave) band level measurements were made using a 2-second time observation window, starting from the band centred on 10 hertz (Hz) up to the band centred on 25kHz (nominal centre frequencies). The distribution of the SPLs measured for each month is presented in Figure 7.90.

Sound pressure from each month shows a fairly typical single modal shape. The modal SPL was similar in August and September at just over 100dB. Modal SPL increased in subsequent months as did the frequency of the higher SPL values. In November the SPL mode was about 10dB greater than in August (Figure 7.90). The increase in sound levels indicated by these data coincides with a period of marine site investigations and capital dredging in the immediate vicinity of the North Bank Lighthouse as part of the MP2 Project. Marine Site Investigations commenced on 13 September 2022 and continued until 27 October 2022. Capital dredging commenced on 15 October 2022 and continued until 6 December 2022. During these operations, there were short periods of increased exposure of SPL up to 150-160dB. The disturbance threshold for harbour porpoise is reported at 140dB re 1µPa (Kastelein et al., 2015, Southall et al., 2019), however porpoise only rarely occur within the harbour area where 3FM Project dredge loading will occur and the likelihood of disturbance is very low.

The SPL threshold for onset of TTS in harbour porpoise is 196dB, and for PTS it is 202dB. Seals and dolphins have higher thresholds (Table 7.35). Therefore hearing impacts on any marine mammal due to dredge loading are very unlikely.

The potential effects on marine mammals of dredging and vessel noise emissions are therefore considered to be negligible to minor negative in the absence of mitigation measures.

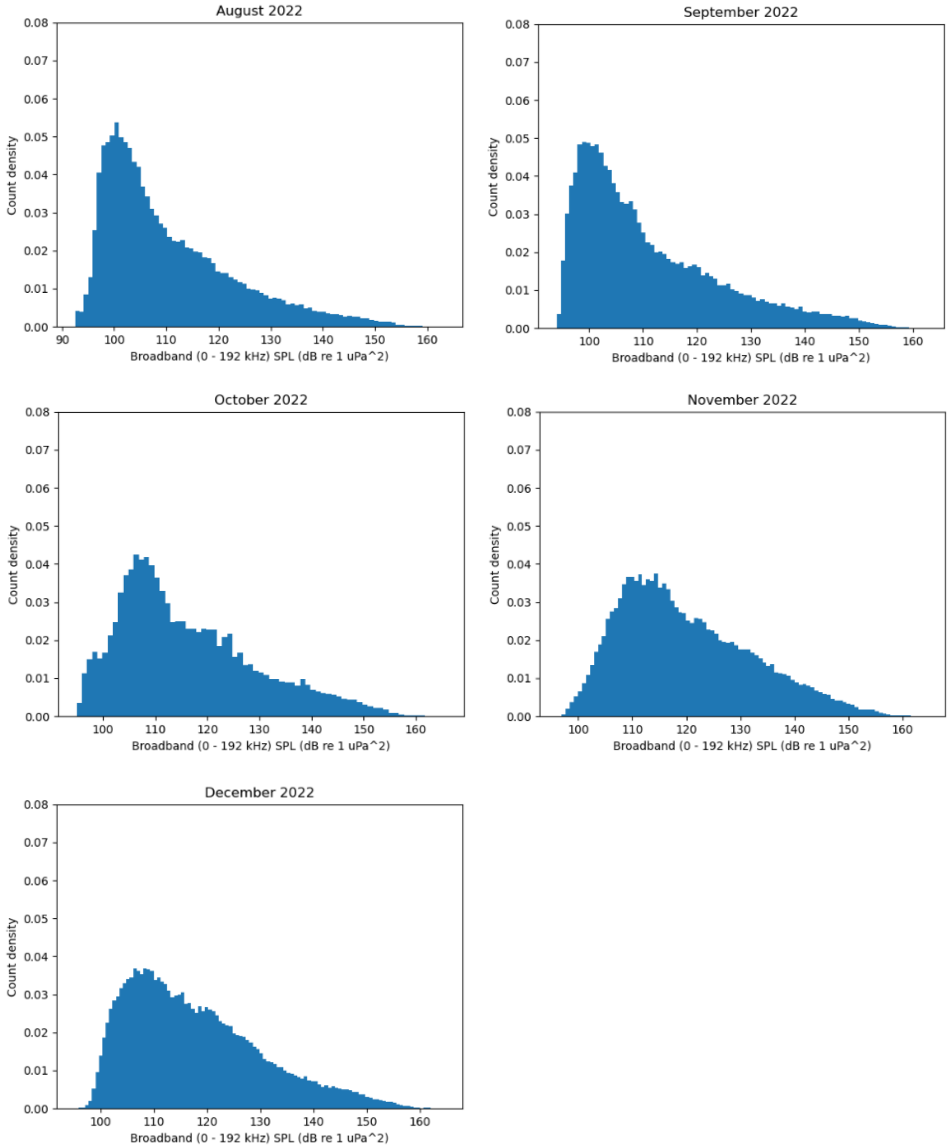

Figure 7.90 The distribution of the broadband sound pressure level (0 – 192 kHz) presented by month from the LIDO system deployed at North Bank Lighthouse in Dublin Harbour.

Sediment Plumes from Dredging (Loading and Disposal)

The 3FM Project requires capital dredging to create the following infrastructure elements:

- Maritime Village / Marina
  - Dredged depth -3.0m CD
  - Dredged Volume 197,000m^3
  - Note the top 1.0m of material is not suitable for disposal at sea (70,000m^3)
- Ro-Ro Terminal (Area K) – Localised Scour Protection to 220 kV cables
  - No dredging of berths required
  - Exception – local deepening to place scour protection
  - Dredged Volume circa 13,000m^3
- New Turning Circle, 325m diameter

  - Dredged depth -10.0m CD
  - Dredged Volume circa 444,000m^3
- Lo-Lo Terminal (Area N) Berthing Pocket for Container Vessels
  - Dredged depth -13.0m CD
  - Dredged Volume 533,000m^3

The total dredge volume is estimated at 1,259,000m^3. Dredging will be carried out using a combination of a Back-hoe dredger and a Trailing Suction Hopper Dredger together with support vessels. The 1,189,000m^3 of dredged sediments which are suitable for disposal at sea (Class 1, uncontaminated, no biological effect likely) will be disposed of at the existing licensed offshore spoil grounds located at the entrance to Dublin Bay to the west of the Burford Bank, (6.75km from the lighthouse at the end of the Great South Wall). The spoil ground is situated within the Rockabill to Dalkey Island SAC which includes harbour porpoise as a qualifying interest. Harbour porpoise have been occasionally observed within the breakwater walls in recent years with grey and harbour seals observed all year around.

Dredging of the berths and the Turning Circle will result in the development of localised high concentrations of suspended solids in the water column in close proximity to the dredger. Sediment plume modelling simulations were undertaken using the MIKE 3 Hydrodynamic model as part of a Coastal Process Risk Assessment (Chapter 13). Models indicated that during loading in Dublin Harbour, apart from the area immediately around the dredger, Total Suspended Solids concentrations will peak between 25mg/l and 30mg/l above background, and the mean value over the whole of the dredging period will be less than 10mg/l to 16mg/l above background. It was therefore concluded that dredging operations in the inner harbour will not result in any significant impact to either the water quality in terms of suspended sediments, or the nearby environmentally designated areas in terms of sediment deposition. Turbidity tracking of sediment plumes during loading operations in July 2021 confirmed that plumes remained in a relatively narrow band while moving downstream, maximum turbidity recorded in the plume was less than 25 NTU, and turbidity values dropped below 10 NTU within a few minutes (RPS, Dublin Bay Sediment plume monitoring report, September 2021).

Sediment plume formation and dispersal during spoil dumping operations has also been studied during the ABR Project and MP2 Project dredging campaigns in March 2020 (RPS, Dublin Bay Sediment Plume Monitoring Report March 2022) and in November 2022 (Dublin Bay Sediment plume monitoring report MP2 Capital Dredging November 2022). Turbidity in the vicinity of the dredger (15m) generally reached maxima of about 50 NTU after spoil discharge, and fell to baseline levels of less than 10 NTU within minutes. The data collected provides evidence that the dumping of dredged sediment at the dump location had no measurable long term effect on turbidity outside the dumpsite or even within the dump site within a very short time period of the dredger releasing its load.

Similar to the ABR Project and MP2 Project, there will be continuous turbidity monitoring for the duration of loading operations and for a minimum period of one week prior to dredging operations commencing and for one week post each dredging campaign, at four different monitoring locations, East Link Bridge, Poolbeg Jetty, North Bank Light and the Tolka Estuary. These monitors will be fitted with alarmed turbidity sensors, with threshold levels being agreed with the EPA. A sediment plume survey at the spoil grounds will be undertaken during each dredging campaign to demonstrate compliance with modelled turbidity results presented in the supporting application documentation.

The extent and duration of sediment plumes is therefore relatively small, and since marine mammals often reside in turbid waters, significant impacts from turbidity are improbable either within Dublin Harbour or at the dump site. The potential effects on marine mammals of sediment plumes associated with dredging are therefore considered to be negligible to minimum negative in the absence of mitigation measures.

Prey / Benthos Impacts

Dublin Harbour

Benthic, epibenthic and infaunal communities may be affected due to entrainment, habitat degradation, noise, contaminant remobilisation, suspended sediments and sedimentation, which could impact marine mammals indirectly through changes in prey availability (Todd *et al*, 2014). Overall, the fauna and habitats identified in the Dublin Port area are typical of estuarine systems and common in Irish coastal waters. The fauna is dominated by highly opportunistic species, typical of estuarine systems with increased nutrient loading (see 0 Benthic Biodiversity and Fisheries). Such species are resilient and recover quickly post disturbance, as has been shown in repeated benthic surveys of the Dublin Port area since 2013. Therefore impacts are temporary and local.

Harbour porpoise occur rarely in Dublin Port and it is not a significant foraging area for them. Seals occur within the Port area regularly, but numbers are relatively low, and the harbour is not a major foraging area for most of the Dublin Bay seal population. In any event, dredging does not occur simultaneously throughout the harbour area and this results in a mosaic of recently dredged and undredged areas. This facilitates continuous use of the harbour benthic resource by marine mammals and their prey, and allows more rapid recovery of benthic communities through recruitment from nearby areas.

The area to be dredged during the 3FM Project constitutes a small fraction of similar habitat type present in the inner harbour area. Areas for dredging include berths which are regularly occupied by vessels and therefore unlikely to be normally available to seals for a high proportion of time. Such areas are also of lower biodiversity value.

Although there will be some permanent loss of benthos habitat due to new structures, the impacts are very local and small in scale. Therefore effects of the 3FM Project on benthos and food chains is considered negligible in view of the large amount of similar benthic habitat present in the area.

Migratory fish, including salmonids and eels, may be a seasonal prey item for seals. In terms of the 3FM Project noise impact significance, the impact on eel is predicted to be imperceptible and the impact on salmon is predicted to be minor negative, short-term in the absence of mitigation (Section 7.3.3.3).

Overall, given the predicted small magnitude of impact of the 3FM Project on most potential prey items, the relatively small fraction of the seal population that frequent Dublin Harbour to forage, and only rare occurrences of harbour porpoise within the harbour area, any impacts on marine mammals through depletion of prey is considered negligible.

Dump Site

A number of surveys of the subtidal benthic and demersal fish communities at the Dublin Bay dredge spoil disposal site near the Burford Bank and surrounding areas, and in Dublin Port have been undertaken on several occasions (2013, 2016, 2018, 2019, 2020, 2022), and include periods pre- and post-dredging campaigns. These included benthic grab samples, drop-down video survey and beam trawls. The faunal communities identified are very similar in successive surveys, indicating a resilience to disturbances. The surveys indicate that impacts due to the disposal activities are short term, and sites show signs of recovery within 6-months following cessation of disposal activities. The benthic community which initially colonises dredge spoil disposal sites is often dominated by rapidly growing, small-bodied infauna, situated close to the sediment surface. This is reflected in the recovery of biomass, as well as species diversity and abundances within the disposal area.

In an analysis of acoustic data collected at the dump site during dredging campaigns in Dublin Port, Cummins (2019) identified a number of instances with significant increases in harbour porpoise acoustic activity during dredging operations (2017-2019). This has been attributed to a limited increase in foraging activity during spoil dumping as porpoises avail of feeding opportunities. The release of organic nutrients from sediment plumes has the potential to temporarily increase the amount of food available to marine mammals (Walker and O Donnell, 1981). Disposal of dredge spoil may provide a boost in benthic productivity which in turn attracts fish, and marine mammals. Pezy *et al.,* (2017) showed increases in dab, place and sole following spoil disposal at a sandy dumpsite site in France. Trawl surveys (most recently in June 2023) confirm that the dump site and its immediate adjoining ground is being used by a wide variety of fish, and surveys indicate that dumping may have increased certain benthic prey species attractive to the fish.

Overall, any impacts on marine mammals through depletion of prey at the dump site is considered negligible.

Demolition of structures

Demolition and/or removal of a limited number of structures will take place along the south side of the Port as part of the development of the 3FM Project. Demolition operations may cause local disturbance to marine mammals in the vicinity. Such disturbance is intermittent, of short duration and very local in scale. The likelihood of impacts on marine mammals is considered to be minor negative and temporary in the absence of mitigation.

Vessel Collision with Marine Mammals

Dublin Port experiences a large number of vessel transits on a daily basis. Vessels range from small recreational craft to cruise and cargo vessels up to 240m in length. The dredger and support vessels operating during the dredging phases of the 3FM Project will not constitute any significant increase in vessel numbers or risk of collision. These vessels operate at slow speeds (approximately 4 knots when dredging) and there is no significant risk of collision with highly mobile marine mammals. The potential impact of construction vessel collisions with marine mammals is therefore assessed to be negligible.

Release of Pollutants

The most significant potential pollutants during the 3FM Project construction are sediment and oil spillages. The risk of pollutant release is controlled through a project-specific detailed Construction Environmental Management Plans (CEMP) that incorporates best practice requirements. The adherence to the CEMP is assured through extensive monitoring programmes, and implementation is overseen by an Environmental Facilities Manager who is independent of contractors and who can halt operations in the event of a breach. The dredging contractor is also required to prepare and submit an Accident Prevention Procedure and an Emergency Response Procedure in advance of operations. Given the limited area of construction operations, the low likelihood of pollutant release, and the high mobility of marine mammals, the risk of impact due to pollutants is considered negligible.

7.4.3.2 Operational Phase Impacts

Increased vessel traffic/size (noise and collision)

The 3FM Project will give rise to an increase in Port traffic. Chapter 2 of the EIAR outlines indicative increases in Ro-Ro and Lo-Lo throughput in Dublin Port up to 2040. Changes in berth functions and construction of new berths will result in a net change of circa ten additional ships per week utilising the berths at the South Port by 2040. This modest anticipated increase in vessel numbers using the shipping channel in Dublin Bay and entering Dublin Port will occur in an underwater noise environment which has been dominated by shipping traffic for more than half a century and which occurs 24/7 all year round. Shipping noise in the outer bay occurs as brief increases in underwater noise levels that revert to background once the vessel has passed. Noise generation by ships berthed in the Port may be more sustained, and while moderate increases in noise levels could occur at busy periods, any long-term increase in noise levels is likely to be small.

Low frequency continuous sound such as that generated by shipping has been reported as the dominant source of anthropogenic sound in maritime areas over a broad frequency range from 5Hz to 300Hz (NRC 2003). Ambient noise in Dublin Bay has been estimated at around 113dB by Beck et al. (2013) and McKeown (2014). This level is higher than that reported from Galway Bay and the Shannon Estuary and reflects the greater vessel traffic at this site. Shipping produces low broadband and "tonal" narrowband sounds. The primary sources are propeller cavitation and singing of propulsion and other machinery (Richardson *et al*. 1995). For large and medium vessels tones dominate up to around 50Hz and broadband components may extend to 100Hz. Noise disturbance, through increased vessel traffic could cause a long-term effect, where the low frequency component overlaps with the vocalisations and estimated hearing range of marine mammals.

Many odontocetes (toothed whales including porpoises and dolphins) show considerable tolerance to vessel traffic. Sini et al. (2005) showed bottlenose dolphins resident in the Moray Firth generally exhibited a positive reaction to medium (16-30m) and large vessels (>30m) and showed some evidence of habituation. Buckstaff (2004) suggested an exposure level of 110-120dB from vessel noise elicited no observable effect on bottlenose dolphins. A similar exposure level elicited minor changes in orientation behaviour and locomotion changes in minke whales (Palka and Hammond 2001). Harbour porpoises are frequently observed near vessels but tend to change behaviour and move away and this avoidance may occur up to 1-1.5km from a ship, with strong avoidance behaviours clear within 400m of a ship (Richardson *et al.* 1995). Seals show considerable tolerance to vessel activity, and seals in Dublin Port have been observed close to drilling rigs and dredging vessels (Russell 2023, pers. obs.) possibly taking advantage of a feeding opportunities close to these vessels. Modelling presented above (Table 7.36) indicates that the risk range for TTS and PTS impacts on marine mammals due to vessel noise are less than 5m. Therefore the impact on marine mammals due to increased vessel noise during the operational phase are assessed as negligible.

The risk of injury or mortality due to collision is considered extremely low as marine mammals are exposed to considerable vessel traffic on a daily basis of approximately 40 vessel movements per day. Vessels approaching and within the Port are slow moving and do not turn quickly. Any animals in the area would have sufficient time to avoid collisions and thus injury or mortality. The potential impact on marine mammals due to vessel collision is therefore considered to be negligible.

7.4.4 Remedial & Mitigation Measures

Mitigation by design has been incorporated at the earliest stages of the 3FM Project development to minimise potential impacts during construction and operational phases. Further mitigation includes measures to avoid or reduce the negative impacts of the project, for example careful timing of an activity to prevent an impact occurring. The mitigation proposed is supported through comprehensive monitoring and auditing procedures as set out in the 3FM Project CEMP to ensure effective implementation and determine any unforeseen negative effects. This will enable any necessary remedial action to be taken in an adaptive approach, including adjustment to the activity generating the impacts and adjustment to the mitigation measures.

The following precautionary measures will be undertaken during the 3FM Project construction phase to minimise the risk of injury or disturbance to marine mammals in the area of operations in line with National Parks and Wildlife Service (NPWS) Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (2014):

- A trained and experienced Marine Mammal Observer (MMO) will be put in place during piling, dredging, demolition and dumping operations. The MMO will scan the surrounding area to ensure no marine mammals are in a pre-determined exclusion zone in the 30-minute period prior to operations. The NPWS exclusion zone is 500m for dredging and demolition works and 1,000m for piling activities.
- Noise-producing activities will only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved. Where effective visual monitoring is not possible, the sound-producing activities will be postponed until effective visual monitoring is possible. Visual scanning for marine mammals (in particular harbour porpoise) will only be effective during daylight hours and if the sea state is WMO Sea State 4 (≈Beaufort Force 4 conditions) or less.
- For piling activities, where the output peak sound pressure level (in water) exceeds 170 dB re: 1µPa @ 1m, a ramp-up procedure will be employed following the pre-start monitoring. Underwater acoustic energy output will commence from a lower energy start-up and thereafter be allowed to gradually build up to the necessary maximum output over a period of 20-40 minutes.
- If there is a break in piling / dredging including dredging & piling plant activity for a period greater than 30 minutes then all pre-activity monitoring measures and ramp-up (where this is possible) will recommence as for start-up.
- Once normal operations commence (including appropriate ramp-up procedures), there is no requirement to halt or discontinue the activity at night-time, nor if weather or visibility conditions deteriorate, nor if marine

mammals occur within a radial distance of the sound source that is 500m for dredging and demolition works, and 1,000m for piling activities.

- Once normal dredging operations commence there is no requirement to halt or discontinue the activity at night-time, nor if weather or visibility conditions deteriorate, nor if marine mammals occur within a radial distance of the sound source that is 500m for dredging and demolition works. Notwithstanding this, MMOs will implement additional best-practice mitigation where feasible by directing operations to areas where marine mammals are absent, or requesting delays to activities to provide animals an opportunity to disperse.
- Any approach by marine mammals into the immediate (<50m) works area will be reported to the National Parks and Wildlife Service.
- Non-piling windows, and implementation of piling controls when marine mammals occur in specified monitoring zones have been set for impact piling.
- Piling is restricted to 0700h and 1900h (Monday to Friday), 0800h to 1300h (Saturday) and no piling will take place on Sundays or Bank Holidays. Therefore, during piling periods, active piling operations will only occur for a maximum of about 38% of that period, allowing extensive unimpeded use of the harbour area by marine mammals throughout project construction.
- An extended monitoring zone will be implemented for harbour porpoise during piling at Area N and Area K. This zone will include all areas within the Bull Walls, and no piling will be permitted if harbour porpoise are present in this area during a pre-watch. A minimum of two MMOs are required to effectively monitor this extended zone.
- The MMO will keep a record of the monitoring and log all relevant events using standardised data forms available from NPWS and submit to the NPWS on completion of the works.
- In line with international best practice, a combination of visual and acoustic mitigation techniques will be used to ensure there are no significant impacts on all Annex II marine species, including harbour porpoise, grey seal and harbour seal. Static Acoustic Monitoring (SAM) through the deployment of FPODS will be used. SAM monitoring sites will be established and maintained throughout the project and for two years post-construction. This technique is to complement and not replace visual techniques.
- The deployment of a SAM system will complement and extend the extensive database currently being collected as part of the ABR and MP2 Project environmental monitoring programmes.
- The deployment of a Passive Acoustic Monitoring (PAM) system at North Bank Light in the inner Liffey channel will continue for the duration of the construction phase. The PAM system uses a hydrophone to detect the presence of marine mammals in real time.

The following precautionary measures shall be undertaken to minimise the risk of impacting on water quality within the receiving environment:

- Sound design principles will be followed to adhere to relevant Irish guidelines and recognised international guidelines for best practice;
- Appropriate erosion and sediment controls during construction to prevent sediment pollution will be implemented;

- Where preferential surface flow paths occur, silt fencing or other suitable barriers will be used to ensure silt laden or contaminated surface runoff from the site does not discharge directly to a water body or surface water drain.
- In the event that dewatering of foundations or drainage trenches is required during construction and/or discharge of surface water from sumps, a treatment system prior to the discharge will be used; silt traps, settlement skips etc. This measure will allow additional settlement of any suspended solids within storm water arising from the construction areas.
- Management and auditing procedures, including tool-box talks to personnel will be put in place to ensure that any works which have the potential to impact on the aquatic environment are being carried out in accordance with required permits, licences, certificates and planning permissions.
- Existing and proposed surface water drainage and discharge points will be mapped on the Drainage layout. These will be noted on construction site plans and protected accordingly to ensure water bodies are not impacted from sediment and other pollutants using measures to intercept the pathway for such pollutants.
- A project specific Pollution Incident Response Plan has been prepared and suitable training will be provided to relevant personnel detailed within the Pollution Incident Response Plan

The following operational phase monitoring will be undertaken:

- DPC will continue to operate a Passive Acoustic Monitoring (PAM) system at the North Bank Light to monitor underwater noise trends as a result of shipping and to monitor the usage of the inner Liffey channel by porpoise and dolphin.

The residual impact before and after mitigation is summarised in Table 7.38.

Table 7.38 Summary of potential residual impacts on marine mammals in the Dublin Port and Bay area during specific 3FM Project operations pre- and post-mitigation

Activity		Without Mitigation		With Mitigation	
		Seals	Harbour Porpoise	Seals	Harbour Porpoise
Construction	Impact Piling	Moderate to Major Negative	Moderate to Major Negative	Negligible	Negligible
	Vibro-Piling	Moderate Negative	Moderate Negative	Negligible	Negligible
	Dredging Noise	Minor Negative	Minor Negative	Negligible	Negligible
	Dredging Sediment Plume	Minor Negative	Minor Negative	Negligible	Negligible
	Dredging Sediment Plume Dump	Minor Negative	Minor Negative	Negligible	Negligible
	Prey / Benthos	Minor Negative	Negligible	Negligible	Negligible
	Demolition	Minor Negative	Minor Negative	Negligible	Negligible
	Vessel Noise	Negligible	Negligible	Negligible	Negligible
	Vessel Collision	Negligible	Negligible	Negligible	Negligible
	Pollutant Release	Negligible	Negligible	Negligible	Negligible
Operational	Vessel Noise	Negligible	Negligible	Negligible	Negligible
	Vessel Collision	Negligible	Negligible	Negligible	Negligible

7.4.4.1 Cumulative Impacts

Chapter 5 of the EIAR identifies and describes other related projects in proximity to, or whose zone of influence might overlap with the proposed 3FM Project. This section considers the potential of cumulative impacts specifically in relation to marine mammals of the proposed 3FM Project in combination with other existing and/or approved projects, and projects which, at the time of assessment, were yet to be approved but for which a decision is likely during the consenting and construction period anticipated for the 3FM Project. It should be noted that cumulative effects of the 3FM Project and other projects on the European sites and their Qualifying Interests are appraised in the Natura Impact Statement submitted with the application for permission.

The projects that could potentially have cumulative impacts on marine mammals in conjunction with the 3FM Project have been identified from the long list of projects in Chapter 20 by considering their potential for cumulative effects on marine mammals, the location, scale and nature of the projects, the zone of influence of individual projects, and the likelihood of temporal overlap. Pressure sources and pathways were also considered in assessing the potential for cumulative effects in relation to marine mammals. The following assessments address the potential cumulative effects in a proportionate manner to ensure that all main sources of potential impact are considered.

Alexandra Basin Redevelopment (ABR) Project – ABP Reg. Ref. PL29N.PA0034

The ABR Project comprises the following main elements:

- Capital dredging of the navigation channel to -10m CD, from 50m downstream of East Link Bridge to Dublin Bay Buoy.
- Refurbishment and construction of quay walls in Alexandra Basin West. This includes installation of Ro-Ro ramps and construction of a Ro-Ro jetty. The basin is to be dredged to -10.0m CD and the contaminated dredged material is to be treated for re-use as infill on site.
- The Bulk Jetty is to be demolished and ore concentrates loading operations are to relocate to Alexandra Quay West Extension.
- Excavation and restoration of Graving Dock No.1 and Infilling of Graving Dock No. 2 with treated dredged material will facilitate development of a Cultural Heritage interpretative space.
- Existing Berth 52/53 is to be infilled with treated dredged material, and existing surface levels raised by approximately 1.4m. This includes quay wall construction, mooring jetty construction and installation of Ro-Ro ramp.

The ABR Project is currently in late construction stage having been granted permission by An Bord Pleanála (ABP) in July 2015 (ABP Ref. 29N.PA0034). Capital Dredging was completed in 2021. The remaining construction works with potential to impact marine mammals are either completed, or at an advanced stage and will be completed before the commencement of the 3FM Project. No significant ABR Project operational impacts are envisaged. Therefore no cumulative impacts are likely.

MP2 Project – ABP Reg. Ref. ABP-304888-19

The MP2 Project was granted planning permission by ABP on 1 July 2020 and must be completed within 15 years of that date. The project is located mainly within the Northern Lands of Dublin Port, and the project also includes capital dredging works within Dublin Port Harbour.

The works proposed as part of the MP2 Project are summarised as follows:

- Construction of a new Ro-Ro jetty (Berth 53) for ferries up to 240m in length. This requires dredging of a berth pocket and installation of slope stabilisation mattresses, installation of piles for jetty and dolphins, and vertical piles for a wash protection structure.
- A reorientation of the already consented Berth 52 (ABP Ref. 29N.PA0034) and modification to Berth 49. These works include Infilling of the old berth 52 basin, using a rock armour causeway to initially seal the basin, and construction of a new quay wall.
- A lengthening of an existing river berth (50A). This will comprise the construction of a new sheet pile to the west end of Berth 50A, and excavation of Pier Head at the Eastern Breakwater and the south end of the existing Oil Berth 3/4 jetty. Sheet pile combi-walls walls will be installed and the void between existing wall at Oil Berth 3 and the proposed new wall will be filled with engineering fill. Capital dredging is required to form an extended berthing pocket at Berth 50A.

- The redevelopment of Oil Berth 3, and infill of Oil berth 4, as a future deep-water container berth for the Container Freight Terminal. This will entail installation of sheet pile combi-walls, dredging of Berth 3 and infilling of Oil Berth 4.
- Localised Navigation Channel widening works to enable vessels of 240m length to turn.
- Redevelopment of the ferry terminal yard including consolidation of passenger terminal buildings, demolition of redundant structures and buildings, and removal of connecting roads to increase the area of land for the transit storage of Ro-Ro freight units as a Unified Ferry Terminal (UFT).
- Installation of a heritage zone adjacent to Berth 53 and the Unified Ferry Terminal set down area.

Of these, the final two bullets entail landside works and will not impact marine mammals. They are not considered further. The works will be phased throughout the life of the MP2 Project and are scheduled for completion in 2032. The main construction activities that have potential to give rise to cumulative impacts are dredging operations (benthos/prey impacts, and suspended solids) and piling noise.

The first capital dredging campaign as part of the MP2 Project took place between October and December 2022. The localised widening of the channel and majority of dredging at Berth 53 was completed. Berth 52 and 53 construction is expected to commence in 2024 and will be completed before the commencement of the 3FM Project. Dredging activity for the 3FM Project has been programmed to ensure that there will be no overlap with either the MP2 Project capital dredging programme or DPC maintenance dredging campaigns.

Both MP2 Project and 3FM Project dredging impacts on benthos habitats are considered to be short-term and slight negative, with recovery expected to occur rapidly once dredging has been completed. DPC will ensure that dredging works for the MP2 Project and 3FM Project occur over separate winter periods. The phased nature of dredging elements, the small spatial extent of areas effected, and the lack of overlap between the MP2 Project and 3FM Project dredging campaigns will allow benthos habitat and biodiversity to recover rapidly, both in the dredged areas in the harbour and at the dump site, and will avoid any significant cumulative impacts.

