3FMProject

Bringing
Dublin Port
To 2040

Natura Impact Statement (NIS)

COMHLACHT CHALAFORT
ÁTHA CLIATH
DUBLIN PORT COMPANY

rps
A TETRA TECH COMPANY

Third & Final
Masterplan
Project

NATURA IMPACT STATEMENT

3FM Project, Dublin Port

3FM Project, Dublin Port
NIS
Rev F
July 2024

www.rpsgroup.com

The report has been prepared for the exclusive use and benefit of our client and solely for the purpose for which it is provided. Unless otherwise agreed in writing by R P S Group Limited, any of its subsidiaries, or a related entity (collectively 'RPS') no part of this report should be reproduced, distributed or communicated to any third party. RPS does not accept any liability if this report is used for an alternative purpose from which it is intended, nor to any third party in respect of this report. The report does not account for any changes relating to the subject matter of the report, or any legislative or regulatory changes that have occurred since the report was produced and that may affect the report.

The report has been prepared using the information provided to RPS by its client, or others on behalf of its client. To the fullest extent permitted by law, RPS shall not be liable for any loss or damage suffered by the client arising from fraud, misrepresentation, withholding of information material relevant to the report or required by RPS, or other default relating to such information, whether on the client's part or that of the other information sources, unless such fraud, misrepresentation, withholding or such other default is evident to RPS without further enquiry. It is expressly stated that no independent verification of any documents or information supplied by the client or others on behalf of the client has been made. The report shall be used for general information only.

Contents

Figures

Tables

1 INTRODUCTION

With the introduction of the Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitat and of wild fauna and flora) came the obligation on Member States to establish the Natura 2000 network of Sites of Community Interest (SCIs), comprising a network of areas of highest biodiversity importance for rare and threatened habitats and species across the European Union (EU).

The Natura 2000 network of sites comprises Special Areas of Conservation (SACs, including candidate SACs) and Special Protection Areas (SPAs, including candidate SPAs) classified under the Birds Directive (Council Directive 2009/147/EC on the conservation of wild birds) both designated under domestic legislation transposing the obligations under Directive 92/43/EEC into Irish law.

SACs are designated for the conservation of Annex I habitats (including priority types which are in danger of disappearance) and Annex II species (other than birds). SPAs are designated for the conservation of Annex I birds and other regularly occurring migratory birds and their habitats. The annexed habitats and species for which each site is designated correspond to the qualifying interests of the sites; and from these the conservation objectives of the site are derived.

SACs and SPAs make up the pan-European network of Natura 2000 sites. 'European sites' are defined in section 177R of the Planning and Development Act 2000, as amended (PDA 2000), and regulation 2(1) of the European Communities (Birds and Natural Habitats) Regulations 2011, as amended (2011 Regulations), as follows:

> *"(a) a candidate site of Community importance,*
>
> *(b) a site of Community importance,*
>
> *(ba) a candidate special area of conservation,*
>
> *(c) a special area of conservation,*
>
> *(d) a candidate special protection area,*
>
> *(e) a special protection area;*

1.1 Appropriate Assessment

1.1.1 The Habitats Directive

A key protection mechanism in the Habitats Directive is the requirement to subject plans and projects to Appropriate Assessment (AA) in line with the requirements of Article 6(3), which states that–

> *Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and if appropriate, after having obtained the opinion of the general public.*

Thus, Article 6(3) defines a two-step procedure for considering plans and projects:

- The first part of this procedure consists of a preliminary 'screening' stage to determine whether, firstly, the plan or project is directly connected with or necessary to the management of the site, and secondly, whether it is likely to have a significant effect on the site; it is governed by the first sentence of Article 6(3).
- The second part of the procedure, governed by the second sentence of Article 6(3), relates to the appropriate assessment and the decision of the competent national authorities.

1.1.2 Transposition into Irish Law

1.1.2.1 Screening

In relation to applications for permission under PDA 2000, section 177U of the 2000 Act requires, *inter alia*, that a screening for appropriate assessment of an application for consent for proposed development shall be carried out by the competent authority to assess, in view of best scientific knowledge, if that proposed development, individually or in combination with another plan or project is likely to have a significant effect on a European site.

While the provisions of section 177U adopt the terminology used in Article 6(3) of the Habitats Directive in terms of the test for screening, section 177U expands on this, in light if the interpretation given in decisions of the Court of Justice of the European Union. Thus, section 177U give effect to the requirement to screen an application for development consent for appropriate assessment by assessing whether the proposed development is likely to have a significant effect on a European site by considering whether such a significant effect can or cannot be excluded.

Regulation 42 of the 2011 Regulations requires *inter alia* that screening for appropriate assessment of a project for which an application for consent is received, and which is not directly connected with or necessary to the management of the site as a European Site, shall be carried out by the public authority to assess, in view of best scientific knowledge and in view of the conservation objectives of the site, if that project, individually or in combination with other plans or projects is likely to have a significant effect on the European site.

1.1.2.2 Appropriate Assessment

Again, in respect of applications for permission under PDA 2000, section 177V of that Act requires, *inter alia*, that an appropriate assessment carried out by the competent authority shall include a determination under Article 6(3) of the Habitats Directive as to whether or not a proposed development would adversely affect the integrity of a European site and an appropriate assessment shall be carried out by the competent authority where it has made a screening determination that an appropriate assessment is required, before consent is given for the proposed development.

Regulation 42 of the 2011 Regulations requires *inter alia* that a public authority shall determine that an appropriate assessment of a project is required where the project is not directly connected with or necessary to the management of the site as a European Site and if it cannot be excluded, on the basis of objective scientific information following screening that the project, individually or in combination with other plans or projects, will have a significant effect on a European site.

1.1.3 The Appropriate Assessment Process

According to European Commission Notice C(2021) 6913 'Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC' (EC, 2021) Appropriate Assessment a step-wise procedure as illustrated in **Figure 1.1**.

As referenced above, the first part of this procedure consists of a pre-assessment stage ('screening') to determine whether, firstly, a plan or project is directly connected with or necessary to the management of the site, and secondly, whether it is likely to have a significant effect on the site.

The second part of the procedure relates to the appropriate assessment itself and the decision of the competent authority or authorities.

A third part of the procedure under Article 6(4), arises only in circumstances where, notwithstanding a negative assessment under Article 6(3), it is proposed to grant approval for a plan or project for imperative reasons of overriding public interest (IROPI). This part of the appropriate assessment process does not arise in the respect of the 3FM Project.

1.2 Objective of the Document

The purpose of this Natura Impact Statement (NIS), which contains a Stage 2 Habitats Directive appraisal, is to assist the competent authorities carry out an appropriate assessment of the implications of the Dublin Port Company 3FM Project on European sites in view of their conservation objectives.

1.3 Document Structure

1.3.1 Methodology and Guidance

Section 2 of this Statement, sets out the methodology followed and guidance documents used in conducting a screening appraisal of the implications of the proposed development on European sites.

1.3.2 Proposed Development

Section 3 of this Statement describes and illustrates the proposed development and activities to be undertaken.

1.3.3 Stage 2 Appraisal for Appropriate Assessment

Section 4 of this Statement contains further examination and analysis of the implications of the proposed development on the Conservation Objectives of those European sites where the possibility of Likely Significant Effects (LSEs) could not be excluded at the screening stage, alone and in combination, in the absence of further evaluation and analysis.

As part of appropriate assessment, and thus at a Stage 2 appraisal, it is permissible to take into account mitigation measures proposed to avoid adverse effects of the proposed development. As such, this Statement prescribes the mitigation measures necessary to ensure that the 3FM Project will not have any adverse effect on the integrity of any European site.