Impacts of suspended solids due to dredging during both MP2 and 3FM Projects on fisheries are expected to be slight negative and temporary. No fish species should be negatively impacted at the population level due to the dredging proposed in these projects. Therefore cumulative impacts on benthos and prey species of marine mammals is expected to be negligible.

Significant mitigation is being implemented for both the MP2 and 3FM Projects in relation to underwater noise due to piling. This includes observing a soft start to percussive piling, and a progressive ramp up to maximum percussive piling energy. Marine Mammal Observers will ensure that marine mammals are not in designated monitoring zones prior to start of piling. DPC will also ensure that piling operations at the proposed Ro-Ro Terminal (Area K) as part of the 3FM Project, which is on the south side of the channel opposite MP2 construction locations to the north of the channel, will not take place simultaneously. This will ensure there will be no cumulative piling impacts on marine mammals. All potential piling impacts are confined to the inner harbour and significant impacts by either project are not likely in Dublin Bay. Piling in the River Liffey Channel upstream of Berth 49 will not take place between March and May in order to avoid the main salmon smolt run. Neither will piling take place in July and August upstream of Berth 49 or driving of the outer piles at Area N in order to avoid the peak of the adult salmon run to spawning grounds. This will mitigate the risk to marine mammal prey species. Provided the mitigation measures as listed in the environmental chapters are employed during construction and/or operation the overall impact to the environment, when considered in combination, is considered negligible. As a result there will be no significant impact on marine mammals by either project, or in combination.

Dublin Port Maintenance Dredging Programme 2022–2029 – Foreshore Licence FS007132 / DAS Permit S0004-03

DPC has permission to carry out regular maintenance dredging over an eight-year period, 2022 to 2029, with an annual maximum permissible dredging volume of 300,000m^3. Maintenance dredging is confined to the period April to September with a closed period operating between 01 April to 14 May in the inner Liffey channel upstream of Berth 49 (including the main channel and side berths but not including basins). Maintenance dredging will not overlap with the 3FM Project capital dredging works which will be restricted to winter months (October to March). The loading of dredged material will be restricted to those areas of the navigation channel, basins and berthing pockets which contain sediments which are suitable for disposal at sea (Class 1: uncontaminated, no biological effects likely).

Dredging impacts on benthos habitats are considered to be short-term and slightly negative, with recovery expected to occur rapidly once dredging has been completed. The phased nature of maintenance and capital dredging elements, and their separation into discrete periods will allow benthos habitat and biodiversity to recover rapidly, both in the dredged areas in the harbour and at the dump site, and will avoid any significant cumulative impacts on biodiversity or prey species. Therefore there will be no cumulative impacts on marine mammals.

Dublin Harbour Capital Dredging Project – Foreshore Application FS007164/DAS Application S0033-01

DPC is currently seeking permission to undertake capital dredging within Dublin Harbour to deepen areas of the navigation channel and basins that were not dredged by the ABR Project to -10m CD (excluding Alexandra Basin West). The total volume to be removed is circa 500,000m^3. The loading of dredged material will be restricted to those areas of the navigation channel, basins and berthing pockets which contain sediments which are suitable for disposal at sea (Class 1: uncontaminated, no biological effects likely).

Capital dredging under the Dublin Harbour Capital Dredging Project has the potential to overlap temporally with the 3FM Project, however DPC will programme these works to ensure they occur over separate winter periods, resulting in no cumulative impacts on marine mammals.

Uisce Eireann – Ringsend WwTP –Upgrade Project BP Ref. PL29S.301798

Uisce Eireann submitted a planning application for strategic infrastructure development to An Bord Pleanála (Ref. PL29S.301798) seeking permission to further progress the upgrade of the Ringsend Wastewater Treatment Plant (WwTP). The application seeks permission for works required to facilitate the use of Aerobic Granular Sludge (AGS) technology, to omit the previously permitted long sea outfall tunnel and to upgrade the sludge treatment facilities at Ringsend, Dublin 4, and to provide for a Regional Biosolids Storage Facility in Newtown, Dublin 11. The proposed development at Ringsend is on the south bank of the River Liffey. The application was granted permission in April 2019. Construction works are largely land based and unlikely to have any impact on marine mammals.

The NIS assessment concluded that the operational phase of the proposed upgrade will result in water quality improvement in Inner Dublin Bay because of a reduction in nutrient load, and that there will be no negative effect on the integrity of any European site as a result. It is unlikely that the prey species of marine mammals in the Port area or in Dublin Bay will be negatively affected. Cumulative impacts in conjunction with the 3FM Project are unlikely.

The Howth Yacht Club Marina Extension - DAS Permit Reg. No. S0010-01

Howth Yacht Club (HYC) is proposing to extend the marina at Howth within the confines of the existing breakwater. A Dumping at Sea Permit was granted in August 2011 (Reg No. S0010-01) for the disposal of 120,000 tonnes of dredged material at the licensed offshore spoil grounds located to the west of the Burford Bank, the same offshore site for the dredge spoil from the 3FM Project.

HYC estimated a maximum daily quantity for dumping of 1,200 tonnes, and 800 tonnes in each load. It also suggested a spring or winter commencement and campaign duration of six months. This volume of material is equivalent to approximately 6% of the annual quantity of material permitted under Dumping at Sea Permit S0024-01 for the ABR Project.

No dumping at sea under the HYC permit has taken place since it was granted in 2011. In the unlikely event that this work was to proceed during the construction phase of the 3FM Project, all dumping will be subject to the approval of the Dublin Port Harbourmaster and dumping activity will not be permitted by the Harbourmaster for DPC and HYC operations simultaneously. Given this, and the relatively small volumes, no cumulative impact on marine mammals is predicted.

7.4.5 Residual Impacts

The assessment of marine mammal features concludes that significant environmental impacts are predicted upon individuals, but not populations, of marine mammals as a result of piling, dredging and demolition works during the construction of the proposed 3FM Project and in the absence of mitigation. Mitigation measures have been proposed to minimise the risk of injury or disturbance to marine mammals in the area of operations in line with National Parks and Wildlife Service (NPWS) Guidelines (2014): Effective implementation of the mitigation measures will ensure there is no significant residual environmental impact upon marine mammal features.

7.5 Avian Biodiversity

This section assesses the potential impacts of the 3FM Project on birds and their habitats (avian biodiversity). The methodology for data collection is presented. The receiving environment of the 3FM Project for birds is described. Impacts are predicted and mitigation measures are presented. It should be noted that potential impacts of the 3FM Project specifically in relation to Special Protection Areas and their Qualifying Interests have been assessed separately in the Natura Impact Statement (NIS).

DPC supports multi-annual bird surveys in Dublin Port and Bay area. These include breeding tern population surveys, black guillemot surveys and winter wetland bird surveys. A number of additional bird-related surveys were undertaken to gather site-specific baseline information and inform the impact appraisal. The surveys related to various proposed elements of the 3FM Project and their potential impact on avian biodiversity. The relevant project elements include:

- the construction of the Southern Port Access Route (SPAR) Bridge;
- sundry landside construction works on the Poolbeg peninsula (including construction of roadways and active travel routes, trailer and container facilities);
- capital dredging in the inner Liffey channel (construction of a turning circle for vessels, and berths);
- construction of new quay walls, wharfs and jetties.

The survey methodologies and the results/findings are outlined. The receiving environment is described in terms of its avian biodiversity. Finally, information on baseline avian biodiversity, and consideration of relevant project works and their potential impacts inform the subsequent impact appraisal and the mitigation proposed.

7.5.1 Methodology

7.5.1.1 Vantage Point Survey

As part of the 3FM Project, DPC propose to construct a new Southern Port Access Route (SPAR) to link the North and South Port Estates, taking HGVs from the port away from the existing public road via a new bridge across the River Liffey, immediately east of the Tom Clarke Bridge. This existing bridge is 10m wide, and the running platform is approximately 1.85m above H.A.T. (6.5 metres above Chart Datum).

To assess the extent of bird flight activity at the location of the proposed new crossing, and the potential risk of bird collision with the proposed new bridge, vantage point (VP) surveys were conducted across the 2022-2023 winter season and the latter half of the 2023-2024 winter season. A VP was chosen which allowed the surveyor an unobstructed view of the proposed crossing point and any birds flying up or down the River Liffey at this location (Figure 7.91).

Since there is no guidance on VP survey protocols for Ireland, guidance developed by Scottish Natural Heritage (SNH) for onshore wind farm ornithology surveys was followed (SNH 2017). The protocol followed during surveys was a systematic 180° scan (including overhead) for birds in flight.

The primary target species, for the purposes of this assessment, were cormorants, divers, grebes, herons, skuas, geese, swans, ducks, terns, waders, gulls, and Birds Directive Annex 1 raptors. Secondary target species included any other waterbirds and other birds of prey.

Surveys were not undertaken in unfavourable weather conditions i.e., persistent heavy rain, poor visibility or winds exceeding c.25 knots (Force 6).

Data collected for each observation included:

- Date of observation
- Time of observation
- Species
- Flock size
- Flight height, using bands A = <5m, B = 5-20m, C = >20m
- Flight direction i.e., West (Upstream) or East (Downstream)

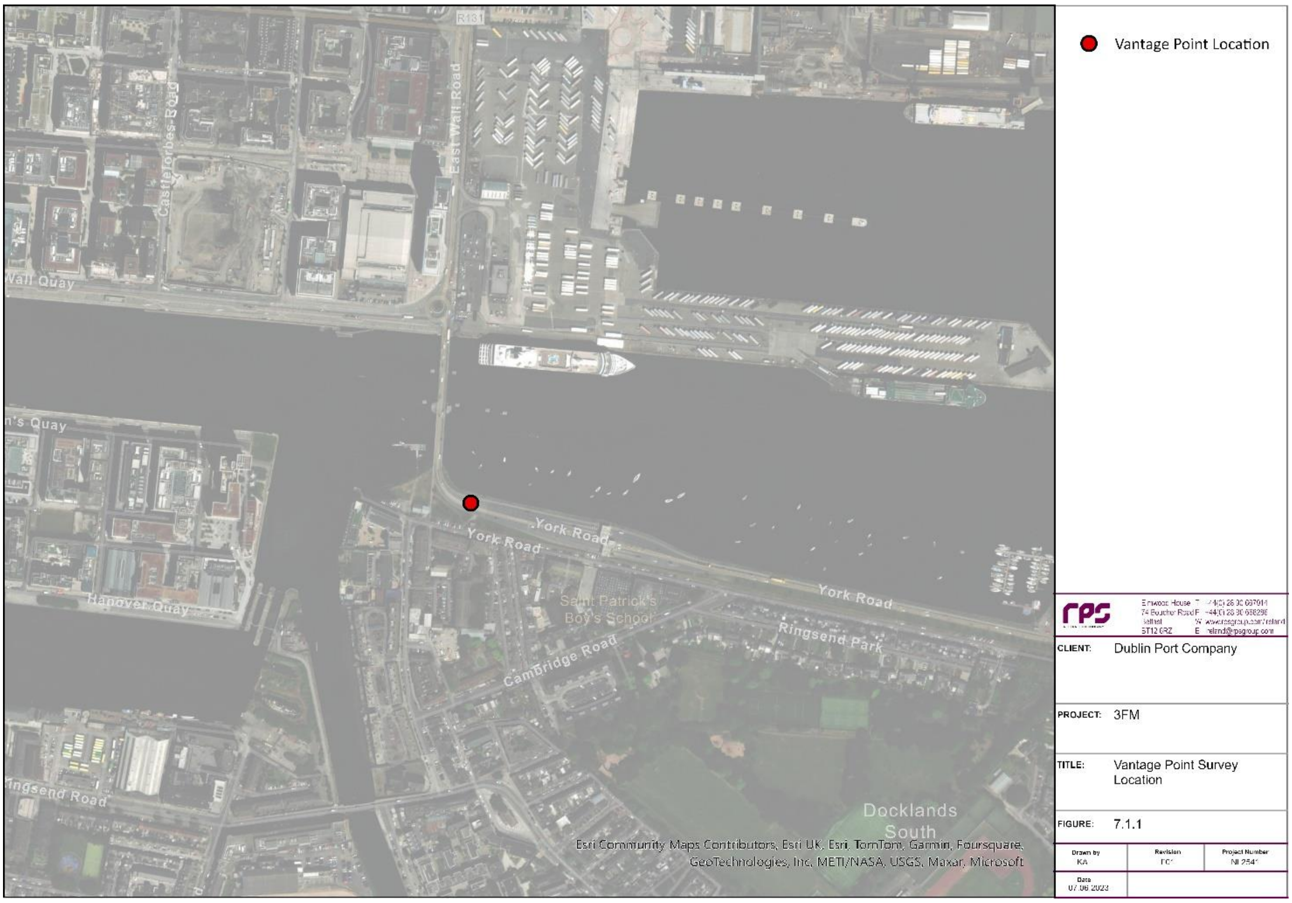

Figure 7.91 Vantage Point Survey Location

7.5.1.2 Breeding Bird Survey

A range of construction works are proposed on the Poolbeg peninsula as part of the 3FM Project, including cycle paths and pedestrian routes, roadworks and areas for trailer and container storage. Some of these works will be in proximity to areas potentially used by nesting birds. A breeding bird survey was conducted on terrestrial habitats from Sean Moore Park/Strand Road, around the coastal fringe, as far as the Ringsend Wastewater Treatment Plant and Shelley Banks (Figure 7.92) to assess use by nesting birds.

The methodology employed was a scaled down version of the British Trust for Ornithology's (BTO) Common Bird Census (CBC) methodology (Bibby *et al*., 2000), which aims to capture breeding bird activity within the survey area.

Three visits were made during the 2022 breeding season: one in the early season (April), one in mid-season (May) and one in the late season (June). The ornithologist slowly walked a transect through the survey area, stopping at regular intervals to scan with binoculars and to listen for bird calls or song. The transect chosen ensured the observer passed within at least 25m of all parts of the survey area.

Survey visits were made in the early morning to coincide with the peak period of bird activity and all species seen or heard in the survey area and immediate environs were recorded, including those in flight. Visits were made during favourable weather conditions.

All species encountered during the survey were mapped and coded using standard BTO species codes and BTO breeding status codes (Appendix 7.5.1).

Although not specifically included in this survey, NPWS has identified the possible presence of a small Sand Martin colony at the mouth of Pigeon House Harbour. The Sand Martins have previously nested in holes in the stonework of the Great South Wall which projects from the western side partially across the mouth of the harbour. The site was visited in on 18th April and 2nd May 2024 to assess possible nesting activity by Sand Martins. The nesting site will be preserved, and mitigation is proposed to minimise any disturbance caused by 3FM Project works in their vicinity during the breeding season.

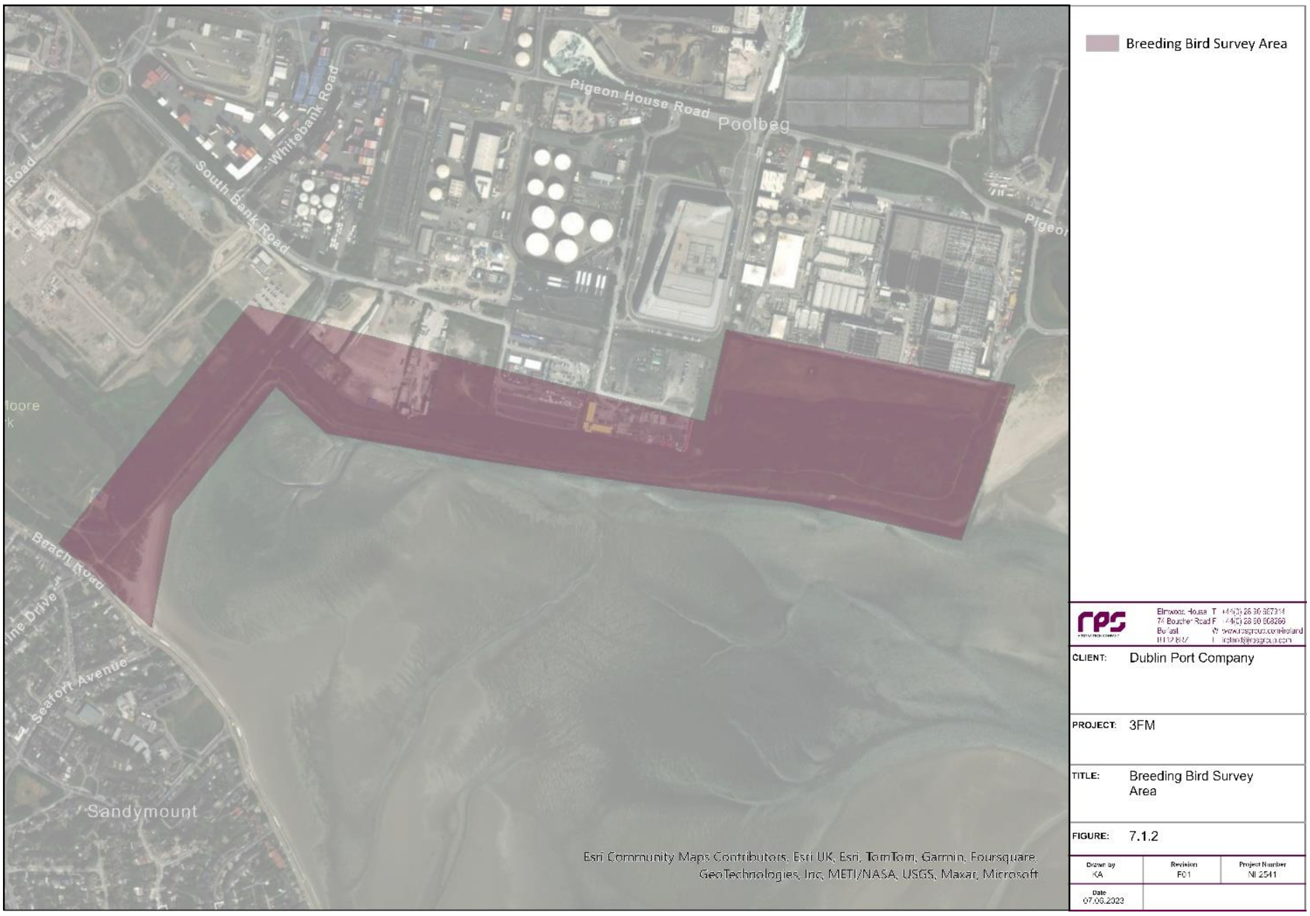

Figure 7.92 Breeding Bird Survey Area

7.5.1.3 Through-the-tide-cycle Counts (TTTCC)

To assess the use of habitats adjacent to the proposed development by waterbirds, through-the-tide-cycle counts (TTTCC) were conducted.

Standard waterbird monitoring in coastal areas is based on two types of counts: high tide counts, when waterbirds are concentrated at roost sites; and low-tide counts, which give an indication as to how waterbirds use intertidal areas for feeding (Armitage *et al.,* 2002). Such counts form the basis of the Irish Wetland Bird Survey (I-WeBS) monitoring of estuaries within Ireland. However, this approach does not provide a complete impression of waterbird usage of intertidal areas, unlike hourly counts of birds across the tidal cycle. TTTCC can determine the distribution of waterbirds on adjacent sub-tidal and intertidal areas (Figure 7.93) throughout the day in various tidal conditions.

TTTCC were carried out on 24 days, covering the 12-month period from April 2022 to March 2023. As waterbird and wader feeding patterns are determined primarily by tide levels, counts were undertaken twice per month, one count across the high-tide conditions and the second count across low-tide conditions.

Figure 7.93 Through-the-tide-cycle Count Survey Area

7.5.1.4 Co-ordinated TTTCC

In addition to the TTTCC conducted between April 2022 and March 2023, a co-ordinated TTTCC was undertaken between October 2023 and March 2024 with three surveyors simultaneously surveying at three sites across Dublin Bay; namely Bull Island, Poolbeg and Shellybanks (Figure 7.94).

Visits were made once per month between October 2023 and March 2024, with counts undertaken each hour for a period of six hours across a range of tidal states throughout the 2023/24 winter season.

All waterbirds seen foraging or roosting within the survey areas were recorded using standard BTO species codes. Birds observed loafing or preening were also recorded and counted as “roosting”. Any birds in flight over the survey areas were not included within counts, unless deemed as using the site by the surveyor and included as “foraging”.

Figure 7.94 Through-the-tide-cycle Count Survey Area October 2023 to March 2024

7.5.1.5 Breeding Tern Disturbance Monitoring

Dublin Bay is of international importance for terns during both the breeding and post-breeding season with Dublin Port supporting a breeding colony of Common Terns *Sterna hirundo,* and Arctic Terns *S. paradisaea* (Boland *et al.*, 2021, 2022). All five species of tern which regularly breed in Ireland are listed on Annex 1 of the Birds Directive.

Currently, the Dublin Port tern colony breeds on four man-made structures within the port: two mooring dolphins; the Coal Distribution Limited (CDL) Dolphin and ESB Dolphin, and also on two specially made nesting pontoons; the Tolka Estuary Pontoon and the Great South Wall (GSW) Pontoon (Figure 7.95).

The CDL dolphin is owned by DPC and is the only structure in Dublin Port to currently host nesting Arctic Tern.

The SPA platform is owned and maintained by ESB who replaced the nesting platform in 2017 with an entirely new and improved structure subdivided into 34 compartments to facilitate monitoring and to minimise disturbance to chicks when the structure is accessed.

The Tolka Pontoon was first deployed in the Tolka Estuary by DPC in 2013 and is separated into three large compartments.

The GSW Pontoon was originally launched at the base of the Great South Wall by DPC in 2015. In 2016, the structure was moved adjacent to the SPA Platform while the latter was undergoing upgrade works. On completion of these works, and following consultation with NPWS, it was relocated away from the SPA Platform to prevent it compromising the Qualifying Interests of the SPA. In 2018 DPC moved this pontoon to its current location approximately 120m on the north side of the Great South Wall, and approximately 750m east of the base of the Great South Wall.

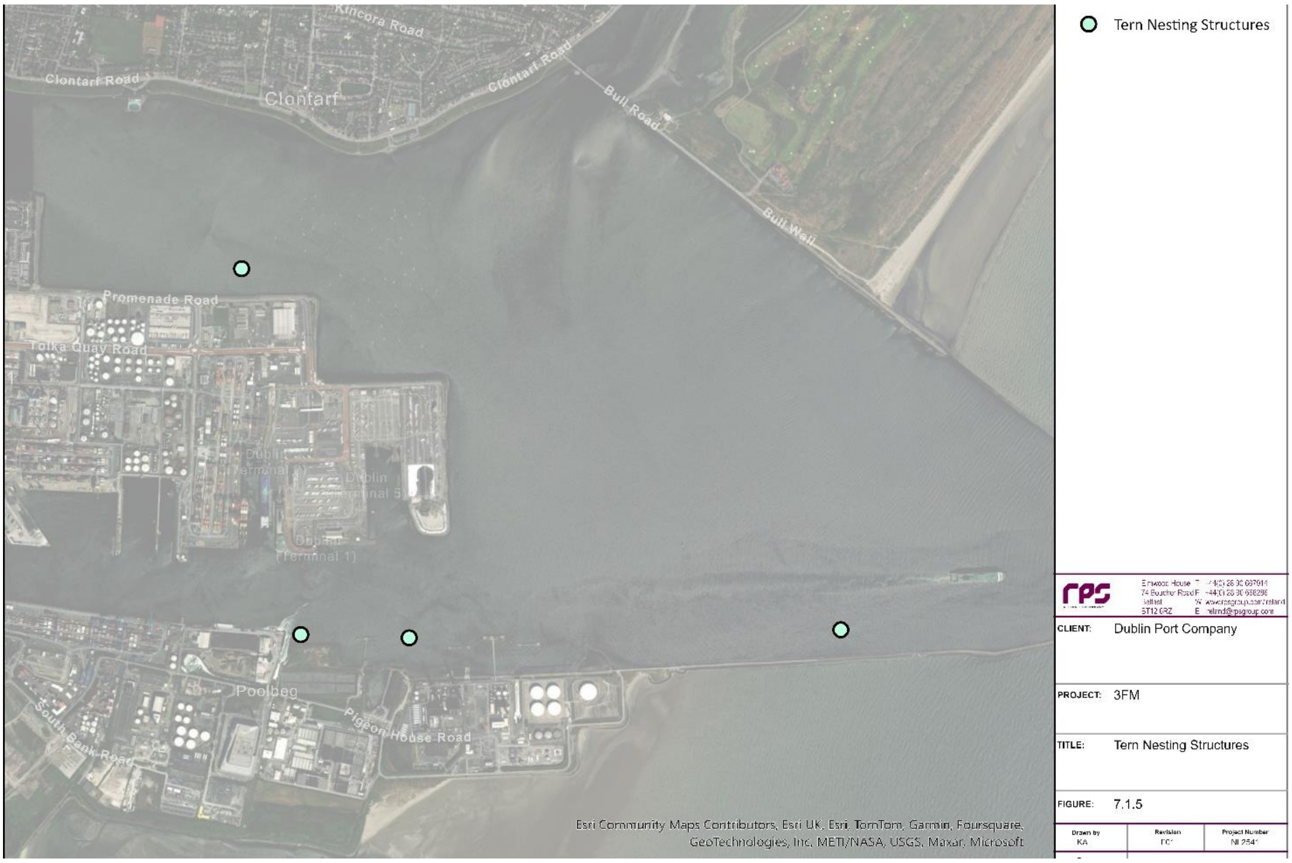

Figure 7.95 Location of the tern nesting structures in Dublin Port area

The CDL Dolphin and the ESB Dolphin are designated as proposed Natural Heritage Areas (pNHAs) and the ESB Dolphin is also designated as part of the South Dublin Bay and Tolka Estuary SPA under the EU Birds Directive (and as such we refer to it in this report as the SPA Platform). These two nesting platforms are the closest to the proposed 3FM Project areas of construction, and were therefore the focus for monitoring of any tern disturbance in relation to ongoing activities in the area. In particular, a new a 325m diameter ship turning circle in front of Pigeon House Harbour is proposed as part of the 3FM Project. It will entail capital dredging to deepen the channel, and the construction of a revetment and vertical quay walls. At its closest point, it will be 33.4m from the CDL Dolphin and 47.3m from the SPA Platform. The construction of the western end of a new piled wharf at Area N will also approach within approximately 50m of the SPA platform.

Non-intrusive monitoring was carried out in June 2022 to record the reaction of nesting terns to a number of events. Observations were made from two locations, one at the 47A Hardstand and the second on the Sludge Jetty, which give unrestricted views of the tern sub-colonies on the CDL Dolphin and SPA Platform (Figure 7.96).

Data recorded included:

- Species of tern affected,
- Number of individuals disturbed,
- Cause of disturbance,
- Level of disturbance (low, moderate, or high).

For the purposes of this study, disturbance level was recorded on the following scale:

- Low – behavioural change (e.g., vigilance or alarm call) but not flight,
- Moderate – took flight but settled again quickly,
- High – took flight and mobbed / did not settle for a prolonged period.

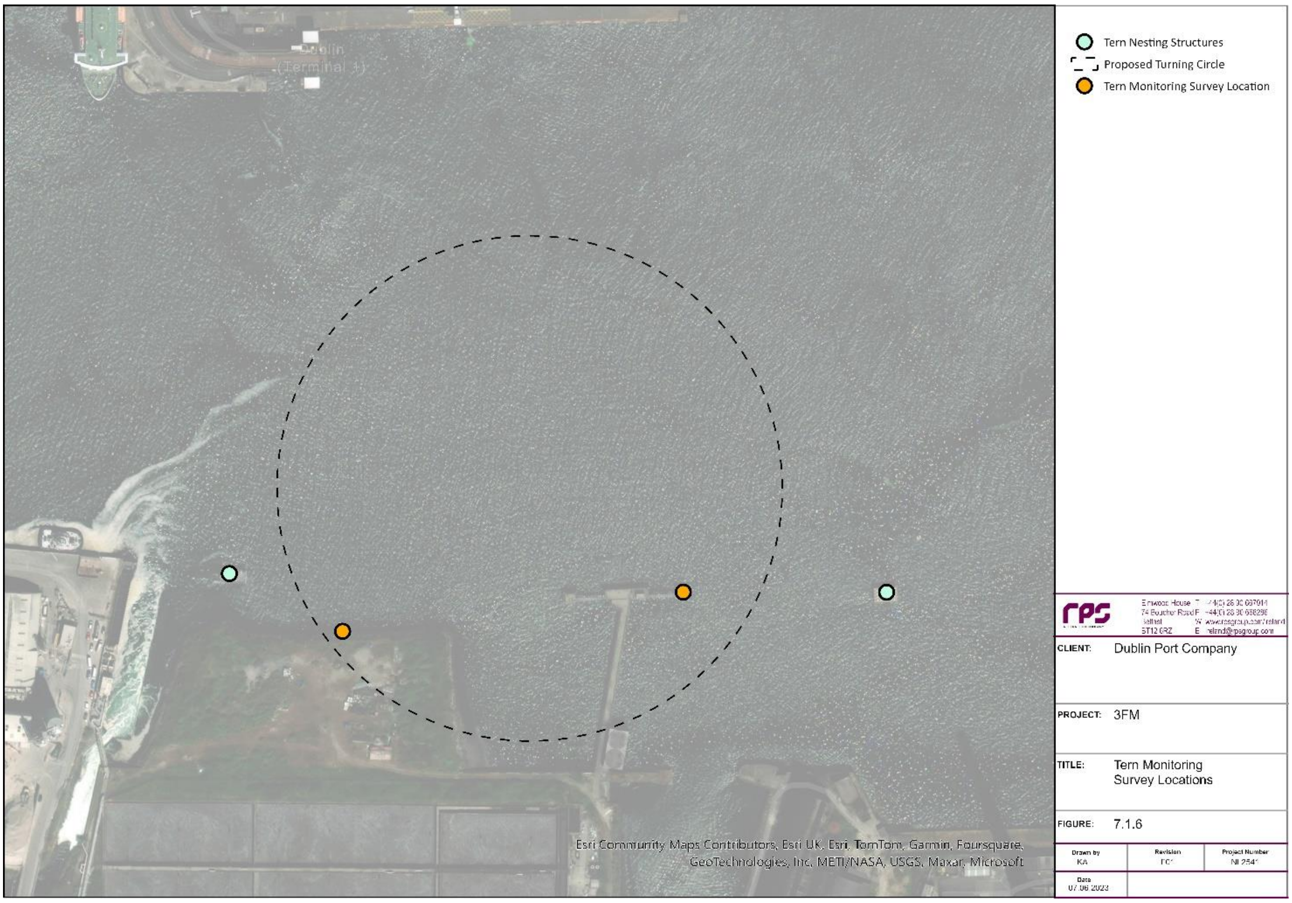

Figure 7.96 Tern Monitoring

7.5.1.6 Poolbeg / Great South Wall Disturbance Survey

A small area of intertidal habitat at the base of the Great South Wall on its northern side, adjacent to the ESB outfall and outside the SPA boundary, was identified as a potentially important feeding area for overwintering birds (Figure 7.97). To establish use of this area by overwintering birds and the potential for disturbance impacts due to the 3FM Project, a series of disturbance surveys were undertaken.