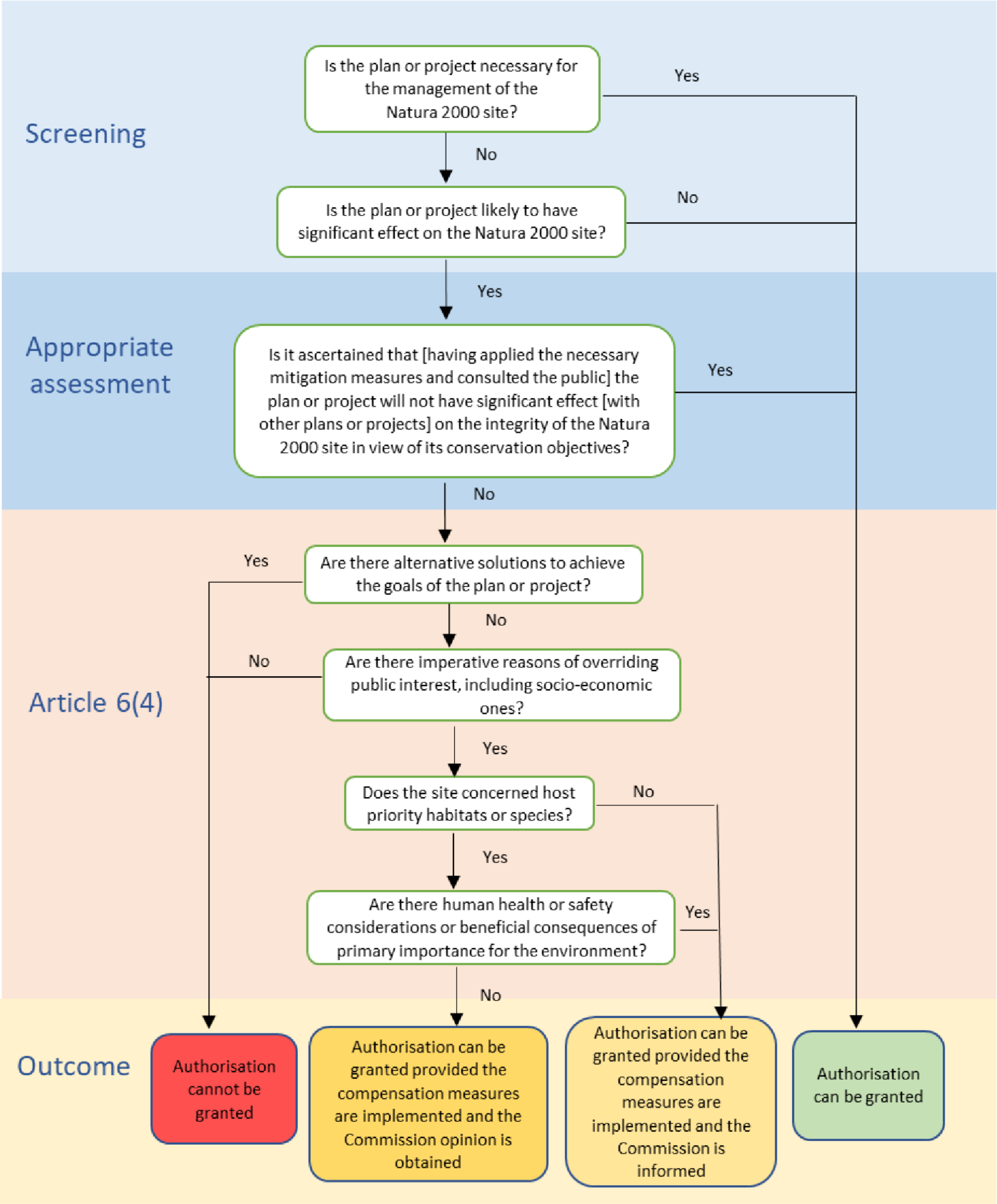


Figure 1.1: Step-wise procedure of Appropriate Assessment (from EC, 2021)

2 METHODOLOGY

2.1 Published guidance on Appropriate Assessment

Guidelines on appropriate assessment for Planning Authorities have been published by the Department of the Environment Heritage and Local Government (DEHLG, 2010) and by the Office of the Planning Regulator (OPR, 2021). In addition to the advice available from the Department and the Planning Regulator, the European Commission has published a number of documents which provide a significant body of guidance on the requirements of Appropriate Assessment, most notably including Commission Notice C(2021) 6913 'Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC' (EC, 2021), which sets out the principles of how to approach decision making during the appropriate assessment process. These principal national and European guidelines have been followed in the preparation this report. The following list identifies these and other pertinent guidance documents which has guided the preparation of this appraisal:

- Communication from the Commission on the Precautionary Principle., Office for Official Publications of the European Communities, Luxembourg (EC, 2000);
- Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Articles 6(3) and (4) of the Habitats Directive 92/43/EEC. Office for Official Publications of the European Communities, Brussels (EC, 2001);
- Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission; (EC, 2007);
- Estuaries and Coastal Zones within the Context of the Birds and Habitats Directives – Technical Supporting Document on their Dual Roles as Natura 2000 Sites and as Waterways and Locations for Ports. European Commission (EC, 2009);
- Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government, Dublin (DEHLG, 2010);
- Guidance document on the implementation of the birds and habitats directive in estuaries and coastal zones with particular attention to port development and dredging. European Commission (EC, 2011a);
- European Commission Staff Working Document 'Integrating biodiversity and nature protection into port development' (EC, 2011b);
- Marine Natura Impact Statements in Irish Special Areas of Conservation: A working document, National Parks and Wildlife Service, Dublin (NPWS, 2012);
- Interpretation Manual of European Union Habitats. Version EUR 28. European Commission (EC, 2013);
- European Commission Notice "Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC", Office for Official Publications of the European Communities, Luxembourg (EC, 2019);

- Institute of Air Quality Management 'A guide to the assessment of air quality impacts on designated nature conservation sites' (version 1.1). Institute of Air Quality Management, London (IAQM, 2020);
- Office of the Planning Regulator Practice Note (PN01) 'Appropriate Assessment Screening for Development Management' (OPR, 2021);
- European Commission Notice C(2021) 6913 'Assessment of plans and projects in relation to Natura 2000 sites – Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC', Office for Official Publications of the European Communities, Luxembourg (EC,2021); and
- European Commission Guidance document on Assessment of plans and projects in relation to Natura 2000 sites – A summary (EC, 2022).

2.2 Adverse Effects on the Integrity of European sites

The European Commission's 2018 Notice (EC, 2019) states that the purpose of the appropriate assessment is to assess the implications of the plan or project in respect of the site's Conservation Objectives ("COs"), either individually or in combination with other plans or projects. The conclusions should enable the competent authorities to ascertain whether the plan or project will adversely affect the integrity of the site concerned. The focus of the appropriate assessment is therefore specifically on the species and/or the habitats for which the European site is designated.

The 2021 Commission Notice notes the difference between the tests for screening (stage 1) and appropriate assessment (stage 2), summarised in **Table 2.1** below.

Table 2.1: Differences between Screening and Appropriate Assessment

Screening	Appropriate Assessment
Ascertains whether significant negative effects on a European site are likely as a result of implementing the plan or project in view of the site's conservation objectives.	Assesses the likely effects on the Natura 2000 site in view of its conservation objectives and assesses whether adverse effects on the integrity of the site will or might occur.
If the occurrence of significant effects cannot be excluded with certainty, the plan or project has to undergo an appropriate assessment.	The plan or project can be authorised only if adverse effects on the integrity of the Natura 2000 site can be excluded.
Typically based on existing data, available knowledge and experience, and expert opinion.	Requires a detailed examination, often field surveys, expert advice, and an expert assessment of the specific case.
Mitigation measures **cannot** be considered.	Assesses mitigation measures to eliminate or reduce adverse effects.

The Commission's 2018 Notice also emphasises the importance of using the best scientific knowledge when carrying out the appropriate assessment in order to enable the competent authorities to conclude with certainty that there will be no adverse effects on the integrity of the site. This guidance notes that it is at the time of adoption of the decision authorising implementation of the project that there must be no reasonable scientific doubt remaining as to the absence of adverse effects on the integrity of the site in question.

The 2018 Notice notes that if the competent authority considers the mitigation measures are sufficient to avoid the adverse effects on site integrity identified in the appropriate assessment, they will become an integral part of the specification of the final plan or project or may be listed as a condition for project approval.

The 2021 Notice advises that it is for the competent authorities, in the light of the conclusions made in the appropriate assessment on the implications of a plan or project for the European site concerned, to approve the plan or project. This decision can only be taken after they have made certain that the plan or project will not adversely affect the integrity of the site. That is the case where no reasonable scientific doubt remains as to the absence of such effects.

The 2021 Notice also reaffirms that the authorisation criterion laid down in the second sentence of Article 6(3) of the Habitats Directive integrates the precautionary principle and makes it possible effectively to prevent the protected sites from suffering adverse effects on their integrity as the result of the plans or projects. A less stringent authorisation criterion could not as effectively ensure the fulfilment of the objective of site protection intended under that provision. The onus is therefore on demonstrating the absence of adverse effects rather than their presence, reflecting the precautionary principle. It follows that the appropriate assessment must be sufficiently detailed and reasoned to demonstrate the absence of adverse effects, in light of the best scientific knowledge in the field.

The **'integrity of the site'** can be usefully defined as the coherent sum of the site's ecological structure, function and ecological processes, across its whole area, which enables it to sustain the habitats, complex of habitats and/or populations of species for which the site is designated (EC, 2019).

2.3 Consideration of Ex-situ Effects

The 2018 Notice advises that Member States, both in their legislation and in their practice, allow for the Article 6(3) safeguards to be applied to any development pressures - including those which are external to European sites but which are likely to have significant effects on any of them.

In that regard, consideration has been given in this NIS to implications for habitats and species located outside of the European sites considered in the appraisal with reference to those sites' conservation objectives where effects upon those habitats and/or species are liable to affect the conservation objectives of the sites concerned.

2.4 Conservation Objectives

The conservation objectives for each European site are to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the site has been selected. The favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing;
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and
- the conservation status of its typical species is favourable.

The favourable conservation status (or condition, at a site level) of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats;
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

The Commission's 2022 Guidance advises that an assessment should be completed for all of the designating features (species, habitat types) that are significantly present on the site (habitats and species with A, B or C, but not D, site assessment in the Standard Data Form for the site) in view of their conservation objectives. EC (2022) additionally notes that "*the lack of site-specific conservation objectives or the establishment of conservation objectives, which are not in line with the required standard, as specified in the Commission note on "Setting conservation objectives of Natura 2000 sites" (EC, 2012), jeopardises compliance with the requirements of Article 6(3)*".

2.4.1 Site-Specific Conservation Objectives

NPWS began preparing detailed Site-Specific Conservation Objectives (SSCOs) for European sites in Ireland in 2011. The European sites within Dublin Bay in closest proximity to the proposed development which are considered in some detail in this report have all had SSCOs set. The published SSCO documents used in the appraisal are identified in Section 4.1 of this document.

The published SSCO documents note that an appropriate assessment based on the most up-to-date conservation objectives will remain valid even if the targets are subsequently updated, providing they were the most recent objectives available when the assessment was carried out. It is essential that the date and version are included when objectives are cited.

The most up-to-date Conservation Objectives for the European sites being considered, and details in relation to the Qualifying Interests and Special Conservation Interests of these European sites is based on publicly available data on these European Sites, sourced from the NPWS website in July 2024.

All European sites considered in this appraisal have published SSCOs, including the recently advertised North-West Irish Sea candidate SPA (cSPA) (site code IE004236), which was notified to the public by the Department of Housing, Local Government and Heritage in July 2023 following selection by the Minister under the 2011 Regulations, as a site to be considered for consideration for classification as a SPA. A further notification then followed in December 2023, commencing a period during which observations and objections to the proposed designation, on scientific/ornithological grounds, may be submitted by interested parties. This notification publicised a closing date for observations or objections to the classification of the site as an SPA in February 2024. As at 5 July 2024, it is understood that the site remains classified as a candidate SPA. However, as set out above, in the context of Irish law, the definition of "European site" includes a candidate SPA and, accordingly, the Article 6(3) assessments should include the North-West Irish Sea candidate cSPA.

NPWS published detailed Site-Specific Conservation Objectives for the North-West Irish Sea cSPA in September 2023. Details of the site, including a Natura 2000 Standard Data Form, will be transmitted to the European Commission when the applicable statutory processes have been completed, which has not occurred as at 5 July 2024.

2.4.2 In-combination Effects

Article 6(3) of the Habitats Directive requires that in-combination effects with other plans or projects are also considered. As set out in the Commission's 2018 Notice (EC, 2019), significance will vary depending on factors such as magnitude of impact, type, extent, duration, intensity, timing, probability, cumulative effects and the vulnerability of the habitats and species concerned. Whilst the Directive does not explicitly define which other plans and projects are within the scope of the in-combination provision of Article 6(3), it is important to note that the underlying intention of this provision is to take account of cumulative impacts, and these will often only occur over time.

In that context, one must consider plans or projects which are completed, approved but uncompleted, or proposed. The 2018 Notice specifically advises [on p.43] that "*as regards other proposed plans or projects, on grounds of legal certainty it would seem appropriate to restrict the in-combination provision to those which have been actually proposed, i.e. for which an application for approval or consent has been introduced*".

The 2021 Notice additionally advises that:

- an in-combination assessment is often less detailed at the screening stage than in the appropriate assessment;
- there is still a need to identify all other plans or projects that could give rise to cumulative impacts with the plan or project in question and
- if this analysis cannot reach definitive conclusions, it should at least identify any other relevant plans and projects that should be scrutinised in more detail during the appropriate assessment.

3 THE PROPOSED DEVELOPMENT

3.1 3FM Project

The 3FM Project (http://www.dublinport3fm.ie) is Dublin Port Company's (DPC's) third and final Masterplan Project. It focuses on development in the south port area, known as the Poolbeg Peninsula, which contains nearly one-fifth of the Dublin Port estate. The estimated capital cost of the 3FM Project is €1.1 billion (2024 costs).

The 3FM Project at Dublin Port has been designed in accordance with the Dublin Port Masterplan 2040. The proposed project focuses on the DPC-owned lands of the south port area on the Poolbeg Peninsula. Figure 3 in the Masterplan (reproduced in **Error! Reference source not found.**) identifies the land uses and development projects on port lands which will allow the port to achieve its ultimate capacity of 73.8m tonnes of cargo throughput per annum by 2040.