The methodology employed was a modified version of that set out in NPWS low tide waterbird surveys: survey methods and guidance notes (Lewis & Tierney 2014). The surveyor monitored the site for six-hour blocks; broken down into three x 90 mins monitoring / 30 mins break, recording disturbance events, the species and number of birds affected and their response to the disturbance event within a pre-determined survey area (Figure 7.97).

Figure 7.97 Location of the potential intertidal feeding area (red rectangle) and the disturbance monitoring area (green rectangle).

Surveys took place between 14th October and 23rd November 2022 and coincided with a programme of capital dredging and marine geotechnical investigations (GI) in the Liffey estuary. The capital dredging was undertaken from 15th October to 5th December 2022 as part of the MP2 Project. The areas dredged are indicated in Figure 7.98. Dredging was by barge mounted back-hoe on the north side of the channel and by Trailing Suction Hopper Dredger (TSHD) on the south side of the channel. The GI survey was associated with the proposed 3FM Project and involved borehole sampling using a jack-up barge. The borehole sampling areas during the period of the bird disturbance survey were immediately east of the sludge jetty at the entrance to Pigeon House Harbour (15th

– 22nd November 2022) and east of the Poolbeg Marina (3rd – 17th November 2022). These activities are good proxies for the proposed 3FM Project works and allow a robust assessment of potential for bird disturbance.

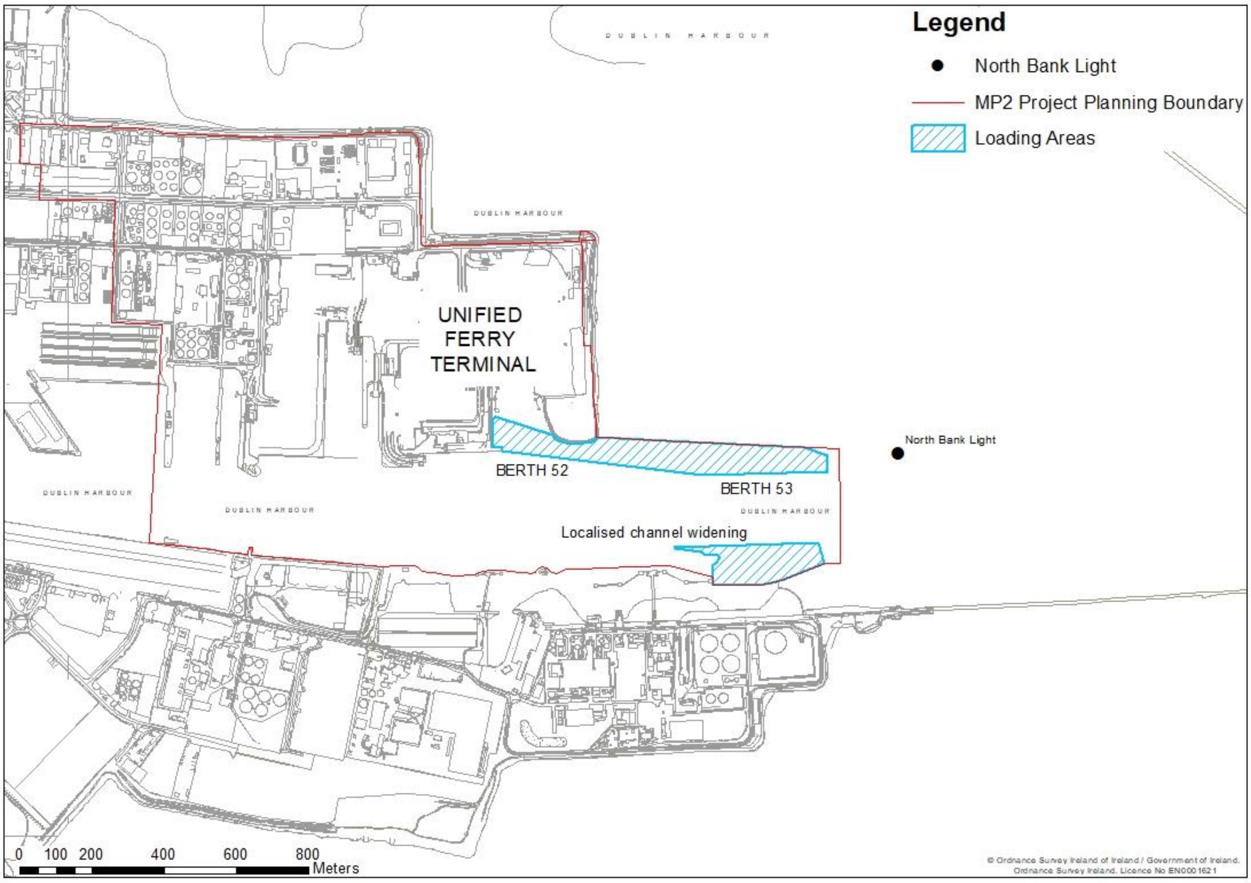

Figure 7.98 Locations dredged in October to December 2022 shown by blue hatched areas

The following data was recorded:

- Date and time of survey
- Weather conditions during survey
- Species and numbers present within survey area at the start of the 90-minute survey window
- Details of any disturbance events during the survey:
- Time of event
- Source of disturbance (as listed below)
- Species affected and number disturbed
- Reaction (based on scale presented below)
- Distance between source of disturbance and birds
- Duration of disturbance (minutes)
- Other notes

Events were coded on a scale from 1 (least disturbance) to 4 (greatest disturbance):

1. Alert
2. Walk/Swim/Dive away
3. Short flight (landing <50m from start position)
4. Long flight (landing >50m from start position)

Sources of disturbance were also assigned a code:

1. Walkers
2. Joggers/runners
3. Birdwatchers/photographers
4. Anglers
5. Shell fishers
6. Bait-diggers
7. Dogs on lead
8. Dogs off lead
9. Vehicles
10. Shellfish Tractor
11. Aeroplane
12. Helicopter
13. Drone
14. Predator (e.g., bird of prey)
15. Dredger
16. GI Vessel
17. Other powered boat
18. Jet-skis
19. Windsurfer/surfer
20. Unpowered boat (e.g. canoe, rowboat, kayak, paddleboard)
21. Other

7.5.1.7 Black Guillemot Survey

The Black Guillemot *Cepphus grylle* (or Tystie) is a circumpolar species which in the UK and Ireland has historically been a species with predominantly Scottish distribution, with around half of the UK and Irish population breeding in the Northern Isles. The Black Guillemot is on the amber list of Birds of Conservation Concern Ireland (BoCCI4 2020-2026) since it is a species for which the global population is concentrated in Europe.

Between the Operation Seafarer census (1969-70) and Seabird Colony Register (1985-91), there was an expansion in the range of Black Guillemots and the colonisation of new sites around the Irish Sea, including man-made structures such as harbour walls, jetties and piers. This increase has continued through Seabird 2000 census dataset to recent years (JNCC 2016). Black Guillemots nest in crevices, both natural and man-made. In Dublin Port they nest in crevices within the quays and other structures between Poolbeg and Butt Bridge on the River Liffey. Artificial nest sites have been installed at some locations to replace nest sites lost during ABR Project works.

The population in Dublin Port has been monitored consistently since 2013 involving two complete surveys per year. The methodology employed was that set out in Mitchell *et al.* (2004). Two visits were made between 26th March and 15th May 2022, between 05.00 and 09.00 when the ornithologist counted all black guillemots on or within c.300m of the port quay walls and associated structures. Any additional information of note, such as adults carrying food, displaying or mating was also recorded. The survey was carried out by boat, which allowed for views across all parts of Dublin Port where Black Guillemots may nest.

7.5.2 Receiving Environment

Dublin Bay is an internationally important area for waterbirds as reflected in the number of SPAs located in the area. Eight SPAs or cSPAs were identified within the potential Zone of Influence of the Project via the NPWS Map Viewer (Table 7.39). The Qualifying Interest species for each site (NPWS 2013a, 2013b, 2015a, 2015b, 2022a, 2022b, 2022c and 2023) are presented in Appendix 7.5.1 with a summary in Table 7.40.

The close proximity of Dublin Bay to so many important waterbird sites makes the area particularly significant for the high concentrations of waterbirds that rely on the Bay throughout the annual cycle. In particular, Sandymount Strand holds the largest concentration of post-breeding terns in Ireland, attracting birds from colonies across Ireland and further afield, making it one of the most important tern staging-sites in North-west Europe (Burke *et al.,* 2020). The safeguarding of the passage populations of Roseate Tern, Common Tern and Arctic Tern, as well as the breeding population of Common Tern are listed as a conservation objective for the South Dublin Bay and River Tolka Estuary SPA (NPWS 2015b).

Dublin Bay qualifies under Criterion 5 of the Ramsar Convention (1988) as a Wetland of International Importance as it regularly supports greater than 20,000 waterbirds, and under Criterion 6, as it supports more than 1% of individuals of a global population of waterbirds (Tierney *et al.,* 2017). The bay regularly exceeds this threshold for international importance of Light-bellied Brent Goose, Black-tailed Godwit and Bar-tailed Godwit, and is nationally important for 23 other species including Oystercatcher (Hutchinson 1979; Sheppard 1993; Boland & Crowe 2012). Both the North Bull Island SPA, and the South Dublin Bay and River Tolka Estuary SPA, have conservation objectives of 1) safeguarding the long-term winter population trends for 17 waterbird species and 9 waterbird species respectively, 2) ensuring that there are no significant decreases in the range, timing or intensity of use of areas by waterbirds; and 3) maintaining the favourable condition of the wetland as a resource for the regularly occurring migratory waterbirds that depend on it (NPWS 2015a; 2016a).

Table 7.39 SPAs within the potential Zone of Influence of the Project

Site Code	SPA	Distance from project	Direction
IE0004024	South Dublin Bay & River Tolka Estuary SPA	0km	
IE004236	North-west Irish Sea cSPA	c.1.9km	East
IE0004006	North Bull Island SPA	c.2.1km	North-east
IE0004016	Baldoyle Bay SPA	c.7.75km	North-north-east
IE0004113	Howth Head SPA	c.11km	East-north-east
IE0004172	Dalkey Islands SPA	c.10km	South-east
IE0004117	Ireland’s Eye SPA	c.11km	North-east
IE0004025	Malahide Estuary SPA	c.13km	North

Table 7.40 Qualifying Interests of SPAs within the potential Zone of Influence of the of Project

Species	Sth Dublin Bay & R. Tolka Est.	North-west Irish Sea cSPA	North Bull Island	Baldoyle Bay	Dalkey Islands	Howth Head	Irelands Eye	Malahide Estuary
Red-throated Diver		✓						
Great Northern Diver		✓						
Great Crested Grebe								✓
Fulmar		✓						
Manx Shearwater		✓						
Light-bellied Brent Goose	✓		✓	✓				✓
Shelduck			✓	✓				✓
Teal			✓					
Pintail			✓					✓
Shoveler			✓					
Common Scoter			✓					
Goldeneye								✓
Red-breasted Merganser								✓
Oystercatcher	✓		✓					✓
Ringed Plover	✓			✓				
Golden Plover			✓	✓				✓
Grey Plover	✓		✓	✓				✓
Knot	✓		✓					✓
Sanderling	✓		✓					
Dunlin	✓		✓					✓
Black-tailed Godwit			✓					✓
Bar-tailed Godwit	✓		✓	✓				✓
Curlew			✓					

Species	Sth Dublin Bay & R. Tolka Est.	North-west Irish Sea cSPA	North Bull Island	Baldoyle Bay	Dalkey Islands	Howth Head	Irelands Eye	Malahide Estuary
Redshank	✓							✓
Turnstone			✓					
Cormorant		✓					✓	
Shag		✓						
Little Gull		✓						
Black-headed Gull	✓	✓	✓					
Common Gull		✓						
Lesser Black-backed Gull		✓						
Herring Gull		✓					✓	
Great Black-backed Gull		✓						
Kittiwake		✓				✓	✓	
Roseate Tern	✓	✓			✓			
Common Tern	✓	✓			✓			
Arctic Tern	✓	✓			✓			
Little Tern		✓						
Guillemot		✓					✓	
Razorbill		✓					✓	
Puffin		✓						

7.5.2.1 Vantage Point Survey

A total of 54 survey hours were conducted on fourteen days between late-September 2022 and late-March 2023 and February and March 2024 (

Table 7.41), with 200 flights recorded. All surveys except one were of three hours duration. The survey of the 28th November 2022 was conducted over a six hour period. Cumulatively the surveys covered much of the available daylight hours during the six-month interval included in the survey.

Table 7.41 VP Survey Dates and Weather Conditions

Date	Start	End	Survey conditions				
			Cloud	Wind	Visibility	Precipitation	Sunrise / Sunset
30-Sep-22	11:00	14:00	6/8	S1	>2km	None	07:24/19:04
26-Oct-22	09:30	12:30	7/8	S2	>2km	None	08:10/18:07
28-Nov-22	08:30	14:30	4/8	3	>2km	None	08:11/16:13
13-Dec-22	09:00	12:00	8/8	NE2	1-2km	Drizzle showers	08:32/16:05
21-Dec-22	08:50	11:50	5/8	E3	>2km	None	08:38/16:07
17-Jan-23	09:00	12:00	4/8	N2	>2km	None	08:35/ 16:48
26-Jan-23	11:00	14:00	7/8	N3	>2km	None	08:24/ 17:04
02-Feb-23	09:30	12:30	7/8	W3	>2km	Drizzle showers	08:14/ 17:17
11-Feb-23	12:00	15:00	6/8	SW3	>2km	Drizzle showers	07:57/ 17:35
11-Mar-23	13:00	16:00	5/8	SW3	>2km	None	06:56/ 18:28
25-Mar-23	10:00	13:00	6/8	WSW3	>2km	None	06:16/18:47
02-Feb-24	08:05	11:05	8/8	WSW3	>2km	Drizzle showers	08:08
02-Feb-24	11:20	14:20	8/8	WSW3	>2km	Drizzle shower	08:08
27-Feb-24	06:45	09:45	8/8	SW2	>2km	None	07:15
27-Feb-24	10:00	13:00	7/8	SW3	>2km	Drizzle shower	07:15
05-Mar-24	08:40	11:40	4/8	S3	>2km	Light rain at end	07:01
05-Mar-24	12:00	15:00	2/8	SSW2	>2km	Light rain at start	07:01

Fifteen target species, and three secondary species were recorded during the surveys. A summary of results is presented in Table 7.42, with full survey results presented in Appendix 7.5.1. The number of birds of each species recorded during individual surveys is also shown in Figure 7.99.

The number of target and secondary species recorded on any day ranged from three to thirteen. Only Black-headed Gull and Herring Gull were recorded on all survey days, and the maximum total number of birds of any species recorded in a survey was 93 (Herring Gull on 30/09/2022). All other species occurred only sporadically or generally in low numbers. However, Brent Goose was recorded in higher numbers on 11th March and on 2nd February in 2023 (14 birds on each day), and 20 and 29 Brent were recorded on 27th February and 5th March in 2024 respectively.

Table 7.42 Target and Secondary Species Recorded (Height Bands A = <5m, B = 5-20m, C = >20m)

Species	Height band	Number of flights	Total number of flights	Number of individuals	Total number of individuals
Black-headed Gull	A	11	59	74	421
	B	30		193	
	C	18		154	
Black Guillemot	A	7	7	10	10
	B	0		0	
	C	0		0	
Brent Goose	A	1	9	5	84
	B	4		51	
	C	4		28	
Common Gull	A	3	12	9	37
	B	7		22	
	C	2		6	
Cormorant	A	2	8	2	9
	B	3		3	
	C	3		4	
Great Black-backed Gull	A	0	8	0	12
	B	5		8	
	C	3		4	
Grey Heron	A	1	2	1	2
	B	1		1	
	C	0		0	
Herring Gull	A	3	66	18	454
	B	31		195	
	C	32		241	
Lesser Black-backed Gull	A	0	5	0	7
	B	4		5	
	C	1		2	
Little Egret	A	0	2	0	3
	B	2		3	
	C	0		0	
Mallard	A	2	8	3	26
	B	3		12	
	C	3		11	
Mediterranean Gull	A	2	4	2	5
	B	2		3	
	C	0		0	
Mute Swan	A	0	1	0	2
	B	1		2	
	C	0		0	
Oystercatcher	A	0	3	0	6
	B	3		6	
	C	0		0	
Redshank	A	1	1	2	2
	B	0		0	
	C	0		0	
Shag	A	0	2	0	3
	B	0		0	
	C	2		3	
Buzzard	A	0	1	0	1
	B	0		0	
	C	1		1	
Sparrowhawk	A	1	2	1	2
	B	0		0	
	C	1		1	

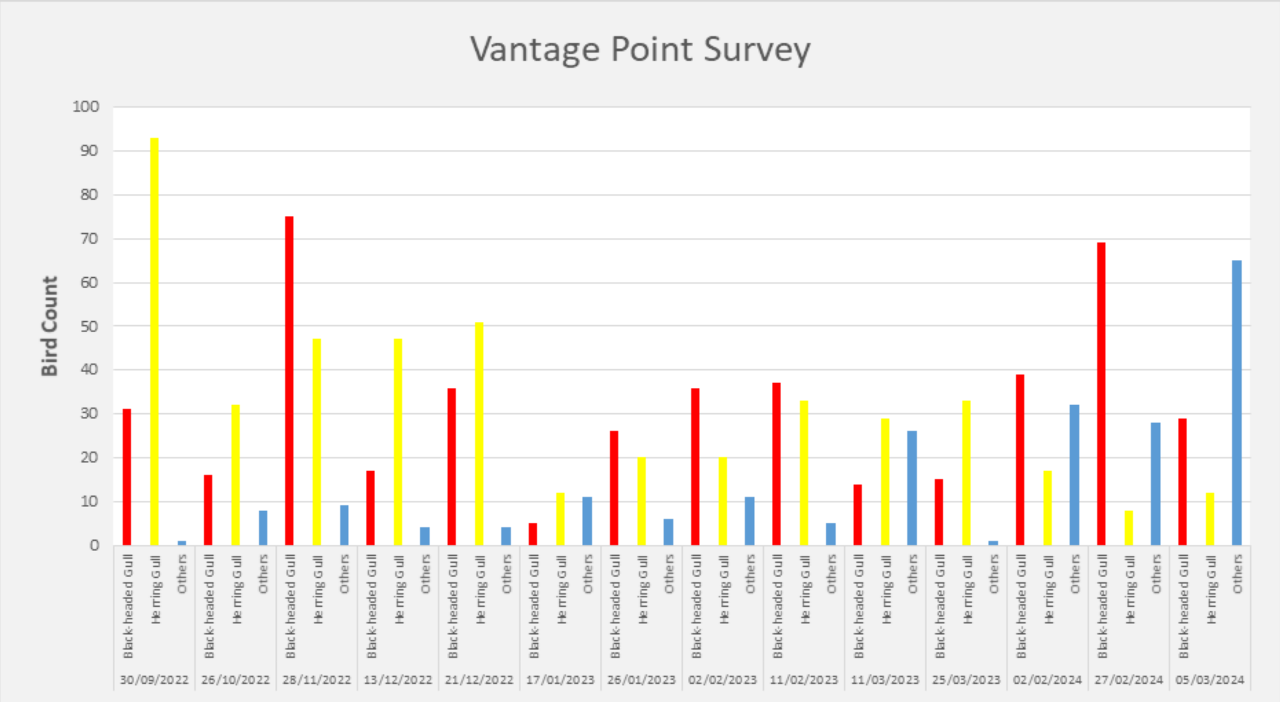

Figure 7.99 The number of birds of each species recorded during individual surveys. Note Black-headed Gull (red bar) and Herring Gull (yellow bar) were present in all surveys and are presented individually. All other species occurred in low numbers or sporadically and have therefore been grouped and shown in blue.

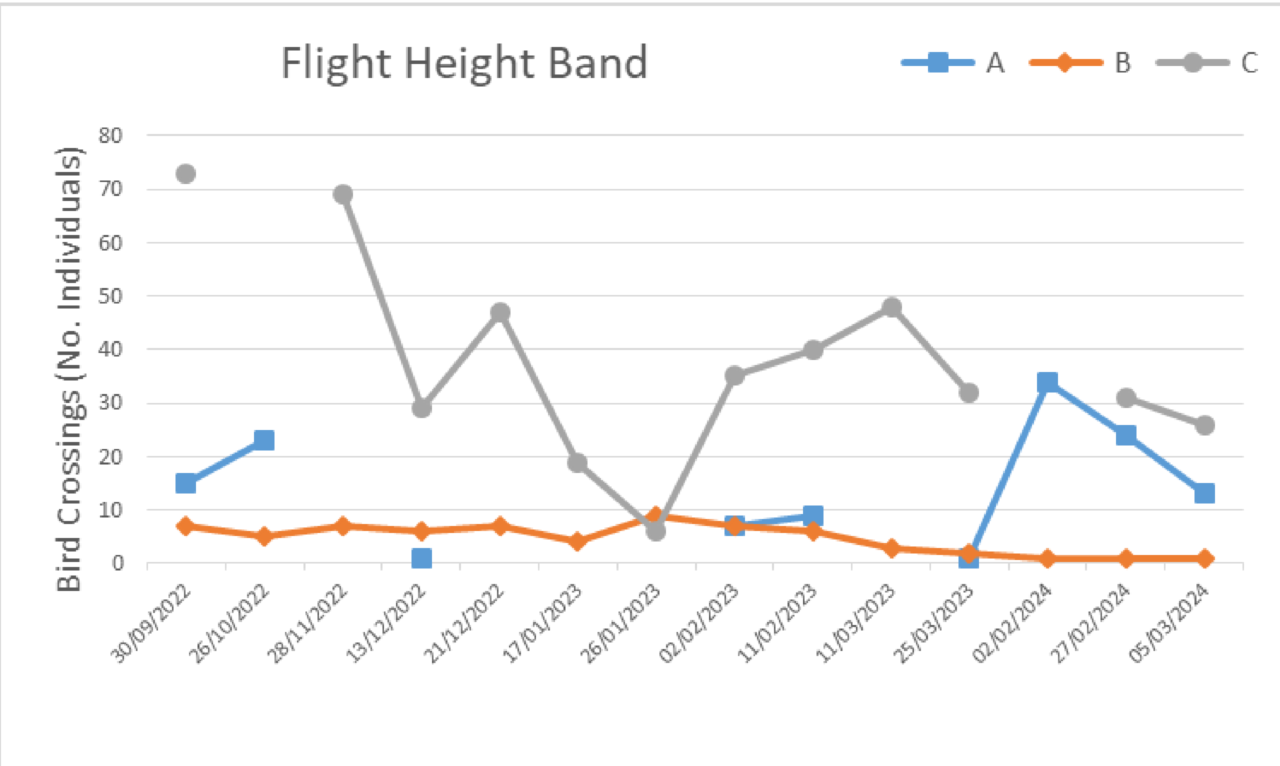

Figure 7.100 Numbers of bird crossings in each height band at the vantage point

The vantage point surveys recorded four SPA qualifying species of the South Dublin Bay and Tolka Estuary SPA using the Liffey Crossing as a flyway, namely Black-headed Gull, Light-bellied Brent Goose, Oystercatcher and Redshank, although none used the flyway in significant numbers in proportion to the total residing population.

The number of birds crossing in each height band are shown in Figure 7.100.

At the crossing point, approximately half (48%) of all bird crossings were at height band B (5-20m) and 17% and 35% were at height bands A (<5m) and C (>20m) respectively. Over two thirds of the 96 crossings recorded at height band B were observations of Black-headed Gull (30 flights) and Herring Gull (31 flights).

7.5.2.2 Breeding Bird Survey

Three monthly visits were made to the survey area during the 2022 breeding season with a minimum of ten days between visits (Table 7.43).

The north-eastern section of the survey area consists of improved grassland that is managed to support the feeding requirements of Brent Geese *Branta bernicla*. Grassy verges, amenity grassland and patches of dry meadows occur throughout the area.

Irishtown Nature Park in the south-eastern sector of the survey area is dominated by a mixture of broadleaved trees and scrub with pockets of grassland. The canopy is a mixture native and non-native trees including ash *Fraxinus excelsior*, common birch *Betula pubescens*, oak *Quercus petraea-Quercus robur* and willows, and the scrub is dominated by non-native butterfly bush, blackthorn and bramble. Dense continuous scrub extends east from Irishtown Nature Park between the industrial land and the existing pathway along the coastal fringe. Further west the habitat changes to a grassy verge- scrub mosaic on either side of the heaped spoil along the pathway.

Evidence of breeding bird activity was primarily confined to scrub and woodland vegetation within the survey area.

Table 7.43 Weather Conditions during Breeding Bird Survey

Date	Cloud (Oktas)	Visibility	Wind (Beaufort)	Temp. (°C)	Precipitation
21-Apr-22	4/8	Excellent	E3	10	None
03-May-22	6/8	Excellent	SE3	15	None
03-Jun-22	6/8	Excellent	NW3	15	None

A total of fifteen species were recorded as present in the area surveyed; including twelve green-listed BoCCI species not of conservation concern, and three amber-listed BoCCI species (Gilbert *et al*., 2021) (Table 7.44). Locations of species recorded during the Breeding Bird Survey are presented in Figure 7.101. Three species were confirmed to have bred in the area based on presence of recently fledged young. The breeding status of the remaining 12 species, including the amber-listed Goldcrest, Greenfinch and Linnet, is assessed as 'possible' (Table 7.44).