The 3FM Project has evolved from the concept drawings of the Masterplan, driven by DPC's understanding of the key environmental constraints formulated by a decade of environmental monitoring, collaborative working with NGOs and Universities, and early consultation with key stakeholders.

The 3FM Project has six key elements:

1) A new public road and bridge called the **Southern Port Access Route (SPAR)** to link the north and south port areas.

The route will include a new bridge over the River Liffey. It will be located immediately east of Tom Clarke Bridge and north of the R131. The route will facilitate Heavy Goods Vehicles (HGVs), active travel users (pedestrians, cyclists, wheelers etc), emergency (blue light) vehicle services and public transport users moving to and from the South Port and Poolbeg Peninsula. The SPAR will allow the 3FM Project to be fully rail enabled through rapid shunting of freight by electric vehicles from the South Port Estate, across the Liffey, to rail intermodal facilities in the vicinity of the North Port Estate. The SPAR will have a direct connection to the Dublin Tunnel via the North Port Estate road system.

2) A new **Lift-on Lift-off (Lo-Lo) container terminal** with an annual throughput capacity of 550,000 Twenty-foot Equivalent Units (TEU) or 5.34 million tonnes. The Lo-Lo container terminal will consist of two main components:
   - A terminal located north of the ESB's Generating Station on the eastern end of Poolbeg Peninsula with 650m of deep water berthage dredged to a depth of -13.0 m CD (Chart Datum), plus associated cargo handling areas (Dublin Port Masterplan Area N). This terminal will accommodate larger Lo-Lo vessels of up to 240 m length, primarily from Continental Europe.
   - A transit container storage yard located on waterside land currently used for bulk cargo handling (Dublin Port Masterplan Area L).

3) Replacement of the existing Lo-Lo container terminal, currently operated by Marine Terminals Limited (MTL), with a new **Roll-On Roll-Off (Ro-Ro) freight terminal** with an annual throughput capacity of

360,000 Ro-Ro units or 8.69 million tonnes. The Ro-Ro freight terminal will consist of two main components:

- A terminal located at existing Berths 42 – 45 including provision of two berths, each with a single tier Ro-Ro ramp, plus associated cargo handling facilities (Dublin Port Masterplan Area K).
- A terminal located on Port-owned land on the southern side of the Poolbeg Peninsula (Dublin Port Masterplan Area O).

This combined terminal will accommodate larger Ro-Ro vessels of up to 240 m length, primarily from Continental Europe.

4) Provision of a **325 m diameter ship turning circle** in the river channel north of Pigeon House Harbour, dredged to a depth of -10.0 m CD. The ship turning circle will enable safe navigation and efficient manoeuvring of vessels up to 240 m in length.

5) Development of a new **Maritime Village** at Pigeon House Road and Berth 41.

This village will accommodate local rowing, sailing, and boat clubs and will provide a significantly enhanced public realm and facilities on the waterside. It will also accommodate the relocation of Port Harbour Operations from the North Port Estate.

6) **Community Gain** - Integrating Dublin Port with Dublin City and its people is a core objective of the Masterplan for Dublin Port. Development of proposed new public amenities on the Poolbeg Peninsula as part of the 3FM Project will provide **community gain** and contribute towards integrating the port with the city. These include:

Enhanced **recreational** amenity through:

- **7 km of new or upgraded Active Travel Path** (cycle, pedestrian, wheelers etc) and **4.9 km of new or upgraded footway** for the North Port Estate, SPAR and Poolbeg Peninsula, which will link with the 1.4 km Liffey Tolka Greenway in the North Port Estate, and from there to the 4.0 km Tolka Estuary Greenway currently under construction by Dublin Port. DPC will provide Dublin City Council with a €5 million contribution for future upgrading of the existing coastal path along the southern perimeter of the Poolbeg Peninsula.
- Development of a sailing, rowing and maritime campus (Maritime Village) adjacent to the existing Poolbeg Yacht and Boat Club in conjunction with local yacht and boating clubs, including a public slipway and facilities for maritime skills training.
- Provision of Recreational Space:
  - **Port Park and Wildflower Meadow** (2.5 ha)
  - **Coastal Park** (1.6 ha)
- Provision of 1.1 ha extension to Irishtown Nature Park.

Enhanced **public realm** through:

- Development of a new public plaza as a key part of the Maritime Village.

- Extensive boundary softening works adjacent to the development sites forming part of the 3FM Project.

Community support through:

- Establishment of a new €2 million Community Benefit Fund for Education, Heritage & Maritime Training Skills projects within the Poolbeg area. The initial capital for the Fund will be administered by DPC in consultation with local stakeholders.

Heritage & Biodiversity enhancements through:

- Commissioning a new Public Access Feasibility Study regarding the Great South Wall so as to identify improved public interpretation, accessibility, facilities and conservation possibilities,
- Provision of up to €1 million funding to implement the study recommendations.
- Provision of an additional permanent marine structure (dolphin) to expand the available habitat and range of the Dublin Port Tern Colonies.

A General Arrangement Drawing illustrating the main elements of the 3FM Project is presented in **Error! Reference source not found.**. Other significant ancillary works include:

- Improvements to the existing road network, linking and providing access to the port terminals, including new signal-controlled junctions and a new roundabout on Pigeon House Road;
- Improved pedestrian access from Irishtown to the proposed Maritime Village; and
- Demolition of the existing Poolbeg Oil Jetty and Sludge Jetty.

Without the 3FM Project, Dublin Port will reach its capacity limit much earlier than 2040, perhaps as early as 2030. If this were to happen, there is a risk of a national port capacity shortage.

Post-2040, additional capacity at other new or existing east coast ports will be required so that, as Dublin Port approaches its ultimate capacity, excess volumes which Dublin Port cannot handle can be accommodated elsewhere.

In addition, but outside the scope of the 3FM Project, DPC is making the following provisions:

- **Reservation for Utilities** – The provision of a 0.62 ha site within Dublin Port Masterplan Area O to accommodate the infrastructure required to deliver District Heating from the Dublin Waste to Energy Scheme. The planning consent for this infrastructure will not form part of the 3FM Project and will be a matter for Dublin City Council. At the date of drafting of this report, there is no proposal, even in concept form, as to the location, scale, mass or nature of any Dublin District Heating Scheme at this site.
- **Renewable Energy Infrastructure** - The provision of a 1.5 ha site within Dublin Port Masterplan Area M for a substation to facilitate the onshoring and transmission of Offshore Renewable Energy by Codling Wind Park offshore wind farm. Planning permission for the development of this infrastructure will be a matter for Codling Wind Park as an offshore renewable energy (ORE) developer.

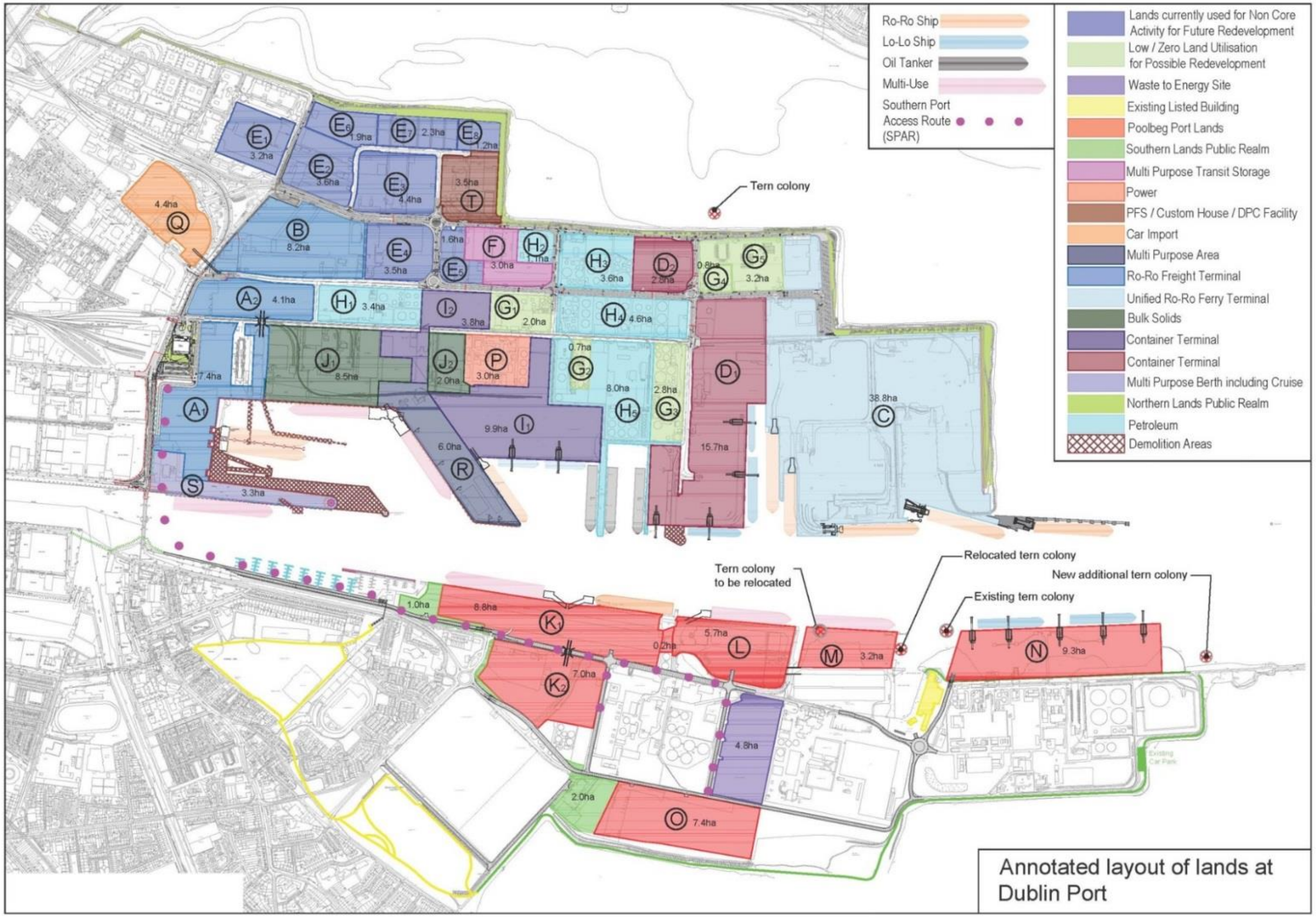


Figure 3.1: Dublin Port Masterplan 2040, reviewed 2018, Annotated Layout at Dublin Port
(Reproduced from Figure 3 of the Masterplan)

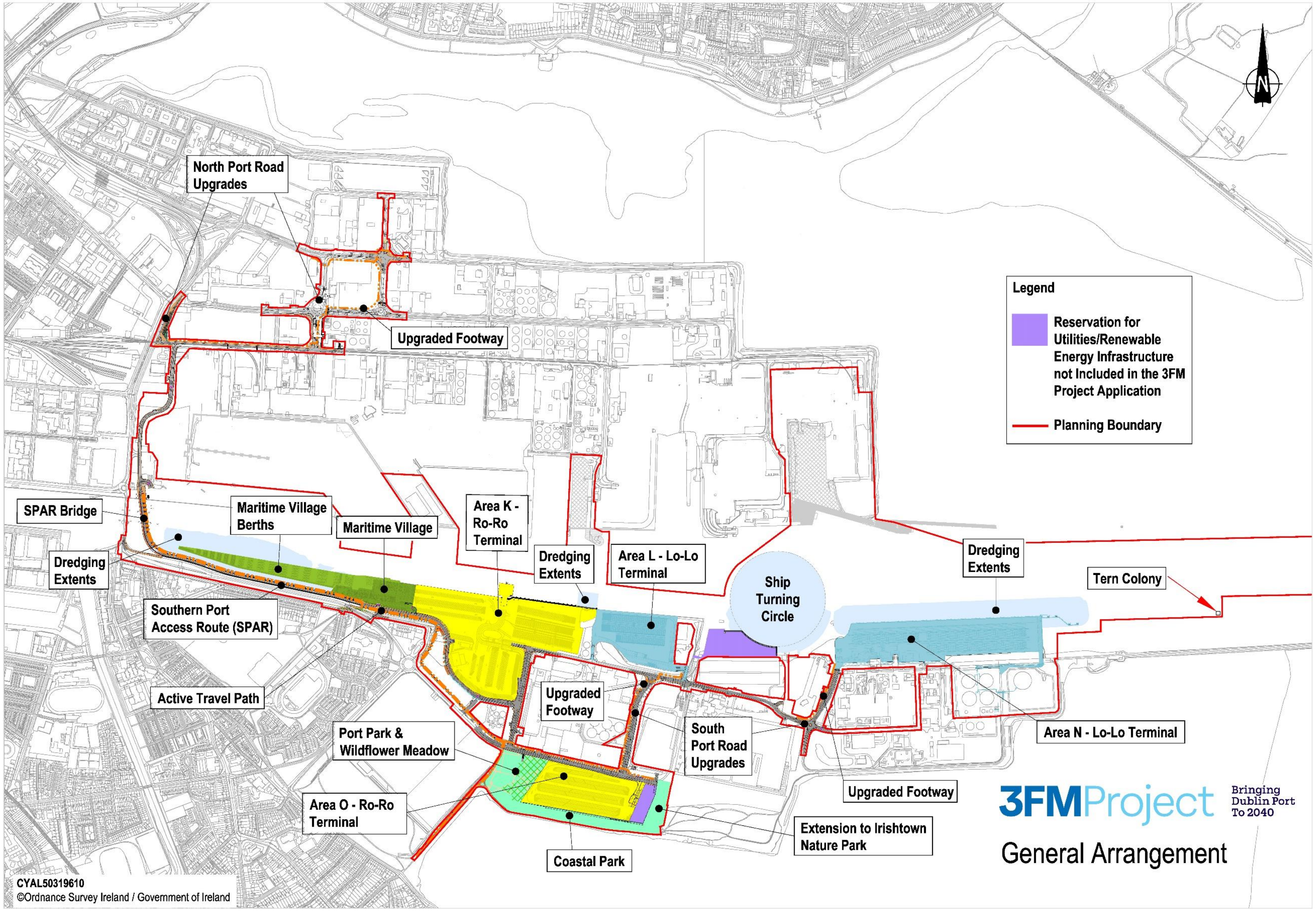


Figure 3.2: Main Elements of the 3FM Project

3.2 Programme and Sequencing of Construction Works

The proposed development has a fifteen year programme of construction works, with many elements of the project not commencing for a number of years. An outline proposed project phasing of the key work elements over a 15 year project period, with a potential commencement in 2026, is presented in **Figure 3.3**.

A summary of the construction sequence is presented here. Further detail is presented in Error! Reference source not found. in the associated AASR. It is important to note that the actual construction sequence is likely to vary over the 15-year construction period due to the difficulty of undertaking the redevelopment of brown-field sites within a working port of national importance. The construction sequence presented is therefore indicative only but is designed to represent a 'worst case scenario' for assessment.