Table 7.44 Results of Breeding Bird Survey

SPECIES	Visit 1	Visit 2	Visit 3	Highest breeding evidence recorded	Breeding Status	BoCCI status
	21-Apr-22	03-May-22	03-Jun-22			
Blackbird	6	2	8	Singing male	Possible	Green
Blackcap	5	3	6	Recently fledged young	Confirmed	Green
Blue Tit	0	4	5	Recently fledged young	Confirmed	Green
Chaffinch	4	0	2	In suitable habitat	Possible	Green
Chiffchaff	1	0	0	Singing male	Possible	Green
Dunnock	8	5	5	Singing male	Possible	Green
Goldcrest	0	0	4	Singing male	Possible	Amber
Goldfinch	9	7	9	Singing male	Possible	Green
Greenfinch	6	6	6	Pair recorded	Probable	Amber
Linnet	11	1	11	In suitable habitat	Possible	Amber
Long-tailed Tit	3	0	0	In suitable habitat	Possible	Green
Robin	7	8	8	Singing male	Possible	Green
Song Thrush	0	3	3	In suitable habitat	Possible	Green
Woodpigeon	0	5	8	In suitable habitat	Possible	Green
Wren	9	12	8	Recently fledged young	Confirmed	Green

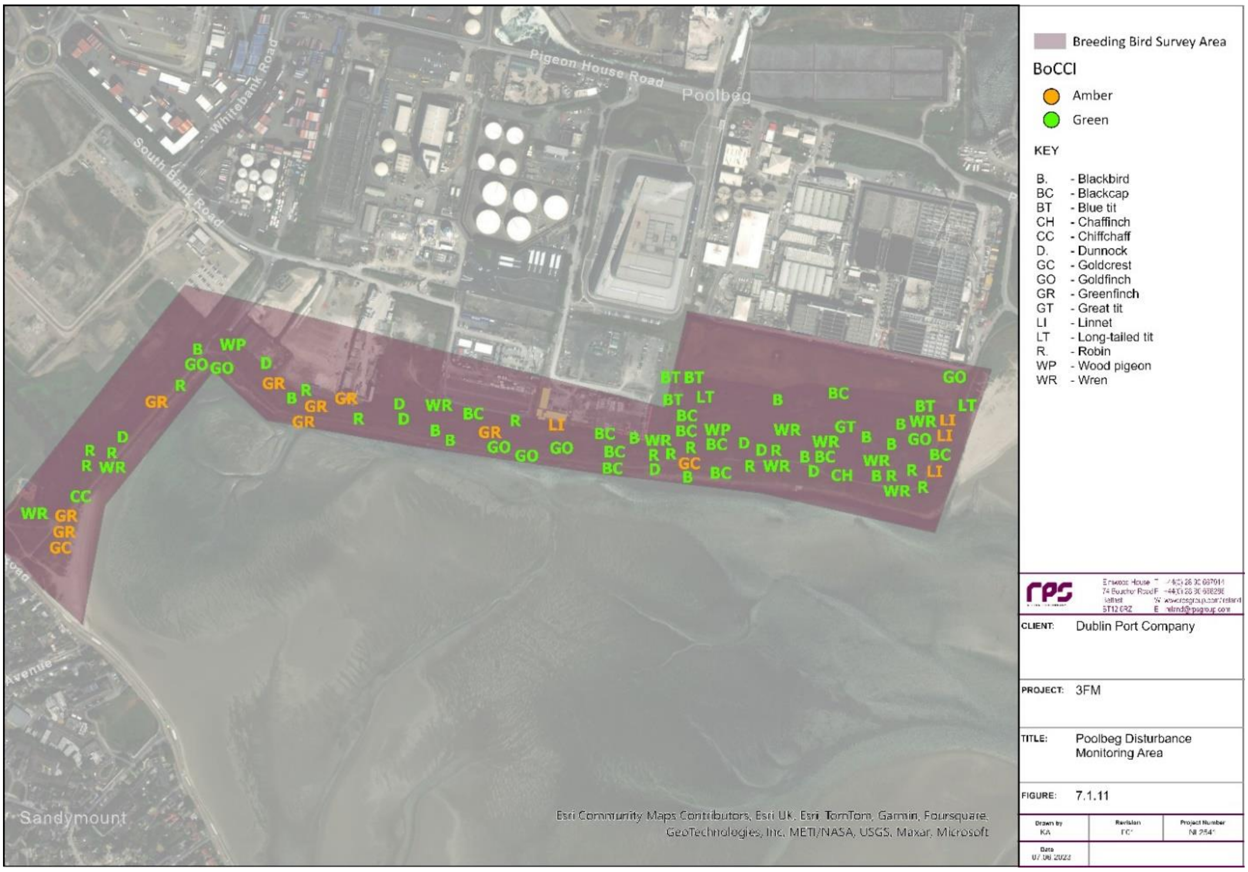

Figure 7.101 Breeding Bird Survey Results

7.5.2.3 Through the Tide Cycle Counts

Two visits each month were made over the 12 month period from April 2022 to March 2023 (Table 7.45) to record waterbirds within the survey area as shown in Figure 7.93.

Table 7.45 Weather Conditions during Through-the-tide-cycle Counts.

Date	Cloud (Oktas)	Visibility	Wind (Beaufort)	Temp. (°C)	Precipitation	Tide
20-Apr-22	6/8	Excellent	E4	10	None	High Tide
26-Apr-22	6/8	Excellent	E4	10	None	Low Tide
13-May-22	7/8	Good	SW4	12	Light shower	High Tide
22-May-22	7/8	Excellent	SW4	10	Light shower	Low Tide
04-Jun-22	4/8	Excellent	NE4	10	None	Low Tide
30-Jun-22	7/8	Excellent	NW4	14	Light shower	High Tide
17-Jul-22	3/8	Excellent	SE2	17	None	High Tide
10-Jul-22	5/8	Excellent	E4	15	None	Low Tide
05-Aug-22	3/8	Excellent	SE3	19	None	Low Tide
18-Aug-22	6/8	Excellent	SW3	22	Light shower	High Tide
12-Sep-22	7/8	Excellent	N4	18	None	Low Tide
23-Sep-22	.	Excellent	SE 2	17	None	High Tide
03-Oct-22	3/8	Excellent	S3	16	None	Low Tide
27-Oct-22	7/8	Good	SE3	13	None	High Tide
03-Nov-22	7/8	Good	SW3	8	None	High (Falling)
29-Nov-22	7/8	Good	W3	6	None	low tide
13-Dec-22	6/8	Good	NEN2	6	None	High
21-Dec-22		Good	E3	7	None	Low (Falling)
16-Jan-23	6/8	Good	N3	6	None	Low (Falling)
23-Jan-23		Good	W3	6	None	High
02-Feb-23		Good	W3	6	None	Low
11-Feb-23	6/8	Good	SW3	6	None	High
08-Mar-23		Good	W4	11	None	High
21-Mar-23		Good	SW4	8	None	Low (Falling)

The counts of individual birds of each species are listed in Appendix 7.5.1 and high and low tide visits are distinguished. The counts are also plotted in Figure 7.103 to indicate the usage of the immediate vicinity of the 3FM Project by waterbirds throughout the 12-month survey period. A total of 34 waterbird species were recorded in the defined survey area at the Poolbeg peninsula over the 12-month period of the TTTCC survey, although many species occurred only sporadically or at very low frequencies (e.g., Gannet, Great Northern Diver). Some species are only present during the breeding season (terns) while others may be more abundant during summer months, but are present year-round (e.g. Black Guillemot, many gull species). Many of the waders and divers are prominent in the survey area during winter months (Razorbill, Guillemot, Great-crested Grebe, Dunlin and Greenshank).

Figure 7.103 shows that of the 34 species recorded, 19 species occurred at less than two individuals per survey on average. Some species were only recorded on a single occasion as one individual bird (Gannet, Great Northern Diver, Little Grebe). Herring and Black-headed gulls were frequently observed and at relatively high numbers. Other gull species were also frequent users of the survey area, as were Cormorant, Shag, Redshank, Little Egret, and Turnstone.

13 species occurred that are either listed as QIs of South Dublin Bay and River Tolka Estuary SPA and/or North Bull Island SPA. A comparison of counts during high tide and low tide surveys for each of these 13 species is presented in Figure 7.102. In the months when present, the numbers of common and arctic terns are sub-equal in high and low tide surveys. Black-headed gull and turnstone are slightly more abundant in the low tide surveys. The remainder of the QI species are significantly more abundant during low tide surveys as would be expected for this group of predominantly waders.

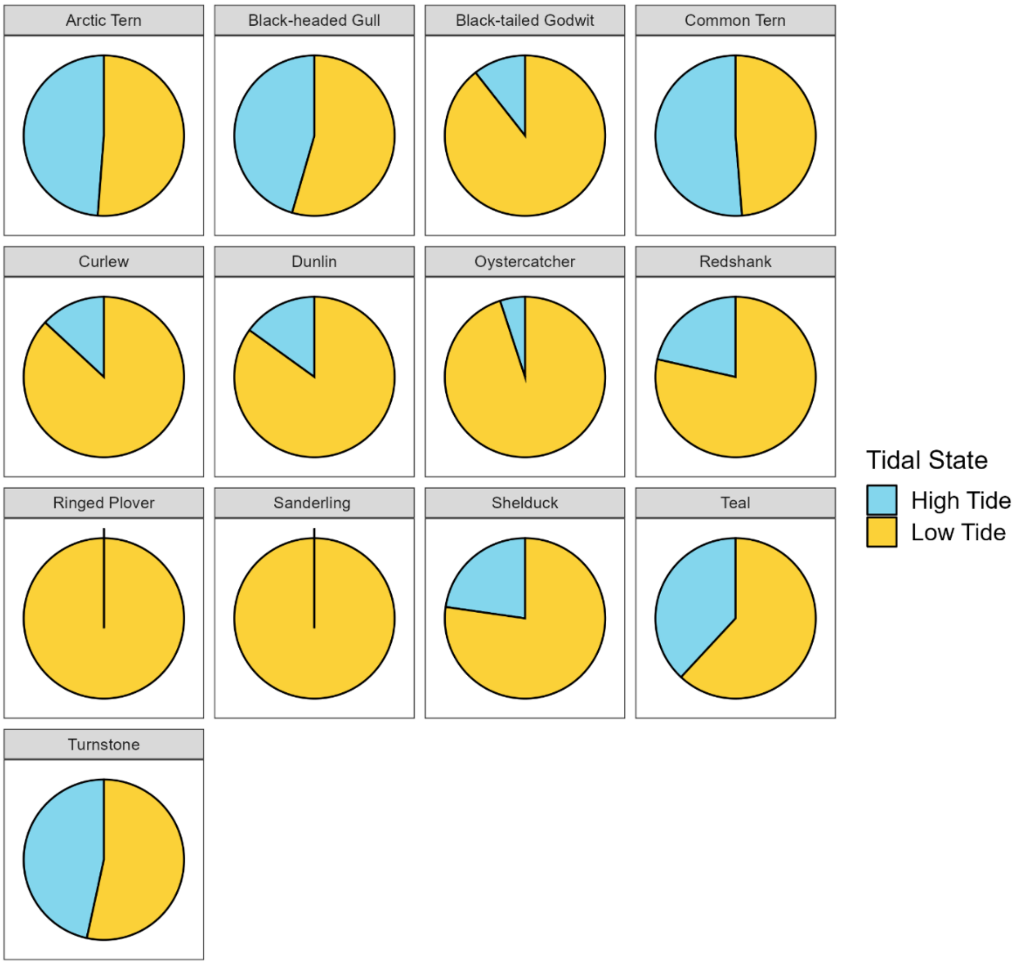

Figure 7.102 Relative high and low tides counts of Qualifying Interest Species recorded during TTTCC

The total counts of birds of all species in each month are plotted in Figure 7.104. High and low tide counts, and the monthly total count are plotted separately. Peak numbers were observed in June and February over the 12-month survey period. Counts in June were dominated by Herring gull numbers, and in February by Oystercatcher numbers.

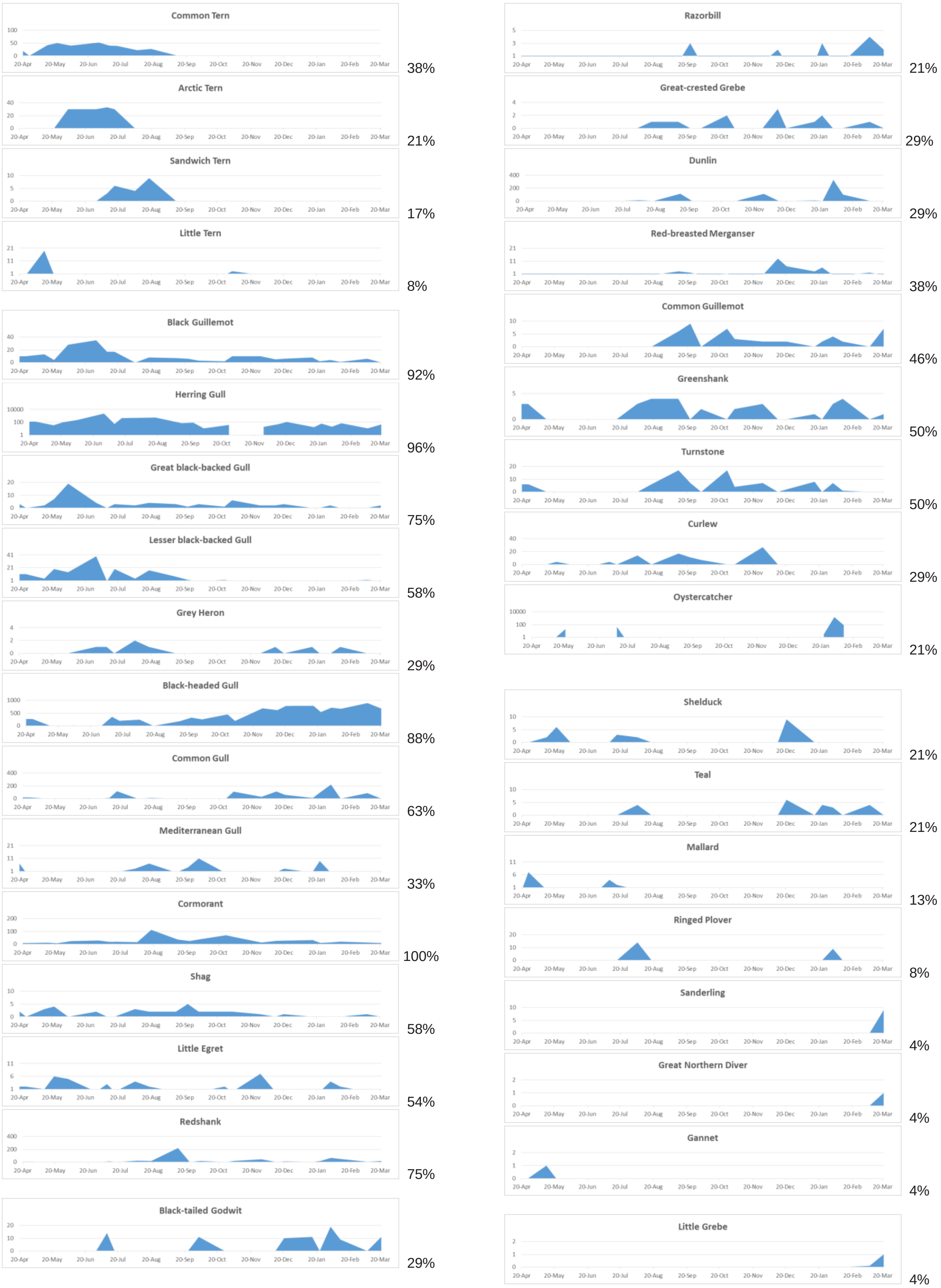

Figure 7.103 Individual counts for each species over the 12-month survey period (High and Low Tide Counts). The figure to the right is the percentage of survey days that the species was present in the area. (Note Herring Gull and Oystercatcher are plotted on a logarithmic scale

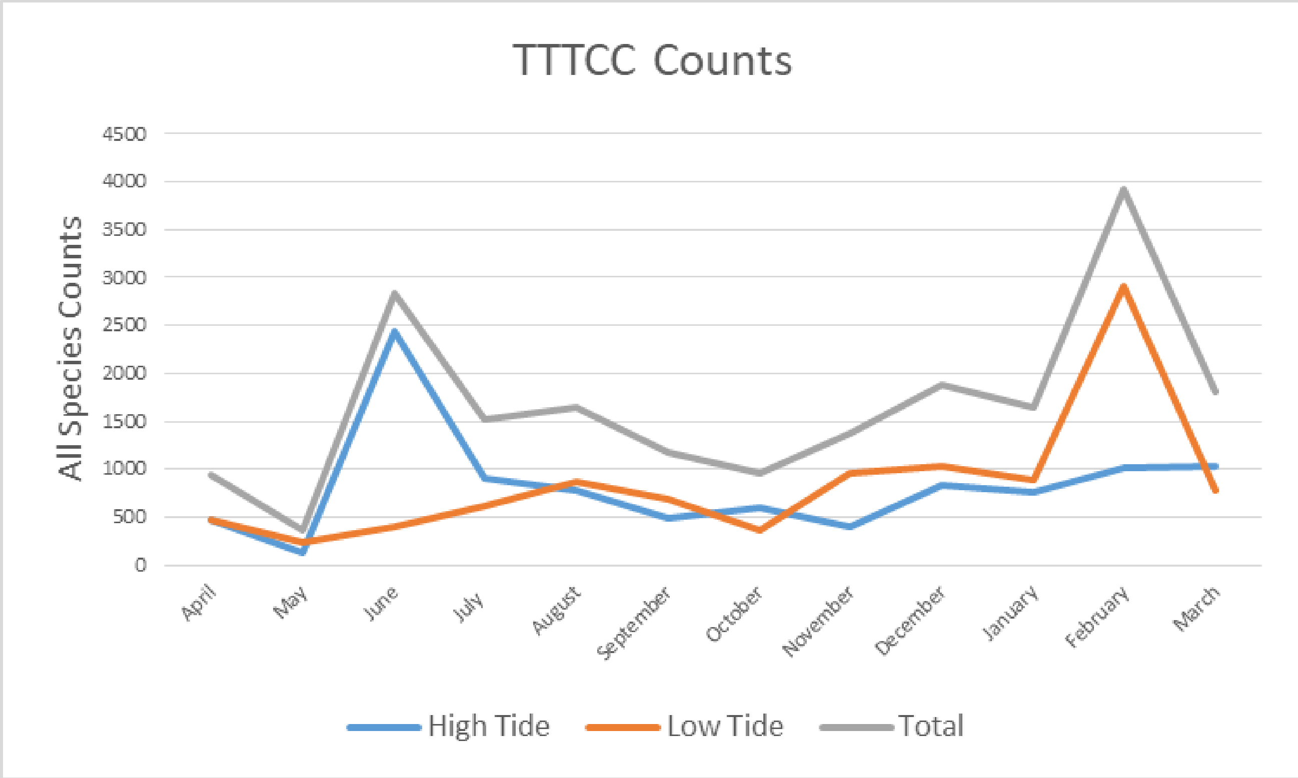

Figure 7.104 Counts of individual birds of all species in the survey area during high and low tide surveys, and the monthly total count

7.5.2.4 Co-ordinated TTTCC

Six monthly visits were made between October 2023 and March 2024 across a range of tidal conditions and times of the day (Table 7.46).

Table 7.46 Weather conditions during co-ordinated TTTCC

Date	Time	Cloud (Oktas)	Visibility	Wind (Beaufort)	Precipitation	Temp. (°C)	Tide time
17-Oct-23	07:30	4/8	>10km	E4	None	10	07:05 (LT)
17-Oct-23	08:30	4/8	>10km	E4	None	11	07:05 (LT)
17-Oct-23	09:30	6/8	>10km	E4	None	12	07:05 (LT)
17-Oct-23	10:30	6/8	>10km	E4	None	12	07:05 (LT)
17-Oct-23	11:30	7/8	>10km	E4	None	12	07:05 (LT)
17-Oct-23	12:30	8/8	>10km	E4	None	13	07:05 (LT)
21-Nov-23	07:45	0/8	>10km	NW2	None	5	11:25 (LT)
21-Nov-23	08:45	0/8	>10km	NW2	None	5	11:25 (LT)
21-Nov-23	09:45	0/8	>10km	NW2	None	6	11:25 (LT)
21-Nov-23	10:45	0/8	>10km	NW2	None	7	11:25 (LT)
21-Nov-23	11:45	8/8	>10km	NW2	None	9	11:25 (LT)
21-Nov-23	12:45	8/8	>10km	NW2	None	10	11:25 (LT)
05-Dec-23	08:30	8/8	3-5km	NW3	None	4	10:46 (LT)
05-Dec-23	09:30	8/8	3-5km	NW3	None	4	10:46 (LT)
05-Dec-23	10:30	8/8	3-5km	NW3	None	4	10:46 (LT)

05-Dec-23	11:30	8/8	5-10km	NW3	None	4	10:46 (LT)
05-Dec-23	12:30	8/8	>10km	NW3	None	4	10:46 (LT)
05-Dec-23	13:30	4/8	>10km	NW3	None	4	10:46 (LT)
09-Jan-24	11:00	4/8	>10km	E5	None	4 (-2)	09:35 (HT)
09-Jan-24	12:00	4/8	>10km	E5	None	4 (-2)	09:35 (HT)
09-Jan-24	13:00	4/8	>10km	E5	None	4 (-2)	09:35 (HT)
09-Jan-24	14:00	4/8	>10km	E5	None	4 (-2)	15:19 (LT)
09-Jan-24	15:00	4/8	>10km	E5	None	4 (-2)	15:19 (LT)
09-Jan-24	16:00	6/8	>10km	E5	None	4 (-2)	15:19 (LT)
21-Feb-24	07:30	8/8	>10km	S4	None	11	10:02 (HT)
21-Feb-24	08:30	8/8	>10km	S4	None	11	10:02 (HT)
21-Feb-24	09:30	8/8	>10km	S4	None	11	10:02 (HT)
21-Feb-24	10:30	8/8	>10km	S4	None	11	10:02 (HT)
21-Feb-24	11:30	6/8	>10km	SW5	None	11	10:02 (HT)
21-Feb-24	12:30	4/8	>10km	SW5	None	14	10:02 (HT)
19-Mar-24	07:30	4/8	>10km	SW3	None	10	07:20 (HT)
19-Mar-24	08:30	4/8	>10km	SW3	None	10	07:20 (HT)
19-Mar-24	09:30	4/8	>10km	SW3	None	10	07:20 (HT)
19-Mar-24	10:30	4/8	>10km	SW3	None	11	07:20 (HT)
19-Mar-24	11:30	8/8	>10km	SW3	None	11	07:20 (HT)
19-Mar-24	12:30	8/8	>10km	SW3	None	12	07:20 (HT)

A total of 38 waterbird species were recorded in the defined survey areas at the Poolbeg outfall, Shellybanks and Bull Island during the 6-month period of the co-ordinated TTTCC survey (Appendix 7.5.1).

At Bull Island, 29 species were recorded, of which 14 are QI of North Bull Island SPA. Two of the QI recorded within the Bull Island survey area occurred, on average, at more than 10% of the SPA population (i.e., Black-tailed Godwit 10.9% and Knot 11.5%).

A total of 26 species were recorded within the Poolbeg survey area, of which 13 are listed as QIs of either South Dublin Bay and River Tolka Estuary SPA or North Bull Island SPA. No South Dublin Bay and River Tolka Estuary SPA QI species occurred in significant numbers as a percentage of the SPA populations. Black-headed Gull was the only QI of North Bull Island recorded, on average, at more than 10% of the North Bull Island SPA population at 12.6%.

Thirty-one species were observed within the Shellybanks survey area, of which 10 species are listed as QIs of South Dublin Bay and River Tolka Estuary SPA. No South Dublin Bay and River Tolka Estuary SPA QI species occurred in significant numbers as a percentage of the SPA populations.

7.5.2.5 Breeding Tern Disturbance Monitoring

Throughout June 2022, over 60 hours of monitoring was carried out at the CDL and SPA sub-colonies within Dublin Port for the purposes of recording disturbance events (Table 7.47).

Table 7.47 Weather Conditions during Breeding Tern Disturbance Monitoring

Date	Start	End	Cloud (Oktas)	Visibility	Wind (Beaufort)	Temp. (°C)	Precipitation
08-Jun-22	09:00	14:30	5/8	Good	4	13	Light shower
09-Jun-22	08:00	14:00	5/8	Good	3	20	None
13-Jun-22	12:00	18:00	7/8	Good	3	12	None
14-Jun-22	10:00	16:30	7/8	Good	2	16	None
15-Jun-22	12:00	18:30	7/8	Good	3	18	None
16-Jun-22	08:00	14:30	7/8	Good	4	16	None
17-Jun-22	14:00	20:00	8/8	Good	2	18	None
20-Jun-22	09:00	15:00	5/8	Good	3	20	None
24-Jun-22	13:00	19:00	4/8	Good	3	19	None
30-Jun-22	11:00	17:30	7/8	Good	3	14	None

Seventy-seven Common Tern (Table 7.48) and seventy-six Arctic Tern (Table 7.49) disturbance events were recorded during monitoring. This equates to 1.25 disturbance events every hour on average.

Approximately 69% (n. 53) of the Common Tern disturbance events observed were classed as “High” and for Arctic Terns, a similar figure of 66% (n. 50) were also “High”.

For both tern species, other birds were the major source of high disturbance events with avian sources causing 35 of 53 high disturbance events in Common Terns, and 31 of 50 high disturbance events in Arctic Terns.

Other causes of high disturbance events were boats passing and in a small number of instances, sudden, loud noises such as ship horns, alarms and loud bangs.

A breakdown of disturbance events is presented in Figure 7.105.

Table 7.48 Common Tern Disturbance Events Recorded During Observations

Date	Number Affected	Source	Cause	Disturbance recorded
08-Jun-22	9	Avian	Great Black-backed Gull	Low
	40	Boat	Boat	High
	40	Avian	Peregrine	High
	40	Boat	Ship	High
	40	Boat	Boat	Moderate
	17	Avian	Great Black-backed Gull	Moderate
	4	Avian	Buzzard	Low
09-Jun-22	40	Avian	Buzzard	High

Date	Number Affected	Source	Cause	Disturbance recorded
	20	Avian	Herring Gull	Moderate
	9	Avian	Herring Gull	Low
	6	Avian	Lesser Black-backed Gull	Low
	7	Avian	Great Black-backed Gull	Low
	11	Avian	Buzzard	Low
	40	Avian	Peregrine	High
	40	Boat	Boat	High
13-Jun-22	30	Avian	Herring Gull	High
	40	Noise	Boat horn	High
	40	Avian	Peregrine	High
	17	Avian	Hooded Crow	Moderate
	25	Avian	Lesser Black-backed Gull	High
14-Jun-22	7	Avian	Great Black-backed Gull	Low
	39	Boat	Boat	High
	40	Avian	Herring Gull	High
	40	Avian	Great Black-backed Gull	High
	30	Avian	Herring Gull	Moderate
	40	Avian	Herring Gull	High
	45	Boat	Yacht	High
	45	Boat	Ship	High
	45	Avian	Herring Gull x2	High
	45	Avian	Herring Gull	High
	40	Avian	Feral pigeon	High
15-Jun-22	27	Avian	Herring Gull	Moderate
	40	Boat	Ship	High
	40	Avian	Great Black-backed Gull	High
	40	Avian	Lesser Black-backed Gull	High
	40	Avian	Herring Gull	High
	40	Boat	Ships x2	High
	40	Aircraft	Helicopter	High
	40	Avian	Herring Gull flock	High
	40	Boat	Ship	High
16-Jun-22	33	Avian	Herring Gull	High

Date	Number Affected	Source	Cause	Disturbance recorded
	40	Avian	Great Black-backed Gull	High
	40	Avian	Feral pigeon	High
	11	Boat	Boat	Moderate
	18	Boat	Yacht	Moderate
	7	Boat	Ship	Low
	28	Avian	Herring Gull	High
	36	Avian	Herring Gull	High
	29	Avian	Buzzard	High
	40	Avian	Lesser Black-backed Gull	High
17-Jun-22	13	Avian	Herring Gull	Moderate
	11	Avian	Feral pigeon	Moderate
	40	Noise	Loud bang	High
	40	Avian	Great Black-backed Gull	High
	33	Avian	Lesser Black-backed Gull	High
	37	Boat	Yacht	High
	20	Avian	Herring Gull	Moderate
20-Jun-22	40	Boat	Boat	High
	20	Avian	Herring Gull	Moderate
	27	Avian	Herring Gull	High
	17	Avian	Great Black-backed Gull	Low
	21	Avian	Hooded Crow	Moderate
	7	Avian	Feral pigeon	Low
	40	Avian	Peregrine	High
24-Jun-22	40	Boat	Boat	High
	40	Avian	Herring Gull	High
	40	Boat	Boat	High
	40	Avian	Feral pigeon	High
	40	Avian	Feral pigeon	High
	40	Avian	Peregrine	High
30-Jun-22	12	Avian	Feral pigeon	Low
	40	Boat	Small rib	High
	40	Avian	Feral pigeon	High
	40	Avian	Feral pigeon	High

Date	Number Affected	Source	Cause	Disturbance recorded
	30	Avian	Cormorant	High
	40	Boat	Yacht	High
	40	Avian	Feral pigeon	High

Table 7.49 Arctic Tern disturbance events recorded during observations

Date	Number Affected	Source	Cause	Disturbance recorded
08-Jun-22	5	Avian	Buzzard	Moderate
	11	Avian	Peregrine	High
	15	Avian	Hooded Crow	High
	15	Avian	Hooded Crow	Moderate
	10	Boat	Ship	Low
	15	Boat	Boats	Low
	6	Aircraft	Helicopter	Low
09-Jun-22	20	Avian	Hooded Crow	High
	30	Boat	Yacht	High
	17	Avian	Lesser Black-backed Gull	High
	30	Avian	Buzzard	High
	20	Avian	Buzzard	High
	10	Avian	Hooded Crow	Low
13-Jun-22	6	Avian	Herring Gull	Low
	9	Avian	Herring Gull	Low
	30	Boat	Boat	High
	10	Avian	Herring Gull	Low
	20	Avian	Lesser Black-backed Gull	High
	30	Avian	Peregrine	High
	30	Avian	Buzzard	High
	30	Boat	Yacht	High
14-Jun-22	6	Boat	Boat	High
	17	Avian	Great Black-backed Gull	High
	17	Avian	Herring Gull	Moderate
	17	Avian	Grey Heron	High
	17	Avian	Herring Gull	Moderate
	17	Noise	Ship alarm	High
	11	Avian	Herring Gull	Moderate

Date	Number Affected	Source	Cause	Disturbance recorded
	8	Avian	Cormorant	Moderate
	2	Avian	Buzzard	Low
	17	Avian	Buzzard	Low
	17	Avian	Herring Gull	Low
15-Jun-22	25	Boat	Boat	High
	24	Avian	Great Black-backed Gull	High
	25	Avian	Buzzard	High
	25	Avian	Herring Gull	High
	25	Avian	Herring Gull	High
	25	Boat	Boat (DWI)	High
	25	Boat	Yacht	High
	17	Noise	Boat horn	High
	18	Boat	Boat	High
16-Jun-22	24	Boat	Dredging boat	High
	18	Avian	Hooded Crow	High
	25	Avian	Hooded Crow	High
	22	Avian	Hooded Crow	High
	19	Avian	Great Black-backed Gull	High
	16	Boat	Ship	Moderate
	25	Noise	Ship Horn	High
	25	Avian	Feral pigeon	High
17-Jun-22	30	Avian	Herring Gull	High
	10	Avian	Mediterranean Gull	Low
	17	Boat	Boat	Moderate
	33	Boat	Boat	High
	35	Boat	Ship	High
	33	Avian	Lesser Black-backed Gull	High
20-Jun-22	27	Boat	Boat	High
	19	Boat	Yacht	High
	11	Avian	Feral pigeon	Low
	9	Avian	Lesser Black-backed Gull	Low
	20	Avian	Hooded Crow	High
	10	Avian	Feral pigeon	Low

Date	Number Affected	Source	Cause	Disturbance recorded
	30	Avian	Herring Gull	High
24-Jun-22	24	Boat	Boat	High
	27	Avian	Herring Gull	High
	27	Avian	Hooded Crow	High
	30	Avian	Hooded Crow	High
	30	Boat	Yacht	High
30-Jun-22	30	Boat	Small boat	High
	19	Avian	Herring Gull	High
	7	Avian	Feral pigeon	Low
	17	Avian	Hooded Crow	High
	21	Avian	Herring Gull	High
	20	Avian	Great Black-backed Gull	High
	30	Boat	Yacht	Low
	11	Avian	Herring Gull	Low
	13	Avian	Lesser Black-backed Gull	Low

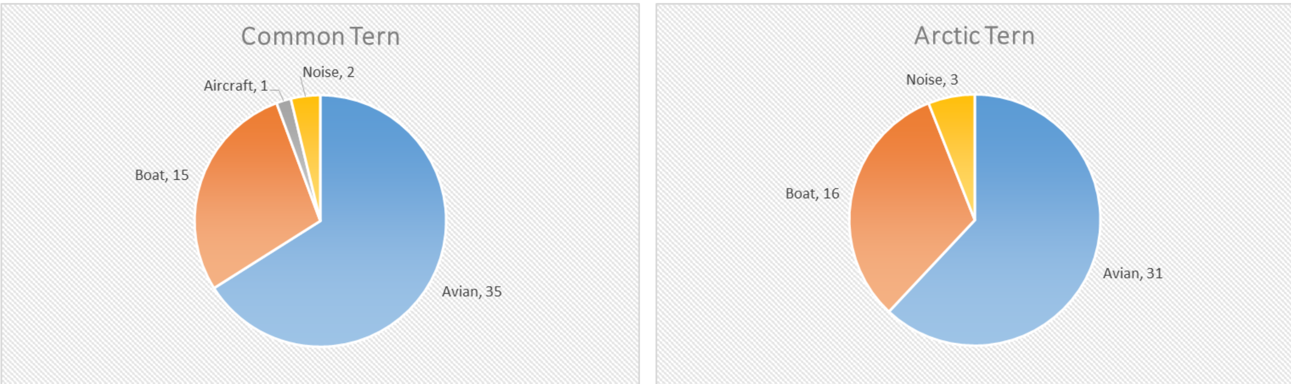

Figure 7.105 Number of High Disturbance events for each source for Breeding Common and Arctic Terns

7.5.2.6 Poolbeg / Great South Wall Survey

A total of 54 hours of observations were made between mid-October and late-November 2022 (Table 7.50). Full counts of all waterbird species observed during the survey are presented in Table 7.51. In total 26 species were recorded in the survey area. Black-headed Gull was present on all occasions and in significant numbers. Herring and Common Gull, Cormorant, Common Guillemot and Turnstone were also frequently observed at the site but in lower numbers.