Precise phasing and timing of work elements may be subject to some change. Following permission for the proposed development, if granted, there will be a period of approximately 12-18 months during which initial design and procurement will take place before construction commences.

Road upgrades will be undertaken at the outset of the project to facilitate access to construction logistics zones and to the key 3FM Project sites.

The proposed Ro-Ro Terminal located on DPC-owned land on the south side of the Poolbeg Peninsula (Masterplan Area O) and the proposed Lo-Lo Terminal yard adjacent to the Liffey (Masterplan Area L) will be used for landside and marine logistics respectively for up to the first 10 years of the project duration. An area at North Wall Quay Extension will also be used for marine logistics during construction of the SPAR.

Tree planting and landscaping will be undertaken early in the project to create green buffer zones, particularly around Masterplan Area O that will provide a barrier to mitigate visual impacts.

Construction of the Turning Circle and Lo-Lo Terminal (Masterplan Area N) will commence at an early stage in the project which includes the construction of the open-piled wharf at Area N. Both will entail capital dredging which will be confined to the winter months (October to March).

The proposed Tern Colony will be constructed at an early stage of the construction of the open-piled wharf at Area N.

The completion of the new Lo-Lo Terminal at Masterplan Area N will allow the existing Lo-Lo Terminal, currently operated by MTL, at Masterplan Area K to be relocated to Area N. This in turn will free up Berth 41 for the construction of the buildings associated with the Maritime Village and Port Operations. This work will be completed prior to demolition of the existing Poolbeg Yacht & Boat Club and Stella Maris buildings to allow for the continuous operation of the marina. Public Realm space will then be constructed on the site of the existing buildings and environs.

The freeing up of space at Area K also allows for the construction of the new Ro-Ro Terminal.

The next stages in the construction of the 3FM Project will focus on the SPAR Bridge, SPAR Viaduct and the Maritime Village berths. To enable these works to proceed, the existing yacht swinging moorings will be removed and temporary pontoons put in place along North Wall Quay Extension, to accommodate the displaced yachts. This will enable the construction of the SPAR Bridge, and capital dredging in advance of the construction of the SPAR Viaduct. At this point in the construction sequence the existing marina berths will continue to operate as normal.

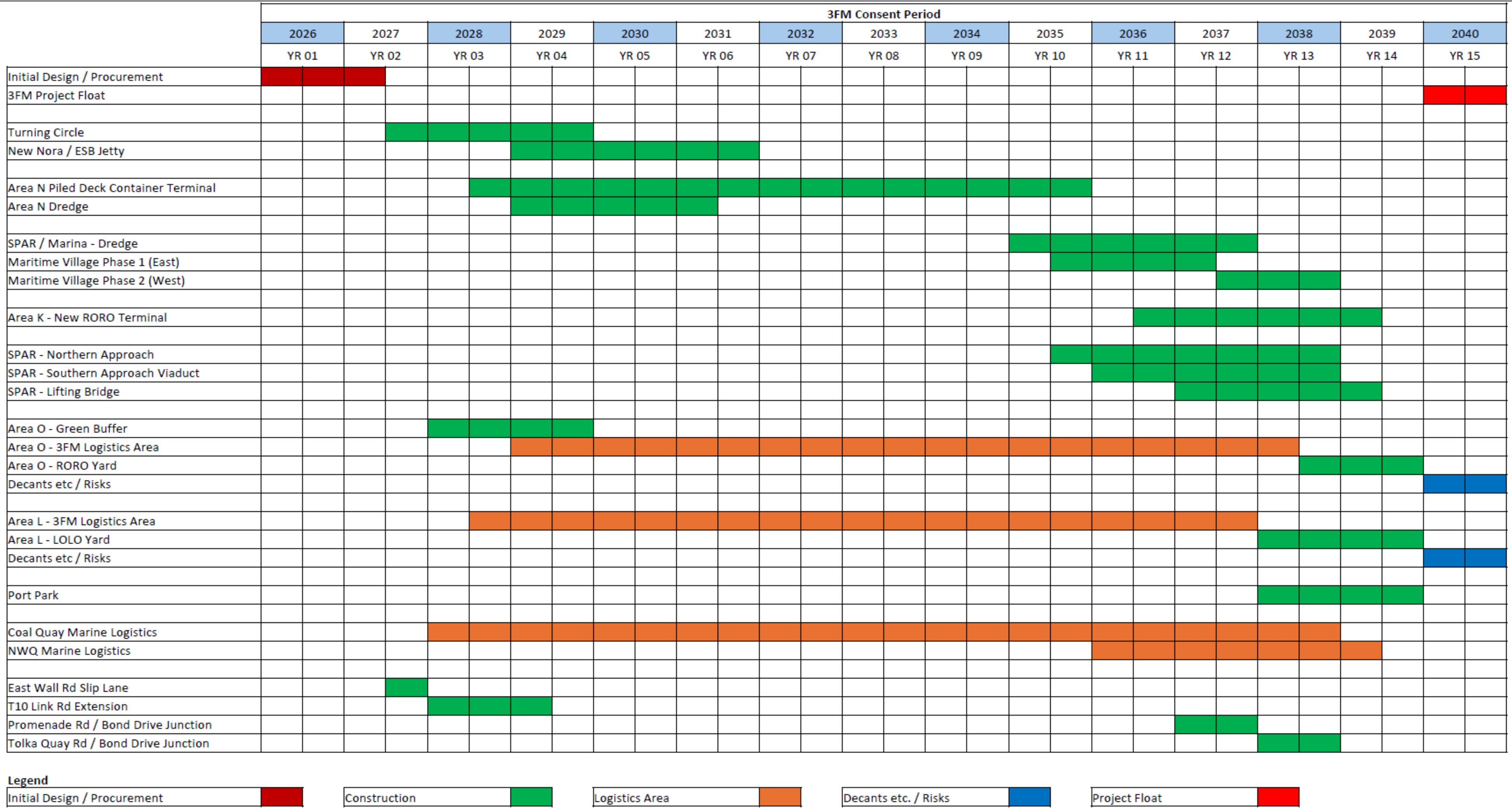
After the SPAR Bridge and SPAR Viaduct works are well advanced, permanent pontoons will be installed to form the western portion of the new marina. This will allow sailing craft using the existing marina to relocate to this new facility. Temporary access arrangements will be put in place to transfer boat owners between the western portion of the new marina and landside facilities by boat (such as the Liffey Taxi).

This in turn will free up the use of the existing marina which will be demolished to allow further capital dredging, completion of the SPAR Viaduct and the eastern portion of the new marina.

Construction of the Lo-Lo Container Yard at Masterplan Area L and Ro-Ro Terminal at Area O are required after Year 10 of the 3FM Project, when the sites are no longer needed as logistics areas. This timing also suits the expected growth in cargo from the Lo-Lo Terminal at Area N and the Ro-Ro Terminal at Area K.

Remaining community gain elements, including Port Park, Wildflower Meadow and the extension to Irishtown Nature Park will also be completed within the final 5 years of the project.

The construction sequence, described above, has been designed to enable the construction works to proceed without significant disruption to existing port operations and to enable the continued use of the marina facilities at Poolbeg. However, to satisfy these constraints, the construction of the SPAR Bridge can only be completed towards the end of the construction sequence. The transportation of plant, materials and construction staff to site must therefore use the existing road networks. Consequently, the construction sequence has been used to derive an estimate of the maximum envisaged construction traffic volumes in order to undertake a robust assessment of the maximum potential impact on the local road network, in combination with other planned construction activity in the area, and to assess the maximum potential impact at sensitive receptors.



	3FM Consent Period																													
	2026		2027		2028		2029		2030		2031		2032		2033		2034		2035		2036		2037		2038		2039		2040	
	YR 01		YR 02		YR 03		YR 04		YR 05		YR 06		YR 07		YR 08		YR 09		YR 10		YR 11		YR 12		YR 13		YR 14		YR 15	
Initial Design / Procurement	🟥	🟥	🟥																											
3FM Project Float																													🟥	🟥
Turning Circle				🟩	🟩	🟩	🟩	🟩																						
New Nora / ESB Jetty							🟩	🟩	🟩	🟩	🟩	🟩																		
Area N Piled Deck Container Terminal						🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩										
Area N Dredge							🟩	🟩	🟩	🟩	🟩																			
SPAR / Marina - Dredge																			🟩	🟩	🟩	🟩	🟩	🟩						
Maritime Village Phase 1 (East)																				🟩	🟩	🟩	🟩							
Maritime Village Phase 2 (West)																								🟩	🟩	🟩				
Area K - New RORO Terminal																						🟩	🟩	🟩	🟩	🟩	🟩			
SPAR - Northern Approach																				🟩	🟩	🟩	🟩	🟩	🟩	🟩				
SPAR - Southern Approach Viaduct																					🟩	🟩	🟩	🟩	🟩	🟩				
SPAR - Lifting Bridge																							🟩	🟩	🟩	🟩	🟩			
Area O - Green Buffer					🟩	🟩	🟩	🟩																						
Area O - 3FM Logistics Area							🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧					
Area O - RORO Yard																										🟩	🟩	🟩		
Decants etc / Risks																													🟦	🟦
Area L - 3FM Logistics Area						🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧						
Area L - LOLO Yard																									🟩	🟩	🟩	🟩		
Decants etc / Risks																													🟦	🟦
Port Park																									🟩	🟩	🟩	🟩		
Coal Quay Marine Logistics					🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧				
NWQ Marine Logistics																					🟧	🟧	🟧	🟧	🟧	🟧	🟧			
East Wall Rd Slip Lane				🟩																										
T10 Link Rd Extension					🟩	🟩	🟩																							
Promenade Rd / Bond Drive Junction																							🟩	🟩						
Tolka Quay Rd / Bond Drive Junction																									🟩	🟩				

Legend

Initial Design / Procurement	🟥	Construction	🟩	Logistics Area	🟧	Decants etc. / Risks	🟦	Project Float	🟥

Figure 3.3: 3FM Project Construction Sequencing (legend top left)

4 STAGE 2 APPRAISAL TO INFORM AN APPROPRIATE ASSESSMENT

4.1 Conclusions of the Stage 1 Screening Appraisal

DPC's Appropriate Assessment Screening Report (AASR) was completed in compliance with EU and Irish law and the relevant European Commission and national guidelines to determine whether or not Likely Significant Effects on any European site could be excluded as a result of the proposed 3FM Project.

The Stage 1 appraisal to inform appropriate assessment firstly established that the proposed 3FM Project is not directly connected with or necessary to the management of any European site.

The possibility of significant effects was then considered using a source-pathway-receptor model, where 'Source' was defined as the individual elements of the proposed works that have the potential to affect the identified ecological receptors both within the European site and *ex-situ* in accordance with the *Holohan* judgment. 'Pathway' was defined as the means or route by which a source can affect the ecological receptor. 'Ecological receptor' was defined as the Special Conservation Interests (for SPAs) or Qualifying Interests (of SACs) for which conservation objectives have been set for the European sites under consideration. Each element can exist independently however an effect is created when there is a linkage between the source, pathway and receptor.

Possible direct and indirect effects arising as a result of activities undertaken as part of the proposed development were discussed under the following themes:

- Habitat Loss;
- Diminution of Water Quality and Habitat Deterioration;
- Underwater Noise and disturbance; and
- Aerial Noise and Disturbance.

Having regard to the methodology employed and the findings of the appraisal and having applied the precautionary principle, it was concluded that a Natura Impact Statement was required, to assess the implications of the proposed 3FM Project, in relation to its potential to give rise to likely significant effects on a number of European sites illustrated in **Figure 4.1** and as outlined below in

Table 4.1, either alone or in combination with other projects.

The conservation objectives used in assessing the likely significant effects of the various qualifying interests ("QIs") of SACs and special conservation interests ("SCIs") of SPAs (and proposed SPAs) passing through to Stage 2 of the Habitats Directive appraisal in this NIS are listed in Table 4.2.

Table 4.1: Screening Appraisal Summary Table of Project Assessment (Alone and In-combination)

Site Name	QI / SCI	Can LSEs be <u>excluded</u> at the screening stage ?				
		Habitat Loss	Deterioration of Water Quality	Underwater Disturbance	Aerial Disturbance	In combination
North Dublin Bay SAC	Mudflats and sandflats not covered by seawater at low tide [1140]		NO			NO
South Dublin Bay SAC	Mudflats and sandflats not covered by seawater at low tide [1140]	NO	NO			NO
	Annual vegetation of drift lines [1210]	NO	NO			
Rockabill to Dalkey Island SAC	Reefs [1170]		NO			NO
	Harbour porpoise (Phocoena phocoena) [1351]		NO	NO		NO
Lambay Island SAC	Reefs [1170]	YES	NO	YES	YES	NO
	Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]	YES	YES	YES	YES	YES
	Halichoerus grypus (Grey Seal) [1364]	YES	NO	NO	YES	NO
	Phoca vitulina (Harbour Seal) [1365]	YES	NO	NO	YES	NO
	Harbour porpoise (Phocoena phocoena) [1351]	YES	NO	NO	YES	NO
Codling Fault Zone SAC	Submarine structures made by leaking gases [1180]	YES	NO	YES	YES	NO
	Harbour porpoise (Phocoena phocoena) [1351]	YES	NO	NO	YES	NO
South Dublin Bay & River Tolka Estuary SPA	Light-bellied Brent Goose (Branta bernicla hrota) [A046]	NO	NO		NO	NO
	Oystercatcher (Haematopus ostralegus) [A130]	NO	NO		NO	NO
	Ringed Plover (Charadrius hiaticula) [A137]	NO	NO		NO	NO
	Knot (Calidris canutus) [A143]	NO	NO		NO	NO
	Sanderling (Calidris alba) [A144]	NO	NO		NO	NO

Site Name	QI / SCI	Can LSEs be excluded at the screening stage ?				
		Habitat Loss	Deterioration of Water Quality	Underwater Disturbance	Aerial Disturbance	In combination
	Dunlin (Calidris alpina) [A149]	NO	NO		NO	NO
	Bar-tailed Godwit (Limosa lapponica) [A157]		NO			
	Redshank (Tringa etanus) [A162]	NO	NO		NO	NO
	Black-headed Gull (Croicocephalus ridibundus) [A179]	NO	NO		NO	NO
	Roseate Tern (Sterna dougallii) [A192]		NO		NO	NO
	Common Tern (Sterna hirundo) [A193]		NO		NO	NO
	Arctic Tern (Sterna paradisaea) [A194]		NO		NO	NO
	Wetland and Waterbirds [A999]		NO			NO
North Bull Island SPA	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]		NO		NO	NO
	Shelduck (Tadorna tadorna) [A048]		NO		NO	NO
	Teal (Anas crecca) [A052]		NO			
	Pintail (Anas acuta) [A054]		NO			
	Shoveler (Anas clypeata) [A056]		NO			
	Oystercatcher (Haematopus ostralegus) [A130]		NO		NO	NO
	Ringed Plover (Charadrius hiaticula) [A137]		NO		NO	NO
	Golden Plover (Pluvialis apricaria) [A140]		NO			
	Grey Plover (Pluvialis squatarola) [A141]		NO			
	Knot (Calidris canutus) [A143]		NO		NO	NO