The frequency of species site usage during October and November based on counts in Table 7.51 is shown in Figure 7.106. Eight species were present in more than 50% of survey counts, and eight species were only represented in less than 10% of counts.

Table 7.50 Times of Disturbance Surveys, weather conditions, and disturbance events times

Date	Start	End	Visibility	Wind (Beaufort)	Temp. (°C)	Ppt.	Tide	Sunset / sunrise	Disturb. start	Disturb. end
14-Oct-22	07:15	08:45	>5km	WSW 3	12	None	Low	07:50		
14-Oct-22	09:15	10:45	>5km	SW 3	10	None	Incoming	07:50		
14-Oct-22	11:15	12:45	>5km	SW 2	12	None	Incoming	07:50		
18-Oct-22	12:00	13:30	>5km	E 3	14	None	Low	07:59		
18-Oct-22	14:00	15:30	>5km	E 3	16	None	Incoming	07:59		
18-Oct-22	15:30	17:00	>5km	E 3	15	None	Incoming	07:59		
25-Oct-22	09:30	11:00	>5km	S 2	12	None	Low	08:10		
25-Oct-22	11:00	12:30	>5km	S 2	13	None	Incoming	08:10		
25-Oct-22	13:00	14:30	>5km	S 3	13	Light rain shower	Incoming	08:10		
28-Oct-22	08:20	09:50	>5km	S 3	13	Light rain shower	Low	08:18		
28-Oct-22	11:00	12:30	>5km	S 3	14	Light rain shower	Low	08:18		
28-Oct-22	12:40	14:10	>5km	S3	15	Light rain shower	Incoming	08:18		
02-Nov-22	08:30	10:00	>5km	NW3	10	None	Falling	07:24	08:43	10:00
02-Nov-22	10:30	12:00	>5km	NW3	14	None	Falling/low	07:24	11:20	12:00
02-Nov-22	12:30	14:00	>10km	NW3	14	None	Low	07:24	13:07	14:10
05-Nov-22	08:00	09:30	>5km	NW3	11	None	High	07:30	08:20	09:31
05-Nov-22	10:00	11:30	>5km	NW3	13	None	High	07:30	10:03	10:15
05-Nov-22	12:00	13:30	>5km	NW3	13	None	High / falling	07:30	11:12	12:00
11-Nov-22	10:00	11:30	>10km	SW3	14	None	Low / rising	07:41	10:03	11:10
11-Nov-22	12:00	13:30	>10km	S3	14	None	Rising	07:41	12:02	12:50
11-Nov-22	14:00	15:30	>10km	S3	14	None	High	07:41	14:11	15:10
14-Nov-22	08:00	09:30	>10km	W2	10	None	Low	07:47	08:19	09:11
14-Nov-22	10:00	11:30	>10km	W2	10	None		07:47	10:30	11:10

Date	Start	End	Visibility	Wind (Beaufort)	Temp. (°C)	Ppt.	Tide	Sunset / sunrise	Disturb. start	Disturb. end
14-Nov-22	12:00	13:30	>10km	W2	10	None		07:47	12:19	13:00
17-Nov-22	08:00	09:30	>10km	W2	9	None	Falling	07:52	08:07	09:13
17-Nov-22	10:00	11:30	>10km	W3	9	None	Falling / low	07:52	10:03	10:50
17-Nov-22	12:00	13:30	>10km	W3	9	None	Low	07:52	12:17	13:10
18-Nov-22	11:00	12:30	>10km	W3	7	None		16:25	11:15	12:12
18-Nov-22	13:00	14:30	>10km	W3	7	None	High	16:25	13:01	14:00
18-Nov-22	15:00	16:30	>10km	W3	7	None	Falling	16:25	15:15	16:02
21-Nov-22	10:00	11:30	>10km	SW4	8	None		16:21	10:17	11:04
21-Nov-22	12:00	13:30	>10km	SW4	8	None		16:21	12:03	13:11
21-Nov-22	14:00	15:30	>10km	SW4	8	None		16:21	14:14	15:01
23-Nov-22	08:30	10:00	>10km	SW3	9	None		08:06	08:42	09:07
23-Nov-22	10:30	12:00	>10km	SW3	9	None		08:06	10:43	11:53
23-Nov-22	12:30	14:00	>10km	SW3	9	None		08:06	12:40	13:30

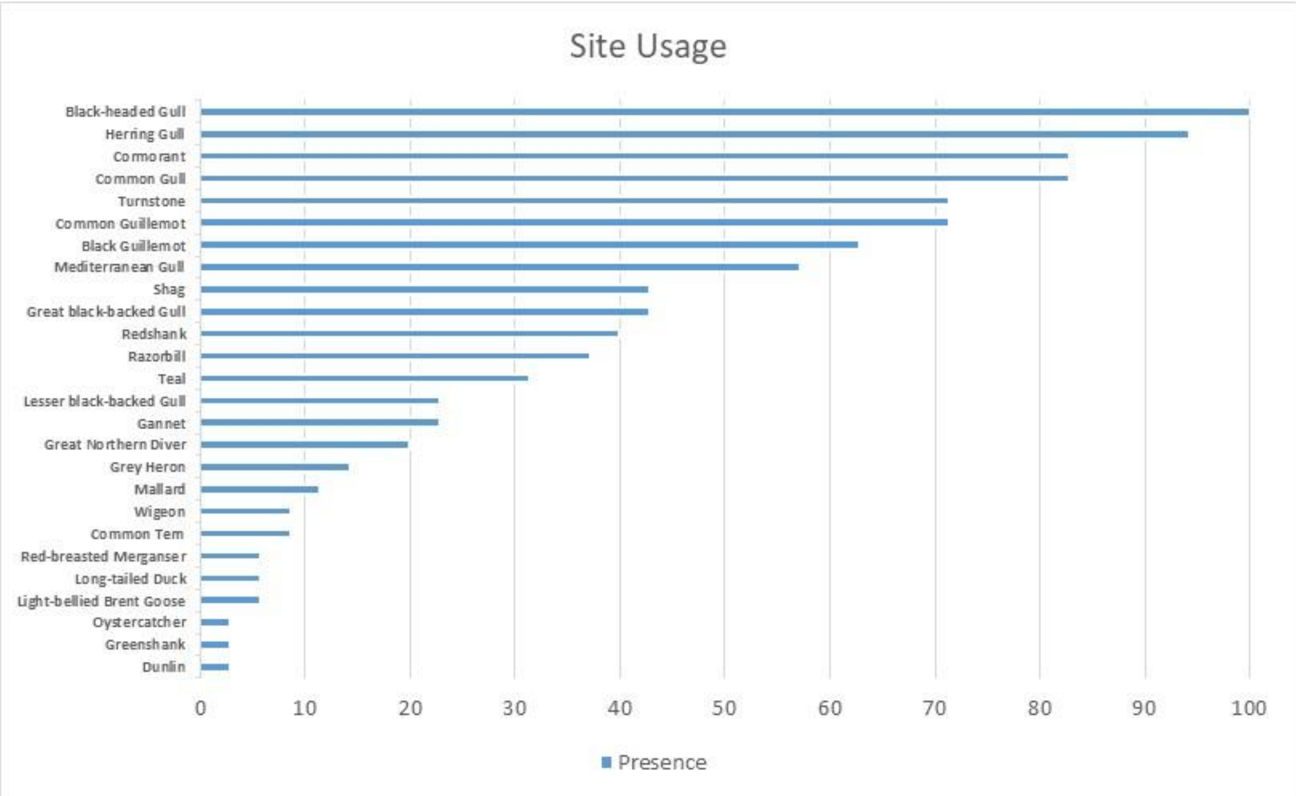

Figure 7.106 Percentage of individual surveys during October and November 2022 in which each species was recorded

Table 7.51 Bird Counts during Disturbance Surveys

SPECIES	14-Oct-22			18-Oct-22			25-Oct-22			28-Oct			02-Nov-22			05-Nov-22			11-Nov-22		
	07:15	09:15	11:15	12:00	14:00	16:00	09:30	11:00	13:00	08:20	11:00	12:40	08:30	10:30	12:30	08:00	10:00	12:00	10:00	12:00	14:00
Black Guillemot	0	0	0	0	6	0	0	0	0	4	3	0	0	7	13	9	6	4	6	0	7
Black-headed Gull	140	828	340	222	550	493	364	80	210	440	330	440	337	449	440	339	490	559	550	600	600
Common Guillemot	2	10	0	0	11	18	0	4	3	6	7	6	8	0	7	3	0	7	0	6	6
Common Gull	8	24	3	0	0	11	5	2	2	14	0	11	0	0	0	7	11	8	17	27	22
Common Tern	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0
Cormorant	5	24	29	37	55	0	15	30	17	57	53	64	47	33	47	34	57	0	67	53	0
Dunlin	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Great black-backed Gull	0	0	0	0	0	7	3	0	1	0	0	0	0	3	0	5	4	0	3	0	6
Great Northern Diver	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Gannet	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	7	0	9	0	0
Greenshank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Heron	0	1	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Herring Gull	9	19	0	19	115	54	15	1	1	27	11	39	38	57	90	57	110	59	67	55	59
Lesser black-backed Gull	27	124	26	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0
Light-bellied Brent Goose	0	0	0	0	0	0	2	0	10	0	0	0	0	0	0	0	0	0	0	0	0
Long-tailed Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	14	0	2	0	7	0	12	0	0	0	0	0	0	0	0	0
Mediterranean Gull	0	0	0	0	0	0	0	0	0	0	0	0	4	0	11	9	7	3	3	0	11
Oystercatcher	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Razorbill	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	11	4	0	0	0	0
Red-breasted Merganser	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redshank	0	0	5	2	0	9	0	0	0	0	0	0	11	0	7	3	0	3	11	0	6
Shag	0	0	0	0	3	2	0	0	0	2	0	3	2	0	3	2	3	0	0	0	0
Teal	0	0	0	0	0	0	0	0	0	0	0	0	7	0	9	13	0	4	0	0	0
Turnstone	0	0	25	22	22	21	23	27	27	12	12	14	22	24	19	0	16	12	13	0	0
Wigeon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 7.51 Bird Counts during Disturbance Surveys Continued

SPECIES	14-Nov-22			17-Nov-22			18-Nov-22			21-Nov-22			23-Nov-22		
	08:00	10:00	12:00	10:00	12:00	14:00	08:30	10:30	12:30	08:00	10:00	12:00	11:00	13:00	15:00
Black Guillemot	9	0	7	ND	11	11	6	11	6	11	1	11	7	0	7
Black-headed Gull	355	460	400	ND	600	670	450	550	460	660	700	710	677	660	715
Common Guillemot	0	0	0	ND	8	2	11	13	13	4	7	7	4	3	0
Common Gull	57	11	11	ND	119	116	111	119	112	112	110	113	110	113	115
Common Tern	0	0	0	ND	0	0	0	0	0	0	0	0	0	0	0
Cormorant	7	57	57	ND	67	66	0	0	51	70	17	19	0	50	29
Dunlin	0	0	0	ND	0	0	0	0	0	0	0	0	0	0	0
Great black-backed Gull	3	0	2	ND	0	0	0	4	3	0	3	0	0	2	2
Great Northern Diver	1	0	0	ND	0	0	1	0	0	0	2	2	0	2	0
Gannet	7	4	6	ND	7	0	0	0	0	0	0	0	0	0	3
Greenshank	0	0	1	ND	0	0	0	0	0	0	0	0	0	0	0
Grey Heron	0	0	0	ND	0	1	0	0	0	0	0	0	2	0	0
Herring Gull	7	47	69	ND	121	112	70	57	119	53	50	59	59	0	73
Lesser black-backed Gull	0	0	0	ND	0	0	0	1	0	0	0	0	0	1	2
Light-bellied Brent Goose	0	0	0	ND	0	0	0	0	0	0	0	0	0	0	0
Long-tailed Duck	1	1	0	ND	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	0	ND	0	0	0	0	0	0	0	0	0	0	0
Mediterranean Gull	2	4	9	ND	7	19	7	4	9	3	6	7	3	0	7
Oystercatcher	0	0	0	ND	0	0	0	0	0	0	0	0	0	0	0
Razorbill	4	4	9	ND	0	0	7	19	11	3	0	7	0	0	4
Red-breasted Merganser	0	0	0	ND	0	0	0	0	0	0	0	0	2	2	0
Redshank	1	4	4	ND	0	0	4	7	0	0	0	0	0	0	0
Shag	1	0	3	ND	0	3	0	0	2	3	2	0	0	3	0
Teal	7	7	0	ND	0	0	12	17	0	8	0	7	11	0	0
Turnstone	20	29	12	ND	0	22	13	13	0	13	0	11	0	0	27
Wigeon	1	1	0	ND	0	0	5	0	0	0	0	0	0	0	0
NOTE: Cells Highlighted yellow – South Dublin Bay and River Tolka Estuary SPA QI									Red Text – North Bull Island SPA QI ND – No data						

A total of 196 disturbance events were recorded during the 54 hours of monitoring over 12 separate days. Full results are presented in Appendix 7.5.1, and the events are summarised here (Table 7.52). The incidence of events equates to approximately 3.6 disturbance events per hour on average. Duration of disturbance was one minute in two thirds of cases, and five minutes or less in all instances. A breakdown of source of disturbance events is presented in Figure 7.107, and the severity of disturbance events in Figure 7.108.

Vessel traffic was responsible for approximately 90% of all bird disturbances at the monitoring site during the survey. The majority of bird disturbances at the site (117; 60%) were due to cargo vessels, ferries, tugs and pilot boats, and some smaller craft. However, around two thirds of these disturbances (72) were at the lower range of impact and did not result in any flight i.e., birds became alert or moved away. The GI vessel was responsible for a further 30% (58) of vessel disturbance events, of which around half (28) did not result in any flight i.e. birds became alert or moved away.

The highest level of disturbance, long flight (landing >50m from start position) occurred in 18 disturbance events. Of these, seven were caused by boat traffic, three by GI vessel, three by drone, three by helicopter, one by a Buzzard flying over, and one by birdwatchers / photographers.

High level disturbance events (categorised as a “Long flight >50m) accounted for less than 10% of all disturbance events, mainly affecting Black-headed Gulls that were loafing in the path of marine traffic or were disturbed by a Buzzard flying over. No Black-tailed Godwit were recorded during these disturbance surveys, and no significant disturbance of any other Special Conservation Interest (SCI) species (i.e., Redshank, Teal or Turnstone) was observed.

Table 7.52 Summary of Disturbance Events

Code	Reaction	Number of disturbance events	Percentage of disturbance events
1	Alert	72	37%
2	Walk/ Swim/Dive away	42	21%
3	Short flight (landing <50m from start position)	64	33%
4	Long flight (landing >50m from start position)	18	9%
	TOTAL	196	100%

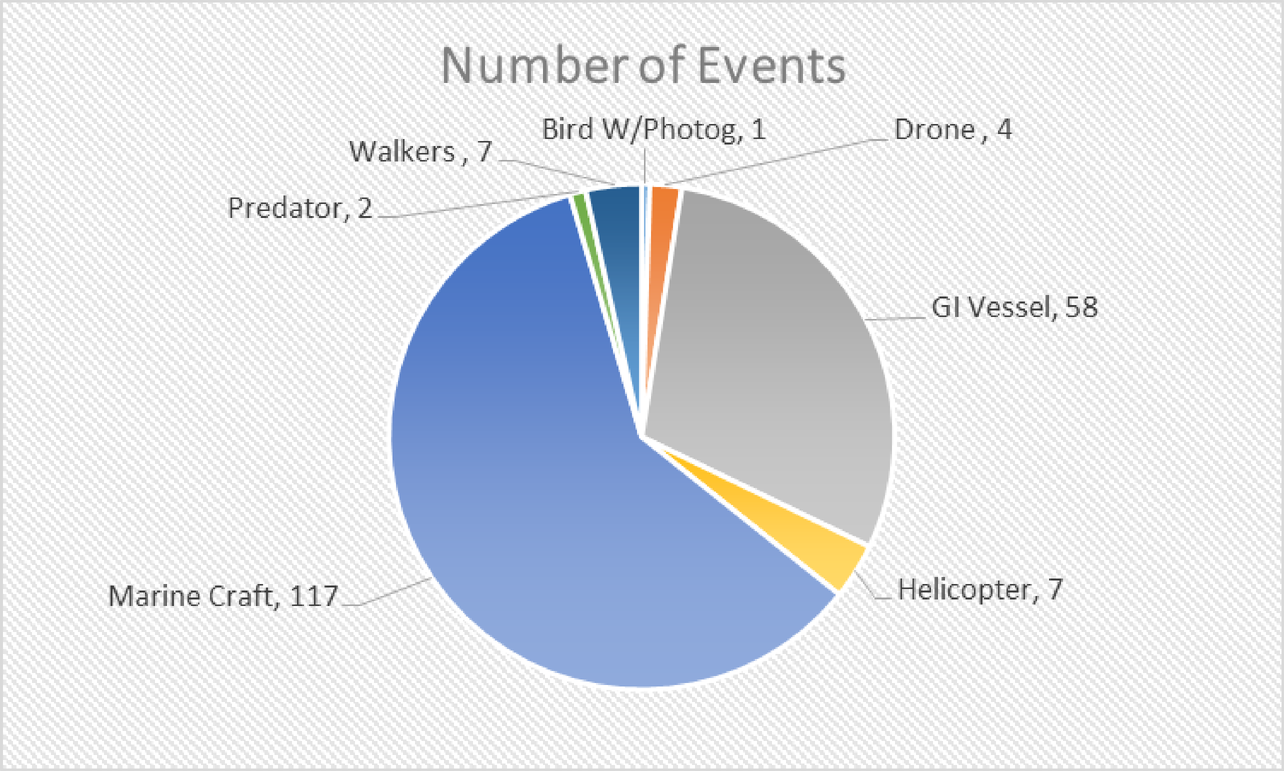

Figure 7.107 Relative frequency of each source of disturbance distinguished for GSW/Poolbeg Survey

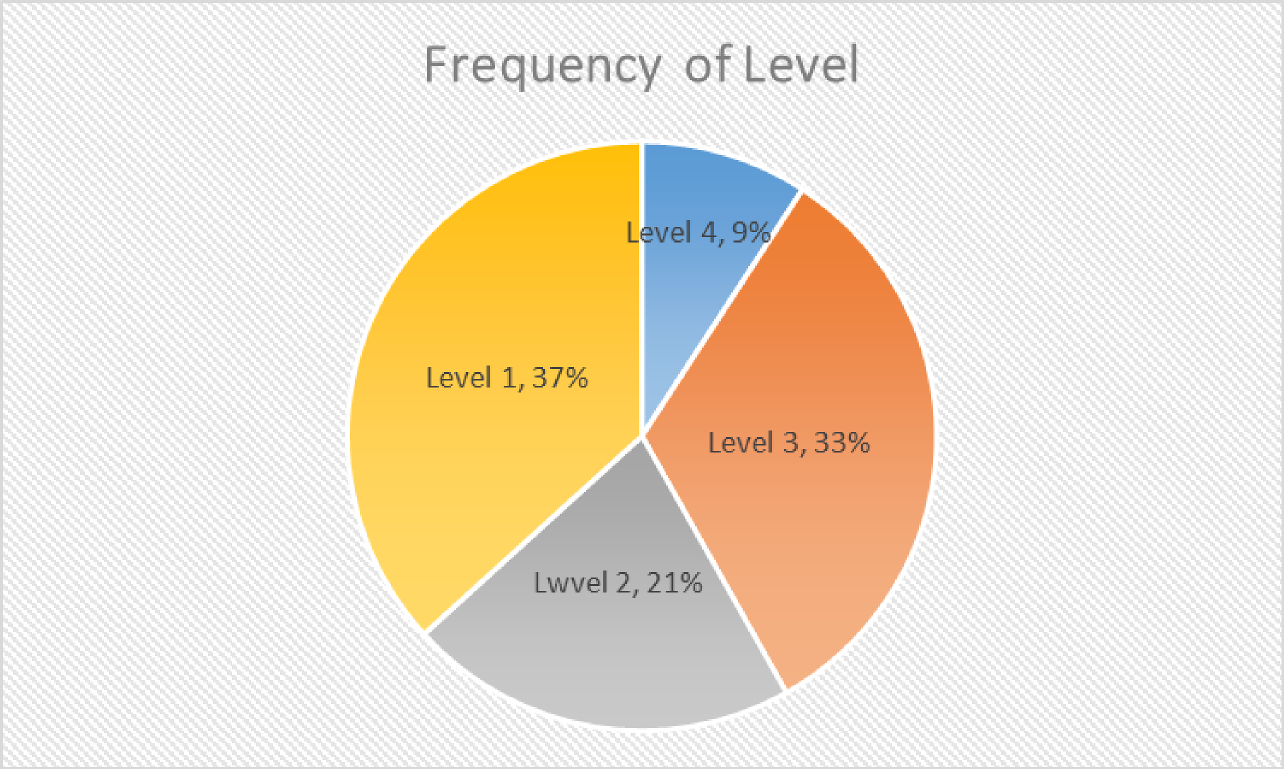

Figure 7.108 Severity of disturbance events from Level 1 least severe, to Level 4 most severe

7.5.2.7 Black Guillemot Survey

Two surveys were carried out during the peak Black Guillemot breeding season, one in April and one in May 2022 (Table 7.53) to assess breeding numbers in the Dublin Port area.

Locations where Black Guillemots were recorded during the surveys are presented in Figure 7.110.

The total number of birds recorded on each survey was 78 and 46 in April and May respectively. The higher number of 78 was treated as the minimum breeding population in 2022. The population of Black Guillemots in Dublin Port is stable and in 2022 was above the long term average of annual counts since 2013 (Figure 7.109). The combined total of adults observed across the breeding season represent approximately 3% of the Black Guillemot breeding population in Ireland (Mitchell *et al*, 2004).

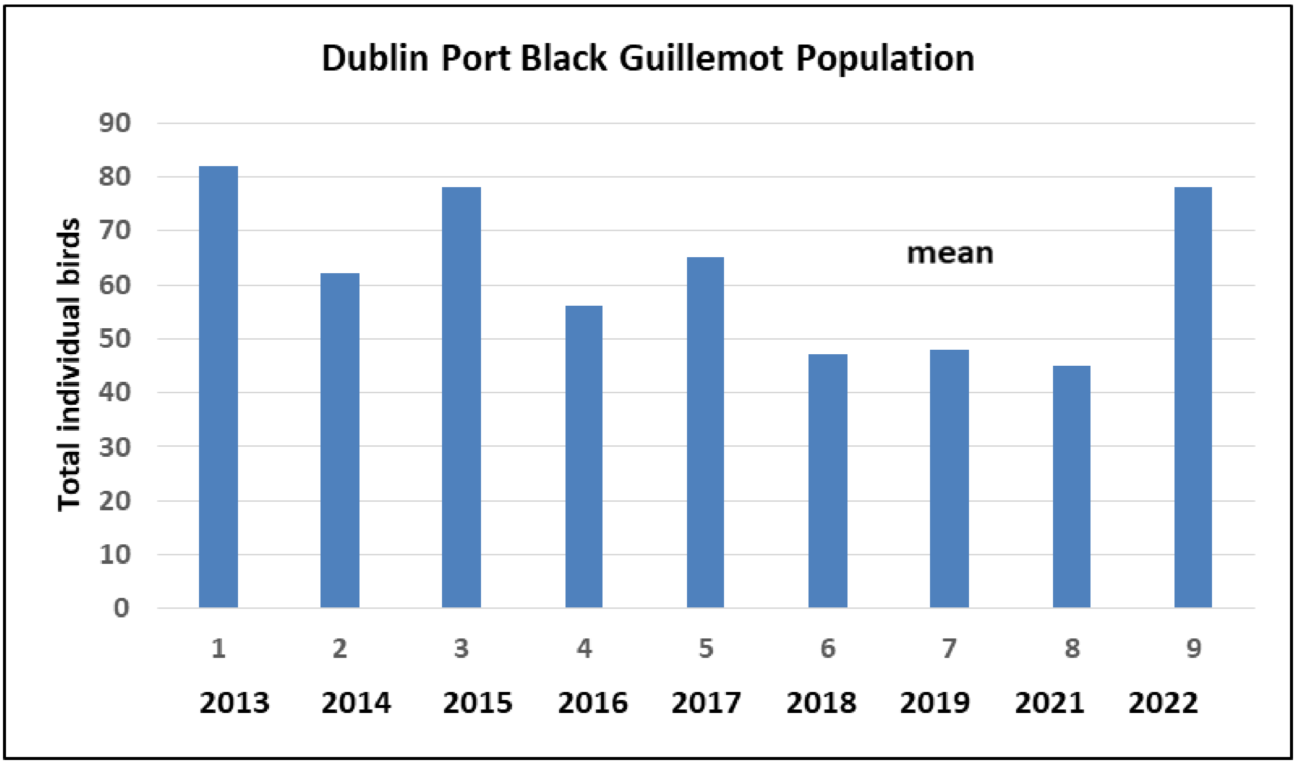

Figure 7.109 Breeding population of Black Guillemot Dublin Port

Direct observations of adults in breeding plumage in proximity to potential nest sites is taken as indication of breeding in the vicinity. Six birds were seen at nest boxes during the survey.

Table 7.53 Weather conditions during Black Guillemot surveys

Date	Visibility	Wind (Beaufort)	Temp. (°C)	Precipitation.	Cloud (Otkas)
25-Apr-22	>16km	WSW 3	9	None	5/8
09-May-22	>16km		9	None	7/8

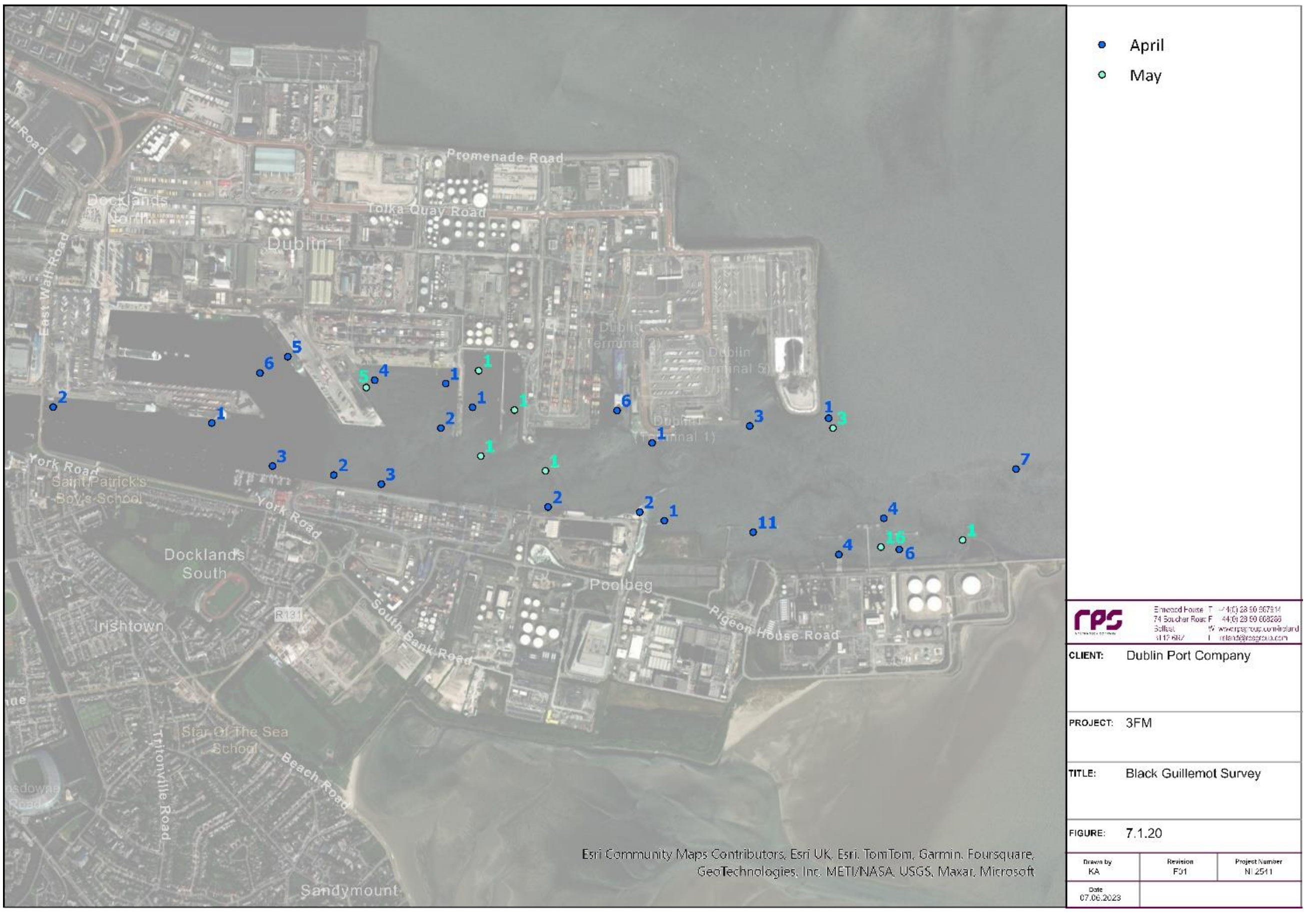

Figure 7.110 Locations and numbers of Black Guillemots counted in surveys in April and May 2022.

7.5.3 Impact Assessment

'*Impact Assessment*' outlines the potential impacts upon relevant biodiversity features as a result of the construction and operational phases of the 3FM Project and cumulatively with other projects, and determines whether or not potential impacts are likely. This section then considers the magnitude of potential effects on relevant biodiversity features and determines whether or not they are significant in the absence of mitigation.

Sources of potential impact during the construction phase, and avian biodiversity features considered are:

- Impact of construction activities on Poolbeg peninsula on nesting passerines
- Construction impacts on waterbirds using the coastal environment around Poolbeg peninsula
- Impacts on nesting terns
- Impacts on nesting Black Guillemots

7.5.3.1 Construction

Construction Impacts on Nesting Passerines

The construction of the Ro-Ro terminal at Area O is the element of the 3FM Project with most potential to impact terrestrial nesting birds. Most of the area to be developed comprises building and artificial surfaces and existing brown field areas. Some of these latter sites have been unmaintained for many years and are transitioning to various vegetation types.

The breeding bird survey identified scrub and woodland vegetation as most important for nesting passerines in the area. While some site clearance will occur, this is largely confined to existing hardstand yard and grassland areas. There will be little loss of areas of scrub and potential impacts are slight and temporary. Critically there will be an extension of the Irishtown Nature Park and the scrub extending westwards from there will remain intact. Further tree and shrub planting along this southern coastal margin is proposed to enhance screening of Area O. This will provide additional opportunities for nesting birds.

Section 40 of the Wildlife Act 1976 as amended by the Wildlife (Amendment) Act 2000 and the Heritage Act 2018, provides that it is an offence to destroy vegetation on uncultivated land between 1st March and 31st August. As such, pre-construction site clearance works and removal of vegetation including trees, scrub, hedgerows and shrubs will take place outside this period, which will ensure breeding birds are protected from harm.

A small Sand Martin colony has been identified by NPWS at Pigeon House Harbour in the vicinity of the area of the proposed turning circle, including a retaining wall at the 47A Hardstand and demolition of the existing sludge jetty. The Sand Martins were reported to nest in crevices in the stonework of a section of the Pigeon House Harbour Wall which projects across the western side of the harbour mouth. Two site visits in April and May 2024 failed to detect any evidence of nesting Sand Martins. This section of wall will not be subject to any 3FM Project works, and will remain intact and available for nesting access. The proximity of demolition works at the sludge jetty, if occurring during the nesting season and if the site is in use, may result in temporary disturbance and slight impact.

Given the results of the ornithological surveys conducted in the survey area and the restrictions on clearance of vegetation discussed above, it is concluded that the Project will not significantly impact upon the breeding populations of wild passerine birds, nor will there be any significant impact on Sand Martins nesting at Pigeon House Harbour. Any effects will be minor and temporary in nature, and the additional planting proposed will be beneficial and provide enhanced nesting and foraging habitat.

Construction Impacts on Waterbirds

A number of activities associated with the construction phase of the 3FM Project could potentially impact on waterbirds using the coastal environment around Poolbeg peninsula. The principal sources of potential impact are disturbances due to presence of workers and operation of plant on site, works-associated vessel movements, and noise generation. Disturbance surveys undertaken in June 2022 (breeding terns), and October-November 2022 (Poolbeg/GSW) along with the TTTCC survey over 12 months from April 2022 to March 2023, also inform the assessment of potential 3FM Project impacts on waterbirds in general. The risk of 3FM Project impact on nesting Common and Arctic Terns, and on Black Guillemots is assessed separately.

Lewis et al., (2019) define disturbance as “any activity that results in a waterbird being displaced from an area.” Response to disturbance can range from “subtle declines in intake rates to more serious changes such as avoidance of entire areas or sites” (Mitchell et al., 1989). Previous studies have found that the highest levels of disturbance to waterbirds in intertidal areas of Dublin Bay was caused by dogs both on and off lead, and walkers (Phalan & Nairn, 2007; Adcock et al., 2018). Stigner et al., (2016) found that, although some waterbirds in areas of high recreational activity become habituated to disturbance events, there was very few instances of habituation to dog activity due to dogs representing a predator threat (Lafferty 2001). When dogs were restricted in these recreational areas, waterbird numbers increased (Stigner et al., 2016).

7.5.3.1.1.1 Human Disturbance

The main potential source of disturbance to waterbirds would be the activity of construction workers close to the shoreline. Human activity elicits a behavioural response in many species of birds, including fleeing from, or sheltering away from humans, or travelling further from sites of human activity to find food or mates (Price 2008; Suraci *et al.,* 2019). An example of this was seen in Mutton Island in Galway Bay. Waders using Mutton Island were studied over a period of five years, during and after the construction of a major sewage treatment plant which was situated between 150m and 200m from the main high tide roost. The waders became more concentrated on the undeveloped part of the island but otherwise showed no negative effects of disturbance. Numbers of birds using the roost increased towards the end of the construction period as human disturbance decreased, due to controls on public access to the island and due to the placement of a high wall around the construction site which screened construction workers from the birds (Nairn 2005). These mitigation methods reduced the potential for human-activity disturbance on the wader roost, resulting in a continued use of the roosting site by the birds.

The main cause of disturbance identified during the breeding tern disturbance survey in June 2022 were other avian species such as Herring Gull and Buzzard. During the Oct-Nov Poolbeg/GSW survey, most disturbance events affecting waterbird species were from anthropogenic sources, such as marine traffic and aircraft.

Although the disturbance monitoring showed that some birds took a short or long flight during a disturbance event, this does not necessarily suggest a significant negative effect when there are alternative habitats of a similar quality nearby, or the bird returns. However, even a short-term disturbance can have a costly energetic effect. Alternative habitats of a suitable quality may not be available in the vicinity of the disturbance event, or there may be other ecological pressures such as cold weather, lack of food sources or increased competition for suitable foraging and roosting habitat (Gill 2007). Less than 10% of disturbance events recorded at the GSW were of a high level (Level 4), and were generally of very short duration.

A total of 34 waterbird species were recorded in the immediate area of the Poolbeg peninsula over a 12-month period, but many species occurred only sporadically or at very low frequencies (e.g. Gannet, Great Northern Diver). Some species are only present during the breeding season (terns), while others are present year round, although they may be more abundant during summer months (e.g. Black Guillemot, many gull species). Many of the waders and divers are most prominent in the survey area during winter months (Razorbill, Guillemot, Great-crested Grebe, Dunlin and Greenshank).

Of the 34 species recorded over 12 months, 15 occurred at maximum numbers of 10 or less, and 20 species at a maximum of 20 or less individuals. Only Black-headed Gulls and Herring Gulls were present in substantial numbers for most of the12- month period. They regularly roost on the jetties and quay walls in this area. Cormorants also regularly frequent the monitoring area, often in numbers of more than 20 birds.

Given the low numbers of species and individual waterbirds that regularly use the area of the proposed 3FM Project, the risk of significant disturbance is low. Any potential impact will be slight and temporary in nature. Specific mitigation in relation to nesting terns (see below) will also further reduce disturbance impact on waterbirds in general.

7.5.3.1.1.2 Noise Impact

Construction noise at the proposed 3FM Project site will include general construction noise from vehicles and plant, and handling of materials. The most significant noise generating activity will be pile driving. Pile driving is an impulsive, but repetitive noise. All birds subject to an impulsive noise disturbance show a species-specific response that varies with increasing exposure and increasing volume (Wright *et al.,* 2010). Many bird species can become habituated to most sounds, but unexpected sounds, such as a gunshot or an impulsive noise like pile driving, can cause an immediate energy expenditure escape flight, although the birds may settle and habituate quickly ignoring all subsequent noises for the day (Owens 1977; Harris & Davis 1998). An example of this is the frequent habituation of birds to gas bangers which are designed to prevent birds landing on crops or airport runways (Harris & Davis 1998). This habituation more regularly occurs when the noise is at regular intervals.

A study was undertaken on the effects of piling noise and vibration disturbance on birds within the Humber Estuary SPA, Eastern England (RPS 2014). Despite consistent periods of double hydraulic piling activity on the landward side of the seawall on the Humber, birds appeared to be largely unaffected by the noise of piling. On some occasions birds were recorded arriving to feed during periods of piling activity. It was considered that the screening of the mudflats by the seawall was effective in minimising disturbance effects. The study results suggest that any disturbance associated with piling activity may have also been due to the increased presence of people.

Wright et al. (2010) investigated the effects of impulsive noise on roosting shorebirds. Bird response to perceived noise levels from an impulsive source at varying distances was measured. Response was classified as none, behavioural change but no flight, flight but soon returned, and flight with site abandonment. The latter two responses (involving flight) were deemed to be energetically costly, and the first two taken to be harmless. A threshold value of approximately 70dB(A) distinguished the harmless and energetically costly responses, and prompted the recommendation (with several caveats) that impulsive noise limits should be restricted to less than 69.9dB at the receptor.

Cutts *et al*. (2009) considered impacts to birds utilising the Humber Estuary and summarised the general construction noise thresholds that can have a potentially detrimental effect on birds. Noise up to 50dB(A) was found to have no effect whereas noise between 50dB(A) and 85dB(A) caused head turning, scanning behaviour, reduced feeding and movement to nearby areas. Above 85dB(A), response included preparing to fly away, flying away and possibly leaving the area (Figure 7.111). The authors recommend that ambient construction noise levels should be restricted to below 70dB(A), to ensure that birds will habituate to regular noise below this level and mitigate any potential energy-expenditure as a direct consequence of noise. Where possible, sudden irregular noises above 50dB(A) should be avoided as this causes maximum disturbance to birds (Cutts *et al*. 2009).

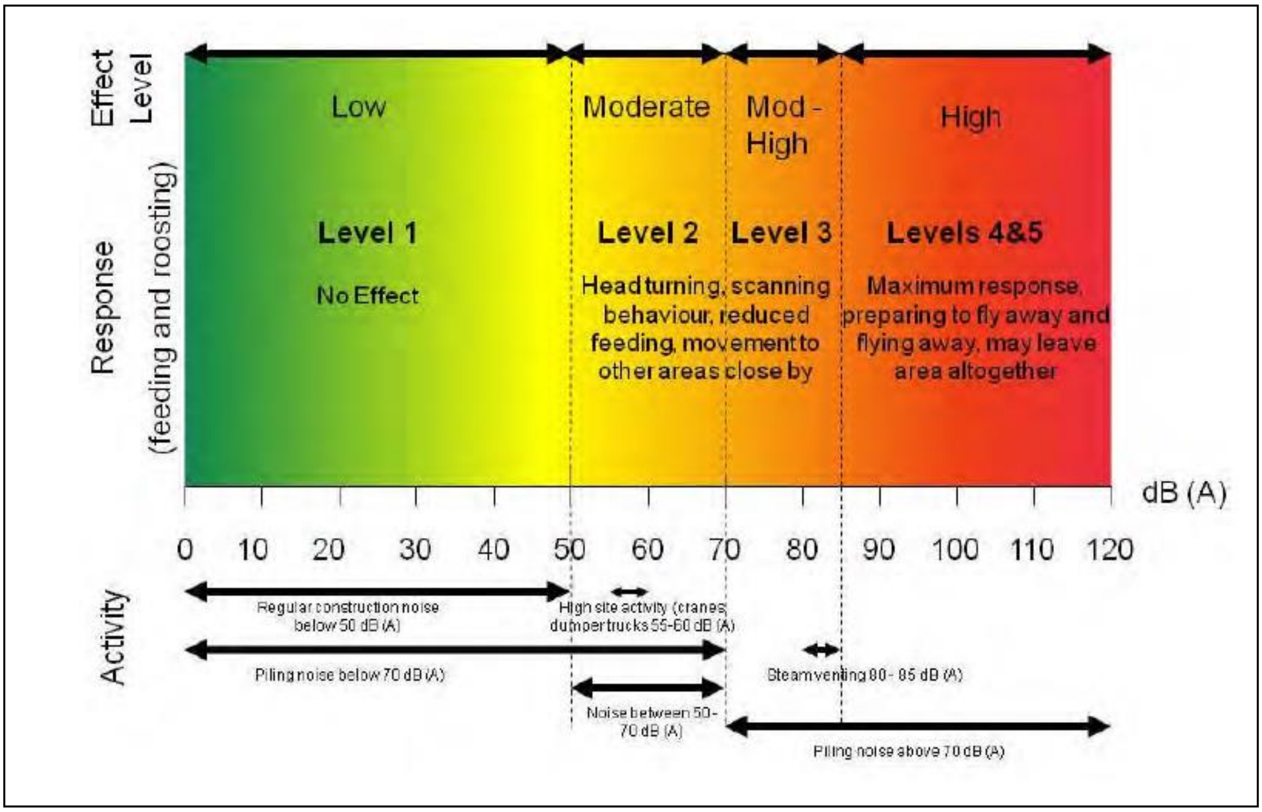

Figure 7.111 Waterbird response to construction disturbance (from Cutts *et al.* 2009)

IECS (2007) showed that in general birds were found to accept a wide range of steady state noise levels from 55dB(A) up to 85dB(A), therefore complete exclusion of the site for foraging, roosting or breeding within up to 250m of the noise was considered very unlikely. Evidence presented by Cutts *et al*. (2009) from repair work to a pipeline in the Humber Estuary has shown that disturbed birds are likely to return within a short time frame once disturbance ceases, potentially within 30 minutes, and with no evidence of effects on numbers during surveys the following week, emphasising the short-term nature of any impacts.

Modelling of construction noise, including operation of piling rigs (RPS, 2023), predicts that noise levels may exceed 80dB(A) to 85dB(A) at some locations near the source during some construction activities, notably during concrete breaking for demolition, and during piling. However, levels rapidly attenuate to below 70dB(A) at distances of about 50m from source, quickly reaching ambient levels throughout the surrounding Liffey estuary and Sandymount areas. The pile-driving locations are screened from areas of key avian importance at Sandymount Strand by existing buildings, port infrastructure and the Great South Wall. Given this attenuation, the noise perceived by birds from 3FM Project construction sources is predicted to be below the 'safe' 55dB(A) threshold prescribed by Cutts *et al.* (2009) in almost all instances. Birds in all parts of the SPA, are expected to rapidly habituate to noise from pile driving operations and there will be no negative impacts.

No negative impacts due to construction noise are expected in the wider environment (including the SPA), and any local impacts in the Liffey estuary are likely to be slight negative and temporary at worst in the absence of mitigation.

Construction Impacts on Nesting Terns

Dublin Port supports a breeding colony of Common Terns and Arctic Terns on four man-made structures within the Port, two of which are designated as proposed Natural Heritage Areas (pNHAs), and one of these is within the South Dublin Bay and Tolka Estuary SPA. The proposal to install a new 325m diameter ship turning circle in the Liffey channel, and piled wharfs at Area N has the potential to cause high levels of disturbance to the nesting tern sub-colonies within the port in the absence of mitigation.

The most significant potential sources of impact on breeding tern colonies are activities and noise arising from extensive piling operations at Area N during construction of a 650m x 150m open pile Lo-Lo wharf. This will entail the driving of 216 tubular piles of 1.626m diameter toward the outer face of the wharf and 2,275 tubular piles of 1.219m in diameter to form the bulk of the support for this structure. Piling will not be continuous, and will be prohibited after 19:00 and before 07:00 each day, and seasonal non-piling windows will apply e.g. no piling during July and August at Area N, except for the innermost smaller diameter piles.

7.5.3.1.1.3 Human Disturbance

Disturbance monitoring at the CDL and SPA sub-colonies throughout June 2022 indicates the nature of disturbance that terns respond to and the degree of severity of that disturbance. The greatest proportion of high-level disturbance events (60% and 66% in the case of Arctic Terns and Common Terns respectively) were caused by other avian species, especially Herring Gull, Great Black-backed Gull and birds of prey, rather than marine traffic or other anthropogenic sources.

Terns are known to be resilient to high levels of anthropogenic disturbance. Globally, terns are increasingly nesting in high traffic areas, such as busy beaches in New York, California and Texas (Gochfeld 1978; Massey 1981; Minsky 1987; Brubeck et al., 1981) and even allow visitors to walk through nesting areas via paths or boardwalks (Cullen 1956; Dunlop 1996). This increasing resilience to human-based activity is a direct result of habituation of the species, and evidenced for example by the increased lack of disturbance events in research-colonies, where Common Terns tolerate biologists approaching their nests to within 10m before flying off, and returning to the nest and/or chicks once the biologist has retreated to 1-2m away (Nisbet 2000). Terns breeding in Dublin Port are habituated to the busy port environment and the constant presence of people on shores near the colonies.

The likelihood of impact due to human disturbance is therefore considered to be low, and any impact is likely to be slight, short term and not significant.

7.5.3.1.1.4 Noise

Anthropogenic noise can cause disturbance to birds in a variety of ways. Some species are more sensitive than others to loud noises (Ortega 2012). There are two recognised levels of response to disturbance: effects and impacts (Robinson and Pollitt, 2002).

- Effects can be seen as observed responses (behavioural and/or distributional) by a bird to a given disturbance. Examples of this include birds changing their feeding behaviour, taking flight or being more vigilant. In these circumstances, although disturbed, birds may be able to use the same or alternative sites without any major negative effects on their energy budget, and ultimately on the survival of individuals (Gill *et al*. 2001).

- Impacts in this context imply a reduction in body condition, productivity or survival and are therefore of primary conservation concern as they may result in a negative effect at the population level, if enough individuals are affected. Whether disturbance results in an impact depends largely on the availability of alternative sites and the energetic costs of displacement (Goss-Custard *et al*. 1995).

Noise from construction activity sources such as pile driving may affect birds by two distinct pathways. Aerial noise may be heard by birds while they are foraging, roosting, swimming or flying close to the construction site. Underwater noise may affect bird species that forage by diving or plunge-diving, including cormorants, shags, grebes, mergansers, auks, gannets, and terns.

In the case of underwater noise any impacts on diving species are likely to be indirect through displacement of prey species. Noise impacts on estuarine fish communities have been assessed in Section 7.3. This assessment finds that, noise from piling is very unlikely to lead to more than a slight, short-term negative impact, in the absence of mitigation, at a population level in marine, estuarine resident and migratory species. Underwater noise is therefore very unlikely to have any significant impact on birds and is considered negligible.

The sounds that birds hear can be divided into threatening and non-threatening sounds. Examples of non-threatening sounds are wave noise on a beach or constant traffic noise from a road. Threatening sounds include impulsive sounds such as gunfire, explosion or barking of a dog. The general sound of construction (not including piling) is not impulsive (sudden, loud or shocking) but tends to be continuous and low frequency noise such as that made by machinery and vehicular traffic. However, impulsive sounds such as demolition and pile driving may require mitigation to prevent disturbance.

On average, birds hear less well than many mammals, including humans. Acoustic deterrents or gas banger devices are not generally effective because birds habituate to them and eventually ignore them completely. Devices that purport to use sound frequencies outside the hearing range of humans are most certainly inaudible to birds as well because birds have a narrower range of hearing than humans do (Birkhead 2012).

Dooling (2002) reviewed the literature on how well birds can hear in noisy (windy) conditions and suggested that birds cannot hear certain mechanical noises as well as humans can in these conditions. Results of a trial on a colony of Crested Terns *(Sterna bergii)* in Australia, found that the maximum responses observed, preparing to fly or flying off, were restricted to exposures to simulated aircraft noise levels of greater than 85dB(A). A scanning behaviour involving head-turning was the minimum response, and this, or a more intense response, was observed in nearly all birds at all levels of noise exposure. However, an intermediate response, such as an alert behaviour, demonstrated a strong positive relationship with increasing exposure. Ambient noise may also impact on communication distance and a bird's ability to detect calls, such as alarm calls. These effects could include damage to hearing from acoustic over-exposure (either increasing in volume or increasing in exposure time), behavioural and/ or physiological effects such as increased production of stress hormones and hypertension, and the masking of biologically relevant sounds such as communication signals (Dooling & Popper 2007; Barber *et al.,* 2010).

Worst-case predicted construction noise levels from the proposed development are 75dB(A) to 80dB(A) at the tern colonies on both the SPA Platform and the CDL Dolphin (RPS, 2023), and are due to demolition and dredging works in their immediate vicinity. This is substantially below the 85 dB(A) level cited above as likely to result in disturbance. It is important to note that dredging will not take place during the tern nesting season and this will significantly mitigate noise impacts. Noise from piling works is likely to be less than 75dB(A) at both colonies. In addition, significant restrictions will apply to 3FM Project piling works with no-piling periods applying to defined locations and specific piling operations, including Area N and the Turning Circle. No piling will take place within 75m of any tern colony during the breeding season and mitigation to attenuate aerial noise arising from the piling operations will apply.

Noise measurements at Dublin Port (Richard Nairn and Eugene McKeown, 09 June 2015) show that a tern colony itself generates noise up to 70 to 80 dB(A) in the breeding season through the continuous calling of the terns. Such noise may therefore exceed audible construction noise from the 3FM Project site at the piling exclusion zone of 75m distance. Even in the absence of the noise generated by the terns, the construction noise levels are not predicted to cause any disturbance or other negative effects on the birds.

It is therefore concluded that the likelihood of impact on breeding terns due to construction noise from the proposed 3FM Project is low. Any potential impact is predicted to be slight and short term, and there will therefore be no significant impacts on these species.

Construction Impacts on Nesting Black Guillemots

The Black Guillemot surveys record all birds present and it is not always possible to allocate individuals to particular nest sites. The sites are mainly inside old drainage pipes, some in the vertical face of quay walls and some in metal ramps. A few are in wooden nest boxes installed in 2015. In September 2021 an inspection of all current and potential nest sites in the Port was undertaken from an inflatable boat. Up to 26 potential nest sites have been identified in existing structures within Dublin Port (east of the East Link Bridge), a proportion of which have been occupied in recent years (Black Guillemot Management Plan, 2023-2030, DPC 2024). The majority of currently used nest sites are in drainage holes in quay structures or ramps that will not be altered under the 3FM Project. The nest sites that will be potentially impacted by the 3FM Project (approximately eight in number) are to the east and west of the entrance to Pigeon House Harbour, at Marine Terminals (berths 41 and 42), at South Bank Quay (berths 45 and 46), and at Berth 18 near the landfall of the proposed SPAR Bridge.

It is well established that Black Guillemots will readily nest in custom-made nest boxes. Large numbers of such nest boxes have been successfully deployed at Bangor Harbour, Co. Down (Greenwood 2002), Rockabill, Co. Dublin, Greenore Port, Co. Louth, and at Dublin Port where they continue to be used by nesting Black Guillemots. A minimum of 12 nest boxes will be installed to compensate for loss of nesting sites due to the 3FM Project. Some will be installed prior to commencement of construction works. It is envisaged that six of these will be installed at the open pile wharf at Area N. Where nesting sites are likely to be unavailable to birds in the following season, they will be blocked in advance of the breeding season to prevent access and nest boxes deployed in the immediate vicinity.

Therefore, any impact on Black Guillemots will be temporary and slight in nature. Monitoring will continue on an annual basis to confirm use of alternative nesting sites, and to identify any need for deployment of nest boxes at additional locations.

7.5.3.2 Operational Phase

The most likely potential impacts arising during the operational phase of the 3FM Project are increased disturbance of waterbirds, impacts on birds using a feeding resource at Poolbeg/GSW, and the potential of birds colliding with the proposed new SPAR Bridge.

Increased Disturbance of Waterbirds

Human-related disturbances to foraging or resting waterbirds during the annual cycle can come from a range of sources, including industrial and recreational sources (Robinson and Pollitt, 2002). Anthropogenic disturbances may cause birds to fly short distances or to alternative areas. Responses to less severe events may include alert pose, or head tilt, and in more severe events long-distance flight, or site abandonment (Collop *et al.,* 2016). High levels of disturbance pose risks during both the breeding season and the winter staging season. These include energetic costs due to reduced feeding times, and higher energy expenditure due to flying away, both of which can reduce the rates of survival within species. These costs can be compensated for by feeding for longer, or flying to an alternative feeding area, however such responses are less likely to adequately compensate when food supplies are low, or there is a lack of suitable alternative places to feed, and when disturbance levels are higher.

It is reasonable to conclude that the existing high levels of anthropogenic noise, traffic and disturbance associated with the docks and businesses in the vicinity of Dublin Port has resulted in the birds that breed and overwinter here becoming habituated to much of the human activity in the area. The nature of such activity will not change in the 3FM Project operational phase. The SPA to the south of the 3FM Project site, including Sandymount which is an important staging site for post-breeding terns, and supports high numbers of foraging waterbirds (including Species of Conservation Interest), is remote and screened from the project area. Nor will the 3FM Project promote any additional activities, or increase in existing activities, in this SPA. It is therefore concluded that disturbance impacts due to the 3FM Project during operation will be negligible and not significant at population level.

Disturbance impacts at Poolbeg/GSW Feeding Area

A small intertidal area is exposed at low tides near the ESB/Ringsend outfall. This area was identified in a submission during public consultation as potentially important for feeding waders, in particular for Black-tailed Godwit, but is not within South Dublin Bay and River Tolka Estuary SPA. The intertidal area comes close to the proposed Wharf N, and is partially within the project red line, but is not subject to any 3FM Project proposed development. Whist this area is not being developed as part of the 3FM Project, and will still be accessible, it is likely that its western portion may be unattractive to feeding waterbirds given the proximity and height of Wharf N when constructed.

This area is not a coded Dublin Bay I-WeBS count sub-site but is included in the survey areas for the Dublin Bay Birds Project and holds regular numbers of Black-headed Gulls, and smaller numbers of Sanderling, Black-tailed Godwits and Redshank. Bird counts at the intertidal area and the adjacent Liffey Estuary during October and November 2022 (Section 7.5.2.6) recorded the presence of 26 species. Black-headed, Herring, and Common Gulls were the most frequently recorded species and present in largest numbers. Cormorants were also frequent in the area at numbers of up to 70 individuals. Amongst the waders, Turnstones were regular at the site, reaching a maximum count of 29 individuals.

Although high-counts of Black-tailed Godwit have been recorded at Poolbeg previously, none were observed in the survey at the Poolbeg/GSW feeding area during October and November 2022. However, small groups of 10 to 19 Black-tailed Godwits were recorded during the TTTCC surveys over a 12-month period, although not specifically at this site. They occurred at low tides mainly during the winter months.

It has long been documented that Black-headed Gulls are attracted to sewage works (Vernon 1972) and it is rational to infer that the small area of intertidal habitat at the Poolbeg Outfall is currently attractive to waterbirds, particularly Black-headed Gulls, as a result of the discharge from Ringsend Wastewater Treatment Plant. The wastewater discharge channel is currently in disrepair and sections of channel wall have failed allowing fugitive discharges upstream of the outfall, and sediment accumulation at the channel outfall. This situation will be addressed as part of a separate project by Uisce Éireann to upgrade works at Ringsend to improve the water quality of Dublin Bay. Such works may render the intertidal area at the outfall less attractive as a feeding location for waterbirds.

Survey data does not support the suggestion that the small intertidal area at the Poolbeg/GSW outfall is a significant feeding site for local birds at a population scale, although it is used by some waders. Most species recorded (gulls, ducks, Cormorants, Shags, Razorbils, Gannet, Red-breasted Merganser) were those that use the sub-tidal resource for feeding, loafing or roosting. Only small numbers of waders (Turnstone, Redshank, Oystercatcher, Greenshank, and Dunlin) were recorded, Turnstone being the most frequent and reaching a maximum count of 29.

While it is likely that construction of the proposed Wharf N will cause some displacement of birds from the western end of the feeding area, this will not have any significant impact on bird populations given the generally small numbers availing of the intertidal resource and its limited extent.

Potential Collision with SPAR Bridge

The construction of the proposed new SPAR Bridge poses a theoretical risk of bird strike during operation.

The Vantage Point survey indicates that only Black-headed and Herring gulls used the flyway over the proposed site of the SPAR Bridge regularly. Other species occurred sporadically or in low numbers, less than 10 birds observed in a three-hour watch period in almost all instances. About one third of birds passed at heights above 20m (35%). Only 17% were below 5m and these were mostly Black-headed Gulls.

The proposed new bridge will be a bascule lift bridge and similar in dimensions to the existing Tom Clarke Bridge which has an opening span of 31.5m, and a running surface that is 1.85m above H.A.T. Supporting piers of the new bridge will largely align with those of the existing bridge as will the opening section. The Tom Clarke Bridge opens three times a day on average to allow river traffic to pass. Opening times are restricted and are generally not permitted between 0630 to 1000, and 1500 to 2000. The proposed new bridge will open synchronously with the Tom Clarke Bridge. There is no history of bird strikes at the Tom Clarke Bridge.

Given the generally low profile of the existing and proposed bridges, the low numbers of birds traversing the site, and their passage at altitudes above 20m in general, the likelihood of bird collision with the structure is low and not significant.

7.5.4 Remedial & Mitigation Measures

'*Remedial and Mitigation Measures*' describes measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant negative effects on relevant biodiversity features within the zone of influence of the 3FM Project.

The assessments of potential impact for the 3FM Project Construction Phase (7.5.3.1) and Operational Phase (7.5.3.2 above) concludes that there is a low risk of any significant environmental effects upon breeding and non-breeding avifauna as a result of disturbance and displacement and in the absence of mitigation. Potential impacts are assessed to be slight/temporary to imperceptible without mitigation (Table 7.54). A range of mitigation is proposed where necessary and there is no significant residual environmental impact upon avian features with mitigation in place.

7.5.4.1 Mitigation Measures

The following mitigation measures will be implemented:

1. A programme to monitor winter wetland birds in the European Site at South Dublin Bay and Tolka Estuary SPA shall be undertaken adjacent to the 3FM Project site within the Tolka Estuary (continuation of the DPC sponsored Dubllin Bay Birds Project). This monitoring programme shall continue throughout the construction phase and for a period of two years after the completion of the works, with monthly surveys from October to March. The results of this monitoring programme shall be submitted to the planning authority at 12-monthly intervals to maintain a public record.
2. The programme to monitor winter wetland birds shall include area OUL63 (Figure 7.112) in the Lower Liffey Estuary. This monitoring programme shall continue throughout the construction phase and for a period of two years after the completion of the works, with monthly surveys from October to March. The results of this monitoring programme shall be submitted to the planning authority at 12-monthly intervals to maintain a public record.
3. The 3FM Project Black Guillemot Management Plan (Appendix 7.5.1h)shall be implemented in full.
4. Where known Black Guillemot nesting sites are likely to be unavailable to birds in the following season due to 3FM Project works, they will be blocked in advance over the winter preceding the breeding season to prevent access and nest boxes will be deployed in the immediate vicinity.
5. A programme to monitor Black Guillemots in Dublin Port shall be undertaken. This monitoring programme shall continue throughout the construction phase and for a period of two years after the completion of the works, with monthly surveys during the breeding season from April to May. The results of this monitoring programme shall be submitted to the planning authority at 12-monthly intervals to maintain a public record.

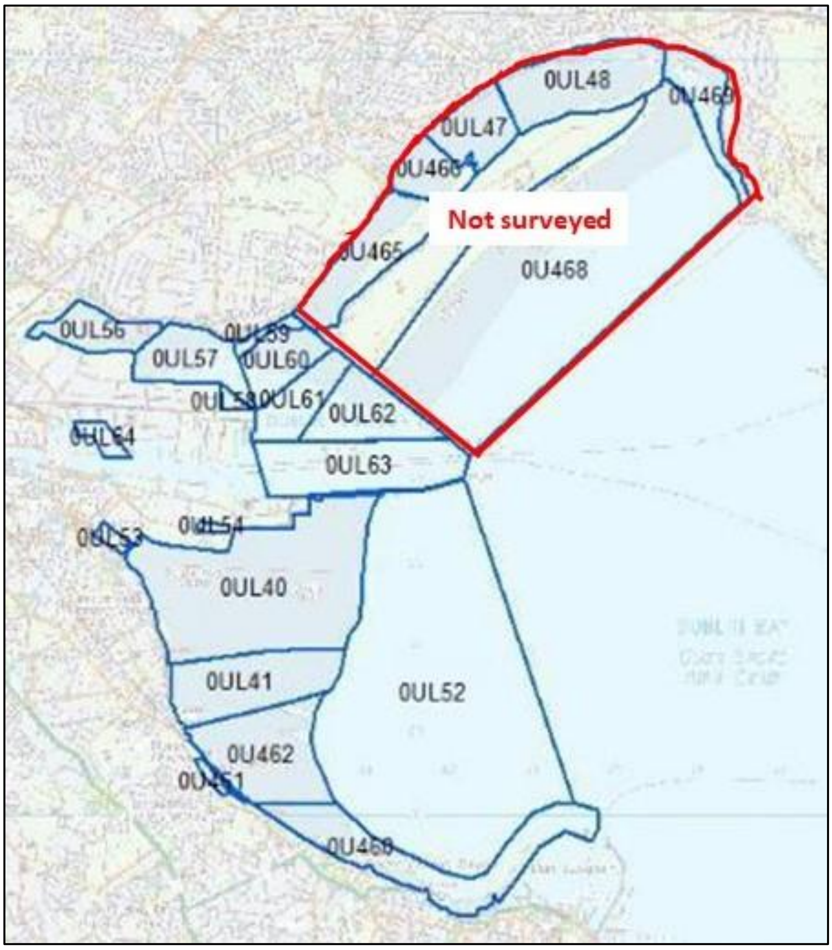

Figure 7.112 Dublin Bay Birds Project survey area showing area OUL63 in the Lower Liffey Estuary

6. A programme to monitor Black Guillemots in Dublin Port shall be undertaken. This monitoring programme shall continue throughout the construction phase and for a period of two years after the completion of the works, with monthly surveys during the breeding season from April to May. The results of this monitoring programme shall be submitted to the planning authority at 12-monthly intervals to maintain a public record.
7. The 3FM Project Tern Colony Management Plan (Appendix 7.5.1i) shall be implemented in full.
8. A programme to monitor the existing Tern colonies and proposed Tern Colony under the 3FM Project shall be undertaken. This monitoring programme shall continue throughout the construction phase and for a period of two years after the completion of the works, with surveys undertaken within the period from April to September, under licence from NPWS. The results of this monitoring programme shall be submitted to the planning authority at 12-monthly intervals to maintain a public record.
9. No pre-construction site clearance or removal of vegetation in terrestrial areas shall take place during the bird breeding season (i.e., 1st March – 31st August). Such works shall be undertaken outside the breeding season (i.e., work should take place during September – February) to ensure no disturbance to terrestrial breeding birds.
10. Planting in the shelterbelt south of Area O should include use of native species that maximise the foraging and nesting opportunities for passerines using the area.
11. No rock breaking shall take place during demolition of the Sludge Jetty within 75m of tern sub-colonies at CDL or ESB Platform during May and June.

12. No piling shall take place within 75m of tern sub-colonies at CDL or ESB Platform during May and June.
13. Capital Dredging for the turning circle shall take place outside the tern breeding season (i.e. 1st April – 30th July).

7.5.4.2 Residual Impacts

Residual Impacts' predicts the residual impact upon relevant biodiversity features within the zone of influence of the 3FM Project, after having taken avoidance, remedial or counterbalancing mitigation measures into account. With the implementation of mitigation proposed above, there are no significant residual impacts predicted on breeding or overwintering birds as a result of the construction and operation of the 3FM Project (Table 7.54).

Table 7.54 Potential impacts on avian features without mitigation and residual impact with proposed mitigation applied

FEATURE CONSTRUCTION PHASE	Potential Impact (no mitigation)	Residual Impact (with mitigation)
Nesting Passerines	Slight temporary	Imperceptible
Sand Martins	Slight temporary	Imperceptible
Waterbirds (Human Disturbance)	Slight temporary	Imperceptible
Waterbirds (Noise Disturbance)	Slight temporary	Imperceptible
Nesting Terns (Human Disturbance)	Slight temporary	Imperceptible
Nesting Terns (Underwater Noise Disturbance)	Imperceptible	Imperceptible
Nesting Terns (Aerial Noise Disturbance)	Slight temporary	Imperceptible
Black Guillemots	Slight temporary	Imperceptible
FEATURE OPERATIONAL PHASE		
Waterbirds Disturbance	Imperceptible	Imperceptible
Impact on Waterbirds using the GSW Feeding Area	Imperceptible	Imperceptible
SPAR Bridge	Imperceptible	Imperceptible

7.5.4.3 Cumulative Impact

Chapter 5 of the EIAR identifies and describes other related projects in proximity to, or whose zone of influence might overlap with the proposed 3FM Project. This section considers the potential for cumulative impacts specifically in relation to avian biodiversity of the proposed 3FM Project in combination with other existing and/or approved projects, and projects which, at the time of assessment, were yet to be approved but for which a decision is likely during the consenting and construction period anticipated for the 3FM Project. It should be noted that cumulative effects of the 3FM Project and other projects on the European sites and their Qualifying Interests are appraised in the Natura Impact Statement submitted with the application for permission.

The projects that could potentially have cumulative impacts on avian biodiversity in conjunction with the 3FM Project have been identified from the long list of projects in Chapter 20 by considering their potential for cumulative effects on avian biodiversity, the location, scale and nature of the projects, the zone of influence of individual projects, and the likelihood of temporal overlap. Pressure sources and pathways were also considered in assessing the potential for cumulative effects in relation to avian biodiversity. The following assessments address the potential cumulative effects in a proportionate manner to ensure that all main sources of potential impact are considered.

Alexandra Basin Redevelopment (ABR) – ABP Reg. Ref. PL29N.PA0034

The proposed ABR development works comprise the following main elements:

- Capital dredging of the navigation channel to -10m CD, from 50m downstream of East Link Bridge to Dublin Bay Buoy over a six year period.
- Refurbishment and construction of quay walls in Alexandra Basin West. This includes installation of Ro-Ro ramps and construction of a Ro-Ro jetty. The basin is to be dredged to -10.0m CD and the contaminated dredged material is to be treated for re-use as infill on site.
- The Bulk Jetty is to be demolished and ore concentrates loading operations are to relocate o Alexandra Quay West Extension.
- Excavation and restoration of Graving Dock No.1 and Infilling of Graving Dock No. 2 with treated dredged material will facilitate development of a Cultural Heritage interpretative space
- Existing Berth 52/53 is to be infilled with treated dredged material, and existing surface levels raised by approximately 1.4m. This includes quay wall construction, mooring jetty construction and installation of Ro-Ro ramp

The ABR Project is currently in late construction stage having been granted permission by An Bord Pleanála (ABP) in July 2015 (ABP Ref. 29N.PA0034). Capital Dredging was completed in 2021. The remaining construction works with potential to impact avian biodiversity are completed, or at an advanced stage and will be completed before the commencement of the 3FM Project. No significant ABR operational impacts are envisaged. Therefore no cumulative impacts are likely.

MP2 Project – ABP Reg. Ref. ABP-304888-19

The MP2 Project was granted planning permission by ABP on 1 July 2020 and must be completed within 15 years of that date. The project is located mainly within the northern lands of Dublin Port, and the project also includes capital dredging works within Dublin Port Harbour.

The works proposed as part of the MP2 Project are summarised as follows:

- Construction of a new Ro-Ro jetty (Berth 53) for ferries up to 240m in length. This requires dredging of a berth pocket and installation of slope stabilisation mattresses, installation of piles for jetty and dolphins, and vertical piles for a wash protection structure.
- A reorientation of the already consented Berth 52 (ABP Ref. 29N.PA0034) and modification to Berth 49. These works include Infilling of the old berth 52 basin, using a rock armour causeway to initially seal the basin, and construction of a new quay wall.
- A lengthening of an existing river berth (50A). This will comprise the construction of a new sheet pile to the west end of Berth 50A, and excavation of Pier Head at the Eastern Breakwater and the south end of the existing Oil Berth 3/4 jetty. Sheet pile combi-walls walls will be installed and the void between existing wall at Oil Berth 3 and the proposed new wall will be filled with engineering fill. Dredging in front of existing Berth 50A will be completed over one month.
- The redevelopment of Oil Berth 3, and infill of Oil berth 4, as a future deep-water container berth for the Container Freight Terminal. This will entail installation of sheet pile combi-walls, dredging of Berth 3 and infilling of Oil Berth 4.
- Channel widening works will comprise dredging over one season (October to March).
- Redevelopment of the ferry terminal yard including consolidation of passenger terminal buildings, demolition of redundant structures and buildings, and removal of connecting roads to increase the area of land for the transit storage of Ro-Ro freight units as a Unified Ferry Terminal (UFT)
- Installation of a heritage zone adjacent to Berth 53 and the Unified Ferry Terminal set down area.

The first capital dredging campaign as part of the MP2 Project took place between October and December 2022. The localised widening of the channel and majority of dredging at Berth 53 was completed. Berth 52 and 53 construction is expected to commence in 2024 and will be completed before the commencement of the 3FM Project. Dredging activity for the 3FM Project has been programmed to ensure that there will be no overlap with either the MP2 Project capital dredging programme or DPC maintenance dredging campaigns. Cumulative impacts on avian biodiversity in conjunction with the 3FM Project are therefore unlikely.

Dublin Harbour Capital Dredging Project – Foreshore Application FS007164/DAS Application S0033-01

DPC is currently seeking permission to undertake capital dredging within Dublin Harbour to deepen areas of the navigation channel and basins that were not dredged by the ABR Project to -10m CD (excluding Alexandra Basin West). The loading of dredged material will be restricted to those areas of the navigation channel, basins and berthing pockets which contain sediments which are suitable for disposal at sea (Class 1: uncontaminated, no biological effects likely).

Capital dredging under the Dublin Harbour Capital Dredging Project has the potential to overlap temporally with the 3FM Project, however DPC will programme these works to ensure they occur over separate winter periods, resulting in no cumulative impacts on avian biodiversity.

Dublin Port Maintenance Dredging Programme 2022–2029 – Foreshore Licence FS007132 / DAS Permit S0004-03

DPC has permission to carry out regular maintenance dredging over an eight-year period, 2022 to 2029. Maintenance dredging is confined to the period April to September with a closed period operating between 01 April to 14 May in the inner Liffey channel upstream of Berth 49 (including the main channel and side berths but not including basins). Maintenance dredging will not overlap with the 3FM Project capital dredging project which will be restricted to winter months (October to March). The loading of dredged material will be restricted to those areas of the navigation channel, basins and berthing pockets which contain sediments which are suitable for disposal at sea (Class 1: uncontaminated, no biological effects likely).

The phased nature of maintenance and capital dredging elements, and their separation into discrete periods will avoid any cumulative impacts on avian biodiversity.

Irish Water – Ringsend WwTP –Upgrade Project BP Ref. PL29S.301798

Irish Water has submitted a planning application for strategic infrastructure development to An Bord Pleanála (Ref. PL29S.301798) seeking permission to further progress the upgrade of the Ringsend Wastewater Treatment Plant (WwTP). The application seeks permission for works required to facilitate the use of Aerobic Granular Sludge (AGS) technology, to omit the previously permitted long sea outfall tunnel and to upgrade the sludge treatment facilities at Ringsend, Dublin 4, and to provide for a Regional Biosolids Storage Facility in Newtown, Dublin 11. The proposed development at Ringsend is on the south bank of the River Liffey. The application was granted permission in April 2019. Construction works will largely be land based and unlikely to have any significant impact on avian biodiversity.

The NIS assessment concluded that the operational phase of the proposed upgrade will result in water quality improvement in Inner Dublin Bay because of a reduction in nutrient load, and that there will be no negative effect on the integrity of any European site as a result. Cumulative impacts on avian biodiversity in conjunction with the 3FM Project are therefore unlikely.

The Howth Yacht Club Marina Extension - DAS Permit Reg. No. S0010-01

Howth Yacht Club (HYC) is proposing to extend the marina at Howth within the confines of the existing breakwater. In the unlikely event that this work was to proceed during the construction phase of the 3FM Project, given the geographic distance between the schemes no cumulative impact on avian biodiversity is expected.

No likely significant effects on avian biodiversity features are predicted as a result of the construction or operation of any of the projects listed in Chapter 20 of the EIAR, and no remedial or mitigation measures are required to reduce the magnitude of the effects predicted in the relevant assessments (where documented) of those other projects.

As there are no likely significant impacts predicted on any avian biodiversity feature as a result of the 3FM Project alone, and no likely significant effects on avian biodiversity features predicted as a result of the construction or operation of any of the projects listed in Chapter 20 of the EIAR, there is no pathway for additional or additive effects resulting in synergistic impacts above a magnitude already predicted in this assessment.

Cumulatively, there will be no cumulative avian biodiversity impacts between the 3FM Project, and the other projects considered in Chapter 20 of the EIAR.

7.5.4.4 Interactions

The assessment of effects of the proposed development on avian biodiversity features has also considered the potential for interactions with other environmental factors. For example, the water quality chapter of the EIAR has predicted the likely significant environmental effects of the 3FM Project on the water environment within the study area. There is also an interaction between water quality and existing and proposed services and utilities to ensure the appropriate collection and treatment of storm water and foul water from the 3FM Project.

The coastal processes chapter of the EIAR has predicted the likely significant environmental effects of the 3FM Project on the wind, wave, tidal and sedimentation regimes within the study area and derived predicted sediment plume and hydromorphological changes within the study area at construction and operational phases.

The airborne and underwater noise chapter of the EIAR has predicted the likely significant environmental effects of the 3FM Project on noise receptors within the study area and predicted noise levels at construction and operational phases.

The waste and land, soils, geology & hydrogeology chapters of the EIAR have predicted the likely significant environmental effects of the 3FM Project on release of contaminated materials into the water column.

Appropriate mitigation measures have been proposed to mitigate the predicted significant environmental effects for each of these environmental factors, as outlined in EIAR chapter 21.

7.5.5 Monitoring

Breeding Terns

A programme to monitor the existing Tern colonies and proposed Tern Colony under the 3FM Project shall be undertaken. This monitoring programme shall continue throughout the construction phase and for a period of two years after the completion of the works, with surveys undertaken within the period from April to September, under licence from NPWS. The results of this monitoring programme shall be submitted to the planning authority at 12-monthly intervals to maintain a public record.

Black Guillemots

A programme to monitor Black Guillemots in Dublin Port shall be undertaken. This monitoring programme shall continue throughout the construction phase and for a period of two years after the completion of the works, with monthly surveys during the breeding season from April to May. The results of this monitoring programme shall be submitted to the planning authority at 12-monthly intervals to maintain a public record.

Overwintering Waterbirds

DPC will also continue to undertake a programme to monitor winter wetland birds in the adjacent European Site at the South Dublin Bay and River Tolka Estuary Special Protection Area. The programme to monitor winter wetland birds shall include monitoring and reporting of area OUL63 in the Lower Liffey Estuary. This monitoring programme will continue throughout the construction phase and for a period of two years after the completion of such works, with monthly surveys from October to March. The results of this monitoring programme will be submitted to Dublin City Council at 12-monthly intervals to maintain a public record.

Sand Martin Colony

A programme to monitor the Sand Martin colony at the mouth of Pigeon House Harbour shall be undertaken. Site visits between April and August will monitor activity to estimate apparently occupied nests. The results of this monitoring programme shall be submitted to the planning authority at 12-monthly intervals to maintain a public record.

7.6 Designated Areas

This section assesses the potential impacts of the 3FM Project on designated areas and any resulting implications for biodiversity features of designated areas in the zone of influence of the 3FM Project. Baseline data in relation to designated areas and relevant environmental information in the Dublin Bay region relevant to the 3FM Project is described. Potential project impacts are identified and their significance assessed, and mitigation measures are presented where relevant.

7.6.1 Receiving Environment

There is a significant aggregation of designated sites in and around Dublin Bay, including European sites (Special Areas of Conservation ("SACs") and Special Protections Areas ("SPAs")), Natural Heritage Areas ("NHAs") and Nature Reserves. It is a coastal wetland complex of considerable nature conservation value in a European and international context and a UNESCO designated biosphere (Dublin Bay Biosphere) extends to over 300 km^2, containing or overlapping with a number of European sites within the Natura 2000 network. Potential effects on European sites are considered in the Habitats Directive appraisals - a Report to Inform Screening for Appropriate Assessment ("RISAA") contains an appraisal of likely significant effects on European sites at the screening stage of appropriate assessment; and a Natura Impact Statement ("NIS") contains an appraisal of implications on European sites for those likely significant effects which could not be excluded at the screening stage. The Habitats Directive appraisals have been submitted under separate cover with the application for development consent for 3FM Project. Potential effects on other designated sites are considered in this section of the EIAR.

The 3FM Project has been assessed for its potential to affect designated sites for which a pathway of effect can be reasonably established between a receptor and the source of effect. The designated sites considered are illustrated in and identified on Figure 7.113 and Figure 7.114, and listed in Table 7.55. They include Ramsar sites, UNESCO Biosphere reserves and proposed NHAs.

The Dublin City Development Plan 2022-2028 identifies a strategic green and blue infrastructure network comprising **Core Areas** (Dublin Bay and the Phoenix Park); **Hubs** (parks and open spaces which buffer the core areas, and are made of the largest, least fragmented continuous natural and semi natural spaces); and **Corridors** (such as the city's rivers and canals and increasingly our streets and public realm which are vital to maintain connectivity of habitats in the landscape and provide for animal movement, seed and pollen dispersal, and plant migration). Irishtown Nature Park is one such 'Hub' identified in Figure 10.1 of Chapter 10 'Green Infrastructure and Recreation' of the Dublin City Development Plan 2022-2028, and zoned as '**Z9**' Amenity/Open Space Lands/Green Network (refer Figure 7.115).

There are no other ecological sites designated at the local administrative area level in Dublin City (such as and for example, there are Nature Development Areas ("NDAs") and Ecological Buffer Zones ("EBZs") identified in the Fingal Development Plan 2023-2029).

The information contained in these figures and tables is based on publicly available data, sourced from NPWS, Dublin City Council, the Ramsar Sites Information Service website and the Dublin Bay Biosphere website in May 2024.

Table 7.55 Designated sites (other than European sites) surrounding 3FM Project

Site Code	Site Name	Features
n/a	**Dublin Bay Biosphere**	In 1981, UNESCO recognised the importance of Dublin Bay by designating North Bull Island as a Biosphere because of its rare and internationally important habitats and species of wildlife. To support sustainable development, UNESCO's concept of a Biosphere has evolved to include not just areas of ecological value but also the areas around them and the communities that live and work within these areas. There have since been additional international and national designations, covering much of Dublin Bay, to ensure the protection of its water quality and biodiversity. To fulfil these broader management aims for the ecosystem, the Biosphere was expanded in 2015. The Biosphere now covers Dublin Bay, reflecting its significant environmental, economic, cultural and tourism importance, and extends to over 300 km². Over 300,000 people live within the newly enlarged Biosphere. Dublin Bay Biosphere contains three different zones, which are managed in different ways: • The **core zone** of Dublin Bay Biosphere comprises 50 km² of areas of high natural value. Key areas include the Tolka and Baldoyle Estuaries, Booterstown Marsh, Howth Head, North Bull Island, Dalkey Island and Ireland's Eye. • The **buffer zone** comprises 82 km² of public and private green spaces such as parks, greenbelts and golf courses, which surround and adjoin the core zones. • The **transition zone** comprises 173 km² and forms the outer part of the Biosphere. It includes residential areas, harbours, ports and industrial and commercial areas.[8]
IE406	**North Bull Island Ramsar site**	The Site covers most of an island within the wider coastal and estuarine waters of Dublin Bay. Salt marshes extend along the length of the landward shore, and a well-developed and dynamic dune system along the seaward shore, where annual vegetation of drift lines is found in places. The island shelters two intertidal lagoons divided by a causeway. The dunes and salt marshes support characteristic plant communities and a number of rare plants which are legally protected. The intertidal habitats feature a rich macrofauna, small areas of eel grass and, in the summer months, green algal mats. The wider estuarine complex provides feeding and roosting habitat for more than 1% of the global population of more than 20 wintering birds, including black-tailed godwit (*Limosa limosa*) and light-bellied brent goose (*Branta bernicla hrota*). The Site also supports notable invertebrates. It is a very popular recreational area and important for educational and research purposes: nature conservation is a main land use within the Site. Much of the land surface of the island outside the Site is taken up by two golf courses. Due to its proximity to the Dublin urban area, the Site is impacted by urban wastewater, extensive tourism and roads.[9]

[8] https://www.dublinbaybiosphere.ie/about/
[9] https://rsis.ramsar.org/ris/406

Site Code	Site Name	Features
IE832	**Sandymount Strand / Tolka Estuary Ramsar site**	The Site in Dublin Bay features extensive intertidal mud and sand flats which extend for almost three kilometres at their widest, and an intertidal biogenic reef and a small section of saltmarsh. The sands support the largest stand of seagrass beds (*Zostera noltii*) on Ireland's east coast. South Dublin Bay is the premier site in Ireland for the Mediterranean gull (*Larus melanocephalus*) and is a regular autumn roosting ground for significant numbers of terns. More than 1% of the global population of light-bellied brent goose, black-tailed godwit and bar-tailed godwit (*Limosa lapponica*) are present in the Site. The proximity of the city of Dublin makes the Site a very popular recreational area, while bait-digging is a regular activity on the sandy flats. It is also important for educational and research purposes. The Site is subject to natural eutrophication and is threatened by the accumulation of organic material. It is also affected by disturbances from roads, land conversions and urban wastewater.[10]
000201	**Dolphins, Dublin Docks pNHA**	Site Synopsis no longer available on the NPWS pNHA Site Synopsis archive[11]. Dolphins, Dublin Docks pNHA comprises two structures comprising colonies of Common, Roseate and Arctic Terns. They are the CDL Dolphin and the ESB Dolphin (replaced in recent years) and both are located near the south bank of the River Liffey. The ESB Dolphin is also contained within South Dublin Bay & River Tolka Estuary SPA.
000206	**North Dublin Bay pNHA**	Site Synopsis no longer available on the NPWS pNHA Site Synopsis archive. North Dublin Bay pNHA overlaps with North Dublin Bay SAC and parts of North Bull Island SPA and South Dublin Bay & River Tolka Estuary SPA. The features of value of North Dublin Bay pNHA are the qualifying interests of North Dublin Bay SAC and North Bull Island SPA.
000210	**South Dublin Bay pNHA**	Site Synopsis no longer available on the NPWS pNHA Site Synopsis archive. South Dublin Bay pNHA overlaps with South Dublin Bay SAC and parts of South Dublin Bay & River Tolka Estuary SPA. The features of value of South Dublin Bay pNHA are the qualifying interests of South Dublin Bay SAC and South Dublin Bay & River Tolka Estuary SPA.
n/a	**Irishtown Nature Park**	With its origins dating back to the 1970s when the site was used as a construction and demolition disposal site, local residents and the then Dublin Corporation took steps to plant out the former landfill site with trees, grasses and wildflower and seeds in the 1980s. The site is now called Irishtown Nature Park, and is zoned in the Dublin City Development Plan 2022-2028 as 'Z9 lands', described in the Plan as "*multi-functional and central to healthy place-making, providing for amenity open space together with a range of ecosystem services. They include all amenity, open space and park lands, which can be divided into three broad categories of green infrastructure as follows: public open space; private open space; and, sports facilities*".

[10] https://rsis.ramsar.org/ris/832
[11] https://www.npws.ie/sites/default/files/general/pNHA_Site_Synopsis_Portfolio.pdf

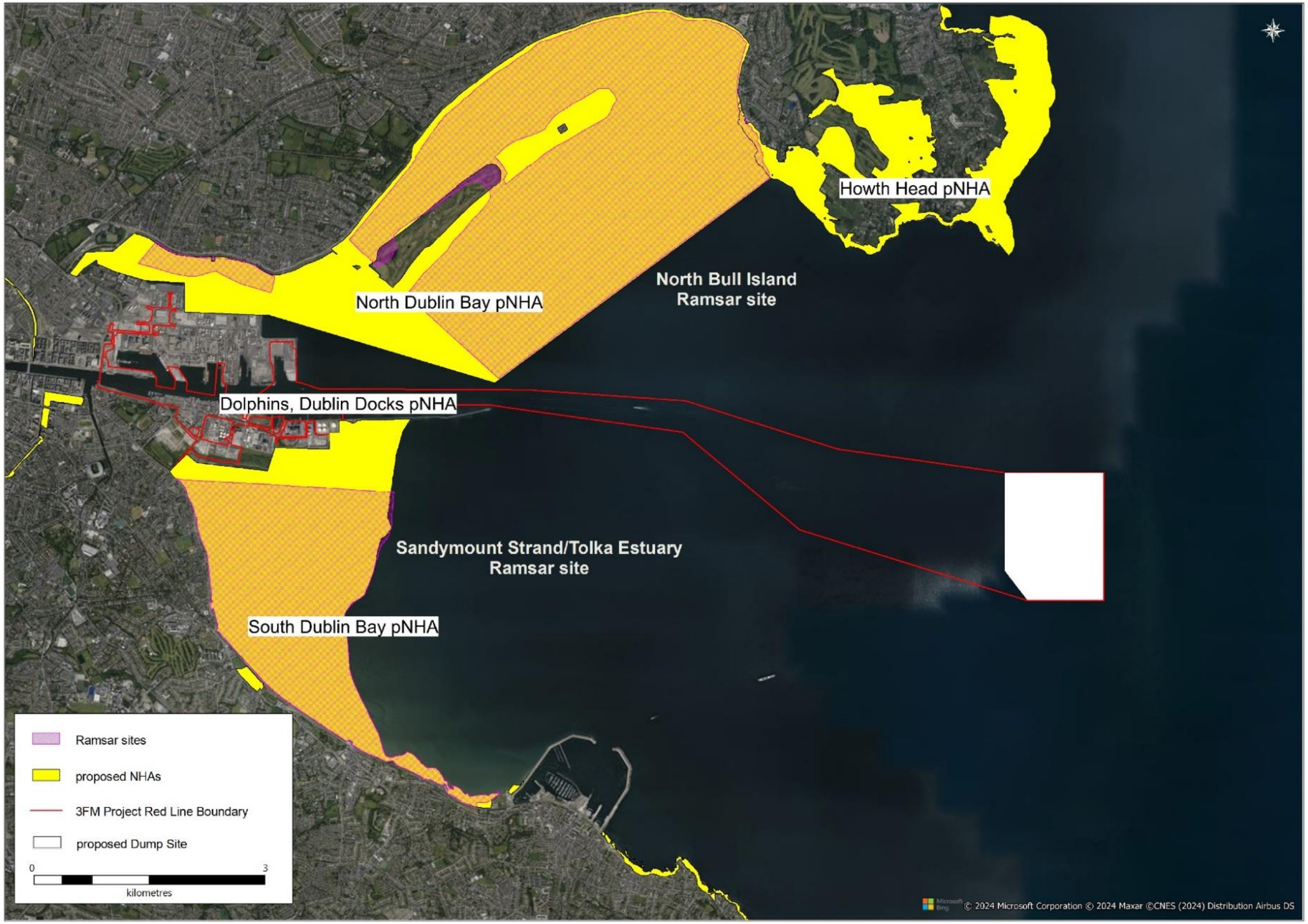

Figure 7.113 Proposed Natural Heritage Areas and Ramsar sites in proximity to 3FM Project

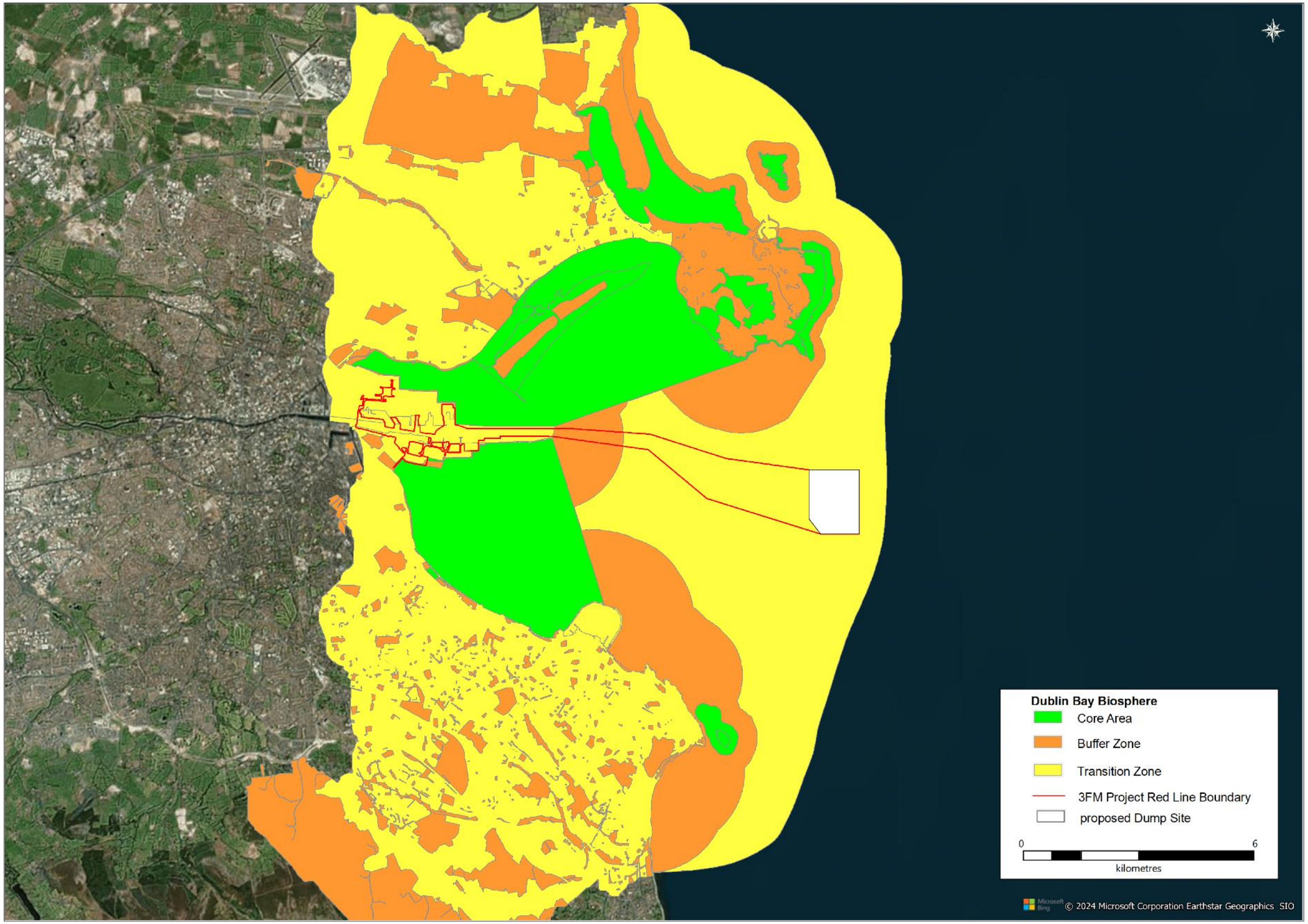

Figure 7.114 UNESCO Dublin Bay Biosphere surrounding 3FM Project

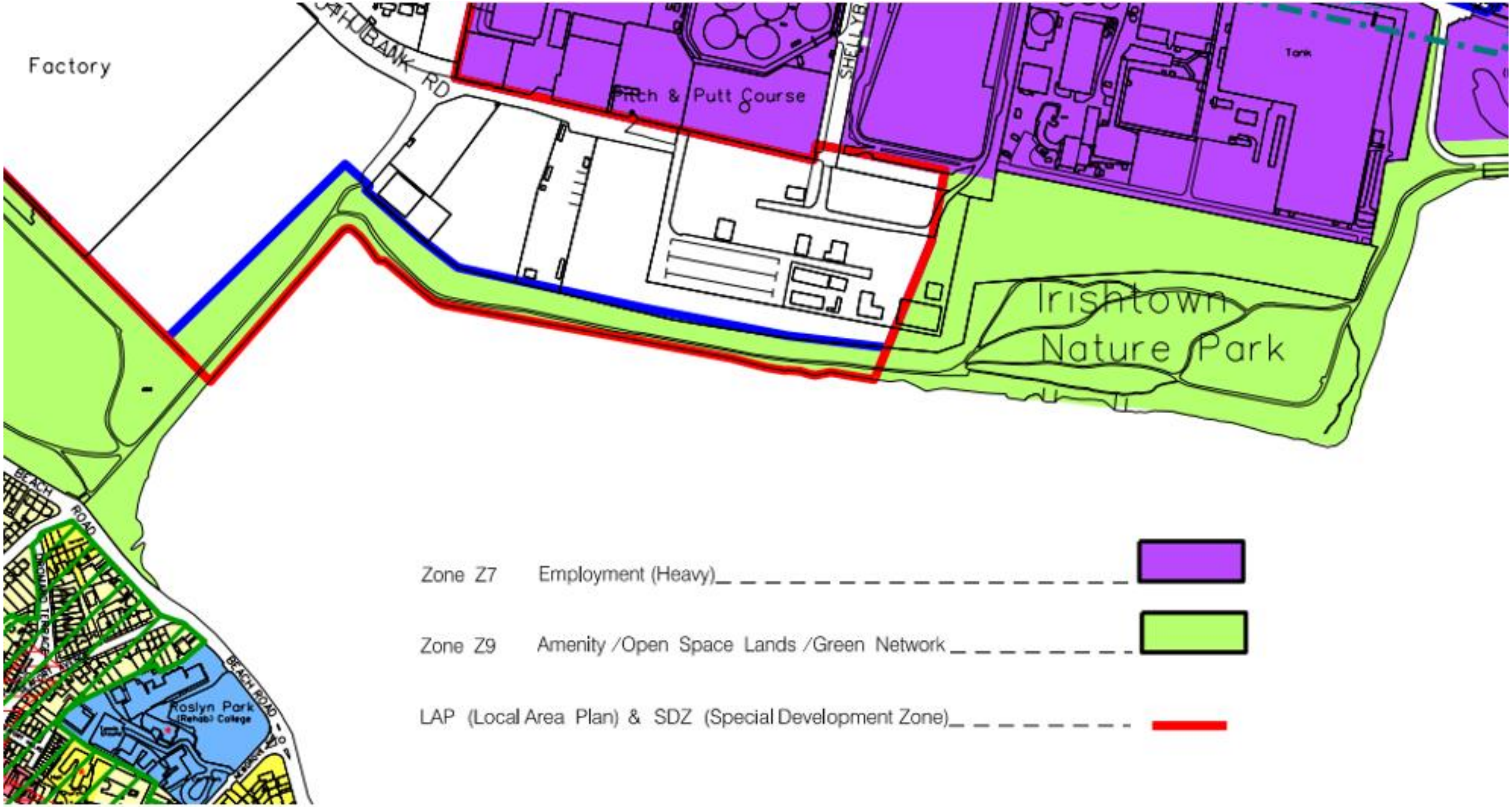

Figure 7.115 Irishtown Nature Park as zoned in the Dublin City Development Plan 2022-2028

The Dublin City Biodiversity Action Plan 2021-2025 (the “DCBAP”) is the third such plan produced by Dublin City Council and follows on from the earlier 2015- 2020 BAP and original 2008-2012 BAP. The DCBAP is based on five themes that focus the outcomes for biodiversity conservation required across the city. Irishtown Nature Park is listed in the DCBAP as one of Dublin City’s public parks that contains legally- protected, rare, and common species including Pyramidal Orchid, Red-tailed Bumblebee, and a rare beetle *Oedemera lurida*. It, along with the coastal edge from Strand Road, past Sean Moore Park and the coastal walking path is also included in the buffer zone of the Dublin Bay Biosphere.

7.6.2 Impact Assessment

In this EIAR, assessment of the 3FM Project comprises an assessment of those pNHAs and Ramsar sites identified above, in addition to the Dublin Bay Biosphere and Irishtown Nature Park. Given the overlap of these identified sites and their features with European sites and their special conservation interests and qualifying interests, the assessment of designated sites in this EIAR is based on the assessment of relevant European sites in the associated Habitats Directive appraisals (however, the conservation objectives of the relevant European sites and the likely significant effects on those objectives arising from the 3FM Project are analysed separately in the AASR and NIS submitted with the application for development consent).

7.6.2.1 Habitat Loss

The footprint of development of 3FM Project is located within one site designated for nature conservation value. Dredging and disposal of dredged material at sea will occur within the buffer zone and transitional zone of marine areas of the Dublin Bay Biosphere. No habitat will be lost from these areas, as the removal and deposition of seabed material at any given area does not cause the habitat to be lost. Seabed levels will be increased or decreased, but the same seabed habitats will remain before, during and after the activities. Temporary effects as a result of suspended sediments and the possibility of accidental pollution are likely to occur, but they are discussed in the following section on water quality and habitat deterioration.

There is no footprint of development within Irishtown Nature Park. 3FM Project includes significant community gain elements including provision of 1.1 ha of land to be transferred to ownership of Dublin City Council to extent Irishtown Nature Park; provision of a new Port Park and Wildflower Meadow (2.5 ha) between Area O and the Poolbeg SDZ lands; and extensive boundary softening works will be undertaken adjacent to the development sites forming part of the 3FM Project to include significant supplementary landscape planting proposed along the vegetated coastal strip of land between Area O and the coastal path between the proposed Port Park and Irishtown Nature Park, referred to as the proposed Coastal Park (1.6 ha). These landscaping proposals are described in Chapter 5 Project Description and in Appendix 5-7 Architectural Design Statement for proposed Port Park by Darmody Architecture and TTT Landscape Architects.

EIAR Chapter 13 describes how indirect effects upon habitats are also possible as a result of hydromorphological impacts associated with the operation of coastal and bankside structures. The installation of marine structures and/or changes in the configuration of the seabed bathymetry through capital dredging works has the potential to impact on coastal processes. The following elements have the potential to impact on coastal processes:

- Installation of SPAR bridge abutments
- Dredging and re-development at Poolbeg marina
- Dredging at Area K
- Removal of the existing caisson pier structure at Area K
- Excavation and reclamation work at Pigeon house road
- Dredging at the Turning circle
- Piling and dredging at Area N

In particular, these elements of work have the potential to impact the following coastal processes during the operational phase of the project:

- Tidal current patterns within Dublin Port and Dublin Bay
- Sedimentation and erosion patterns within Dublin Port and Dublin Bay
- The inshore wave climate within Dublin Port and surrounding area
- The dispersion of thermal plumes generated by various power plants within the Dublin Port area
- Prevailing water levels and the existing flood risk in Dublin Port and the surrounding area

Coastal process modelling supporting the assessment in EIAR Chapter 13 concludes that in the vicinity of the SPAR bridge and the Poolbeg Marina, current speeds may change by ±0.20 m/s which could result in scouring of the seabed around the proposed SPAR bridge foundations during periods of extreme river flow discharge conditions. This area is within the Transition Zone of the Dublin Bay Biosphere. Mitigation is required.

In other areas, predicted changes in current speed reduce rapidly outside the works areas and changes to mid-ebb or mid-flood current speeds are less than ±0.15 m/s within 50 – 150 m of the works. No notable changes to the tidal regime were detected outside of Dublin Port and the tidal regime is predicted to remain substantially unchanged post 3FM Project and no notable changes to the tidal regime were detected outside of Dublin Port.

In relation to inshore wave climate, EIAR Chapter 13 predicts that there are virtually no changes to the wave climate with Dublin Port or beyond during south easterly events. This is because most of the proposed 3FM Project is located on the southern side of the navigation channel which is well sheltered during south easterly events.

Changes in bathymetry due to dredging activities have the potential to alter the energy with which waves break and could conceivably result in wave overtopping of structures and flood defences. However, consideration of changes to the wave climate due to the 3FM Project presented above show no discernible change in relevant proximate areas such as Clontarf, Fairview and Ballybough bordering the Tolka Estuary.

Changes in wave height within the Port beyond the immediate footprint of the 3FM Project works is predicted to be less than ±0.20 m during typical storm conditions. These changes are not considered significant, and the risk of potential coastal flooding due to the 3FM Project in these areas is determined to be negligible. Such effects would not result in a significant environmental effect on any of these designated sites, and in accordance with the methodology outlined, mitigation is not required.

7.6.2.2 Water Quality and Habitat Deterioration

Suspended Sediments and Accidental Pollution

Temporary effects as a result of diminution of water quality have the potential to occur during the construction phase of the works, principally for marine work elements but also for landside elements. Mobilised suspended sediments and cement/hydrocarbon release through construction activities are the principal potential sources of water quality impact. The following have the potential to occur at construction phase:

- Increased suspended sediment levels due to the accidental release of sediment to the water column during:
  - Demolition of buildings & structures;
  - Berth Construction including the construction of waterside berths, quay walls, jetties and open piled structures.
  - Capital Dredging and Sediment disposal operations;
  - Landside ancillary works to serve the marine operations including the construction of ramps and deck structures to access linkspans, services and drainage installation, and installation of jetty furniture and fender systems etc;
  - Road and bridge construction to link the North and South Port Estates.
- Accidental release of highly alkaline contaminants from concrete and cement during the demolition of buildings and structures and the construction of hardstand areas, waterside berths, quay walls, jetties, bridging structures, etc.; and
- General water quality impacts associated with works machinery, infrastructure and on-land operations including the temporary storage of construction materials, oils, fuels and chemicals.

The operational phase impacts associated with the 3FM Project (buildings/structures, roads, berths and associated marine berthing and landside works areas) represents an increase in or intensification of the current normal day to day port activities. These associated impacts are currently well understood and managed within the Port's operational and maintenance procedures. The principal potential sources of water quality effects are:

- Increased suspended sediment levels due to port operations including the ongoing maintenance dredging of the new berths;
- Increased number and size of vessels using Dublin Port;
- General water quality impacts associated with works machinery, infrastructure and on-land operations including the temporary storage of construction materials, oils, fuels and chemicals and releases associated with the operation and maintenance of surface water and foul drainage systems;
- Discharges from dredging vessels at construction stage and vessels using the berths of the operational project (ballast water, wastewater, oil spillages, fuel bunkering); and
- Discharges from cargo handling (leakages from containers, bulk material spillages, losses from conveyor systems).

In the absence of mitigation, temporary negative water quality and marine or wetland habitat deterioration effects could occur in the coastal zones of North Bull Island Ramsar site, Sandymount Strand / Tolka Estuary Ramsar site, Dolphins, Dublin Docks pNHA, North Dublin Bay pNHA and South Dublin Bay pNHA or core areas and buffer areas of the Dublin Bay Biosphere. Such effects would result in a significant environmental effect given the sensitivity of these sites, and in accordance with the methodology outlined, mitigation is required.

Air Quality

In relation to air quality and fugitive dust emissions, the main activities with relevance to air quality and dust impacts are the demolition of Poolbeg Oil Jetty, the Poolbeg Yacht & Boat Club, Marina and Stella Maris Rowing Club, the existing Sludge Jetty, and demolition of a number of other existing structures, partial demolition, or breaking out, of existing concrete and bituminous surfacing, demolition associated with Berth 41, demolition associated with the SPAR, and demolition works to facilitate the construction of the linkspan infrastructure. Dust emissions can lead to elevated PM10 and PM2.5 concentrations and may also cause dust soiling.

The significance of impacts due to vehicle emissions during the construction phase will be dependent on the number of additional vehicle movements, the proportion of HGVs and the proximity of sensitive receptors to site access routes. EIAR Chapter 10 notes that it is not likely that construction traffic would lead to a significant change (> 10%) in Average Annual Daily Traffic (AADT) flows near to sensitive receptors. Construction traffic will arrive and depart the port via the national road network (M1, East Wall Road, etc.). All HGV movements will be in compliance with the Dublin City Council HGV Management Strategy. Within the North Port Estate, traffic will be routed through the existing road network to reach the 3FM Project application boundary. Traffic within the proposed site will be diverted in a phased manner to ensure the existing facilities at Terminal 1 and Terminal 2 remain operational with minimal impact.

An indicative Construction Programme for the 3FM Project has been used to determine the anticipated construction traffic on the road network. The peak HGV traffic volume will occur Q3 2030. There will be an average daily traffic over this period of 57 HGV movements per day, based on a 5-day working week. The peak week within the proposed construction stage will be Q4 2030 where on average there will be 81 HGV movements per day. This would incorporate a peak of 17 HGV movements each way per hour between 7am and 8 am. Both the DMRB and the NRA Guidelines state that air quality impacts from changes in road traffic volumes may be significant and should be assessed where the traffic volumes show an increase or decrease in traffic emissions of 5-10% or more. The traffic analysis indicates that current traffic volumes on the East Wall Road are 15,622 AADT and hence the 81 traffic movements equates to circa 1% of the East Wall Road volumes. EIAR Chapter 10 notes that in employing the DMRB/TII criteria, construction traffic volumes will not be significant and the resultant air quality impact from construction traffic is negligible.

In relation to operational phase vehicle emissions Chapter 10 of the EIAR notes that the impact of the proposed development was assessed relative to “Do Nothing” levels, and that the impact of the proposed development leads to an increase in NOX concentrations of at most 0.58μg/m^3 within the South Dublin Bay SAC and by 0.39μg/m^3 within the North Dublin Bay SAC. Appendix 9 of the TII guidelines state that where the scheme or development is expected to cause an increase of more than 2μg/m^3 and the predicted concentrations (including background) are close to, or exceed the standard, then the sensitivity of the habitat to NOX should be assessed by the project ecologist. Concentrations are not predicted to increase by 2μg/m^3 or more and the predicted concentrations are well below the standard.

The contribution to the NO_2 dry deposition rate along a 200m transect is detailed in EIAR Appendix 10.2. The maximum increase predicted in NO_2 dry deposition rates is 0.032 Kg(N)/ha/yr. The maximum increase in the NO_2 dry deposition rate within the Dublin Bay Biosphere, North Bull Island Ramsar site, Sandymount Strand / Tolka Estuary Ramsar site, Dolphins, Dublin Docks pNHA, North Dublin Bay pNHA and South Dublin Bay pNHA is 0.021 Kg(N)/ha/yr. In both cases this reaches only 0.1% of the critical load for marine habitats of 30-40 Kg(N)/ha/yr.

Such effects would not result in a significant environmental effect on any of these designated sites, and in accordance with the methodology outlined, mitigation is not required.

7.6.2.3 Noise and Disturbance

The above sites designated for nature conservation value surrounding the 3FM Project are designated on the basis of the presence of a wide range of natural habitats but also the presence of species:

- Dolphins, Dublin Docks pNHA is designated for its breeding Common and Arctic tern colonies.
- North Dublin Bay pNHA and North Bull Island Ramsar site are designated *inter alia* for their embryonic and stabilised sand dune systems, saltmarsh, shingle beach and wetland habitats but also for their overwintering water bird assemblages.
- Sandymount Strand / Tolka Estuary Ramsar site and South Dublin Bay pNHA are designated *inter alia* for their embryonic sand dune systems, shingle beach and wetland habitats but also their overwintering water bird assemblages and tern roosting functions.
- Dublin Bay Biosphere contains coastal areas used by overwintering and resident waterbirds and marine areas used by breeding seabirds and populations of marine mammals.

Avifauna

The assessment of avian biodiversity in the previous section points out that sources of potential disturbance impacts during construction phase are:

- The impact of construction activities on Poolbeg peninsula on nesting passerines;
- Construction impacts on waterbirds using the coastal environment around Poolbeg peninsula; and
- Impacts on nesting terns and nesting Black Guillemots from construction of marine elements of 3FM Project along the waterfont of the lower Liffey channel.

The main impacts identified at operational phase are increased disturbance of waterbirds from operational port activities associated with 3FM Project in and around the Great South Wall and at the Dolphins, Dublin Docks pNHA breeding platforms and potential collision risks of waterbirds with the SPAR bridge.

In the absence of mitigation, negative disturbance effects on the breeding passerines of Irishtown Nature Park and adjacent terrestrial habitats could occur at construction phase. Negative disturbance effects on the breeding tern colonies of Dolphins, Dublin Docks pNHA could occur at construction and operational phase, in the absence of mitigation. Negative disturbance effects on the resident and overwintering waterbird populations of South Dublin Bay pNHA and Sandymount Strand / Tolka Estuary Ramsar site could occur at construction and operational phase, in the absence of mitigation. Similarly, negative disturbance effects on the resident and overwintering waterbird populations of North Dublin Bay pNHA and North Bull Island Ramsar site could also occur at construction and operational phase, in the absence of mitigation, as the waterbirds of these protected sites north and south of Dublin Port both use the same wetland areas around the Poolbeg peninsula.

Such effects would result in a significant environmental effect given the sensitivity of these sites, and in accordance with the methodology outlined, mitigation is required.

The assessment on avifauna above notes that in relation to collision risks of waterbirds with the SPAR bridge, the Vantage Point survey indicates that only Black-headed and Herring gulls used the flyway over the proposed site of the SPAR Bridge regularly. The proposed new bridge will be a bascule lift bridge and similar in dimensions to the existing Tom Clarke Bridge which has an opening span of 31.5m, and a running surface that is 1.85m above H.A.T. Supporting piers of the new bridge will largely align with those of the existing bridge as will the opening section. The Tom Clarke Bridge opens three times a day on average to allow river traffic to pass. Opening times are restricted and are generally not permitted between 0630 to 1000, and 1500 to 2000. The proposed new bridge will open synchronously with the Tom Clarke Bridge. There is no history of bird strikes at the Tom Clarke Bridge. Given the generally low profile of the existing and proposed bridges, the low numbers of birds traversing the site, and their passage at altitudes above 20m in general, the likelihood of bird collision with the structure is low and not significant. Such low risks would not result in a significant environmental effect on any of these designated sites, and in accordance with the methodology outlined, mitigation is not required.

Marine Mammals

The assessment of marine mammals in the previous section points out that Dublin Bay and marine areas of the Dublin Bay Biosphere are an important site for marine mammals. Harbour porpoise, grey and harbour (common) seals occur all year round within this area, and bottlenose dolphin, common dolphin, and minke whale occur regularly, while humpback whales and Risso's dolphins are occasionally recorded adjacent to Dublin Bay.

The assessment of marine mammals notes that sources of potential injury or disturbance impacts during construction phase are likely to be due primarily to underwater noise generated from piling and dredging operations, with increased vessel noise post-project completion during the operational phase being the principal source of potential effect. Other pressures with potential for impact include generation of sediment plumes, elevated turbidity and release of pollutants, and their associated indirect effect pathways on prey species, is captured above under 'Water Quality and Habitat Deterioration'.

Noise disturbance during activities such as piling, demolition, dredging and dumping could, in the absence of mitigation, potentially lead to disturbance and displacement of marine mammals, with the main effects that could potentially occur being:

- Physical (Non-auditory)
    - Damage to body tissue (e.g., tissue rupture, internal haemorrhage)
    - Induction of gas embolism or decompression sickness
- Physical (Auditory)
    - Gross damage to ears

  - Permanent threshold shift (PTS) in hearing
  - Temporary threshold shift (TTS) in hearing
- Perceptual
  - Masking of communication with conspecifics
  - Masking of other biologically important sounds
  - Interference with the ability to acoustically interpret the environment
  - Adaptive shifting of vocalisations (with efficiency and energetic effects)
- Behavioural
  - Gross interruption of normal behaviour (i.e., temporarily changed)
  - Behaviour modified (i.e., behaviour becomes less effective/efficient)
  - Displacement from an area (short or long-term)
  - Disruption of social bonds, including mother-young associations
- Chronic/Stress
  - Decreased viability of an individual
  - Increased vulnerability to disease
  - Increased potential for impacts from negative cumulative effects
  - Sensitisation to sound (or other stresses) – exacerbating other effects
  - Habituation to sound – causing animals to remain within damage range

Modelling supporting the assessment of marine mammals has indicated that while there is large variation in modelled risk ranges, the TTS risk range for harbour porpoise during short duration impact piling activities (single blow) is typically 1,400 m to 2,000 m. For seals the TTS risk range is reduced and extends from 140 m to 300 m from the source. In the case of short duration sheet piling, the TTS risk range for seals was less than 20 m, and for harbour porpoise less than 180 m.

In the case of long duration impact piling activity (one hour or equivalent to 1,200 blows), modelling indicates that the TTS risk range for seals and harbour porpoise extends throughout the harbour area inside the bull walls. In the case of long duration sheet piling seals have a modelled TTS risk range of 2,200 m to 2,400 m, while the TTS risk range for porpoise extends throughout the Port area but remaining inside marine area bound by the North Bull Wall and Great South Wall.

In the case of PTS, the risk range due to single impact piling blows for seals was generally around 30 m, and 250 m to 500 m for harbour porpoise. For other short duration piling noises, the PTS risk range was below 5 m for all marine mammals. For long duration impact piling activities, the PTS risk range for seals was 1,200 m to 1,600 m, and for harbour porpoise the range extends throughout the inner harbour area, while long duration sheet piling had a modelled PTS risk range of < 250 m for seals, and < 1,200 m for harbour porpoise.

In the absence of mitigation, negative disturbance or injury effects on the cetaceans and pinnipeds of the Dublin Bay Biosphere could occur at construction phase. Such effects would result in a significant environmental effect given the hearing sensitivity of these marine mammals, and in accordance with the methodology outlined, mitigation is required.

7.6.3 Remedial and Mitigation Measures

Mitigation measures to reduce suspended solids and avoid pollution at construction stage and operational stage derive from Chapter 9 of the EIAR and are set out in Table 21.1 of Chapter 21 '*Summary of Mitigation Measures and Conclusions'* of the EIAR.

Mitigation measures to avoid injury to and disturbance of individuals of marine mammals at construction stage derive from Section 7.4 of this chapter and are set out in Table 21.1 of Chapter 21.

Mitigation measures to avoid passerine, breeding seabird and waterbird disturbance at construction stage and operational stage derive from Section 7.5 of this chapter and are also set out in Table 21.1 of Chapter 21.

7.6.4 Residual Impacts

No further or additional likely significant effects were predicted upon the Irishtown Nature Park, any proposed NHA site, Ramsar site or the Dublin Bay Biosphere.

With the application of the prescribed mitigation measures, there is no significant residual impacts predicted upon any designated site as a result of the construction and operation of 3FM Project.