Site Name	QI / SCI	Can LSEs be excluded at the screening stage ?				
		Habitat Loss	Deterioration of Water Quality	Underwater Disturbance	Aerial Disturbance	In combination
	Dunlin (Calidris alpina) [A149]		NO		NO	NO
	Black-tailed Godwit (Limosa limosa) [A156]		NO		NO	NO
	Bar-tailed Godwit (Limosa lapponica) [A157]		NO			
	Curlew (Numenius arquata) [A160]		NO		NO	NO
	Redshank (Tringa totanus) [A162]		NO		NO	NO
	Black-headed Gull (Croicocephalus ridibundus) [A179]		NO		NO	NO
	Wetland and Waterbirds [A999]		NO			NO
Howth Head Coast SPA	Kittiwake (Rissa tridactyla) [A188]		NO			
Dalkey Islands SPA	Roseate Tern (Sterna dougallii) [A192]		NO		NO	
	Common Tern (Sterna hirundo) [A193]		NO		NO	
	Arctic Tern (Sterna paradisaea) [A194]		NO		NO	
North-West Irish Sea SPA	Manx Shearwater (Puffinus puffinus) [A013]		NO			
	Cormorant (Phalacrocorax carbo) [A017]		NO			
	Shag (Phalacrocorax aristotelis) [A018]					
	Lesser Black-backed Gull (Larus fuscus) [A183		NO			
	Roseate Tern (Sterna dougallii) [A192]					
	Common Tern (Sterna hirundo) [A193]		NO			
	Arctic Tern (Sterna paradisaea) [A194]		NO			

Site Name	**QI / SCI**	**Can LSEs be excluded at the screening stage ?**				
		Habitat Loss	**Deterioration of Water Quality**	**Underwater Disturbance**	**Aerial Disturbance**	**In combination**
	Little Tern (Sterna albifrons) [A195]		YES			
	Puffin (Fratercula arctica) [A204]		NO			
	Red-throated Diver (Gavia stellata) [A001]		NO			
	Great Northern Diver (Gavia immer) [A003]		NO			
	Common Scoter (Melanitta nigra) [A065]		NO			
	Black-headed Gull (Chroicocephalus ridibundus) [A179]		NO			
	Common Gull (Larus canus) [A182]		NO			
	Great Black-backed Gull (Larus marinus) [A187]		NO			
	Little Gull (Hydrocoloeus minutus) [A862]		NO			
	Fulmar (Fulmarus glacialis) [A009]		NO			
	Herring Gull (Larus argentatus) [A184]		NO			
	Kittiwake (Rissa tridactyla) [A188]		NO			
	Guillemot (Uria aalge) [A199]		NO			
	Razorbill (Alca torda) [A200]		NO			

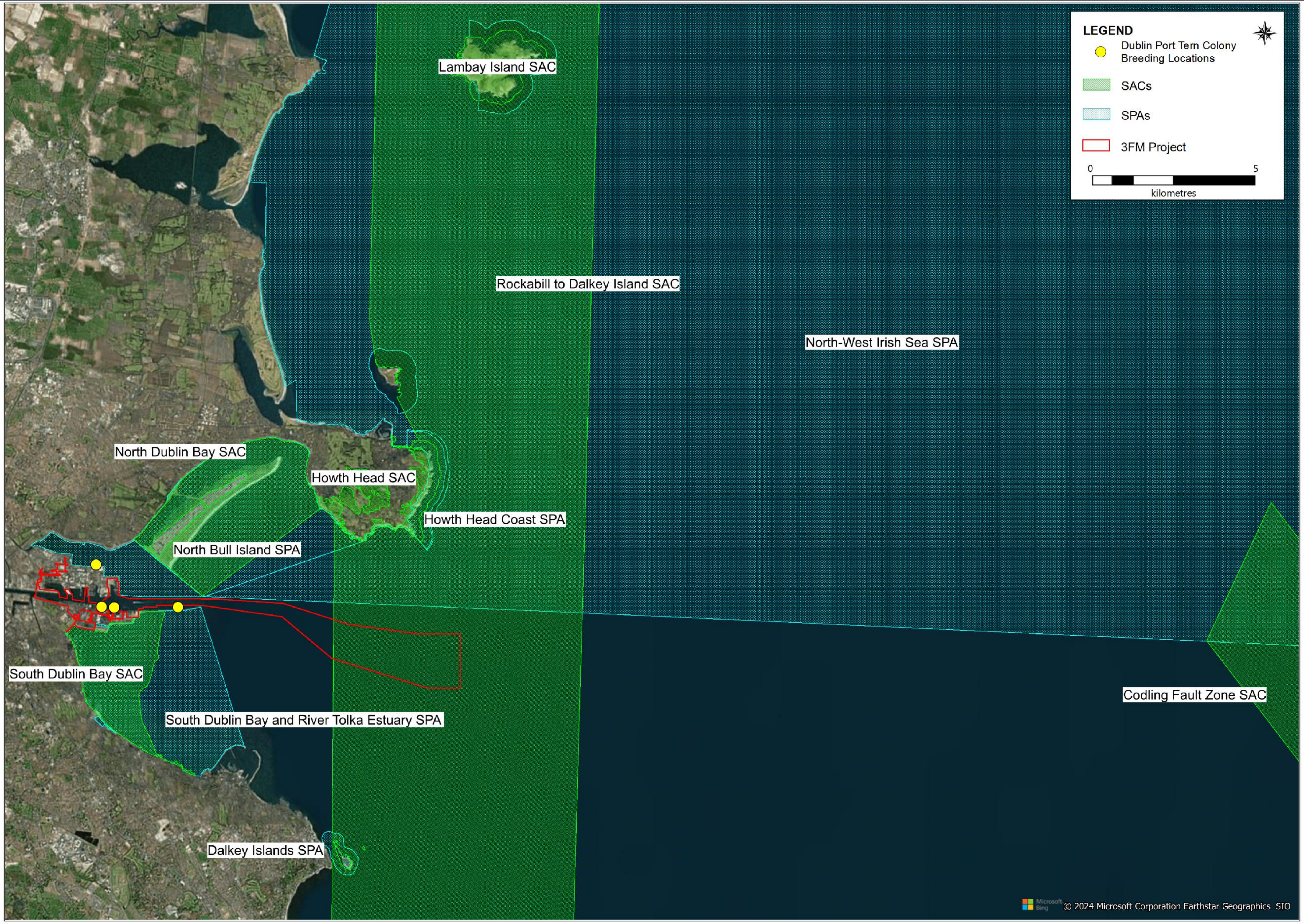


Figure 4.1: European sites considered in the Habitats Directive Appraisals

Table 4.2: Qualifying Interests and Special Conservation Interests of the European sites considered

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td>IE000206</td><td>North Dublin Bay SAC</td><td>Conservation Objectives Specific Version 1.0 (06/11/13)
To maintain or restore the favourable conservation condition of 9 no. Annex 1 habitat type in the SAC, as defined by a range of attributes and targets; and of 1 no. Annex II species in the SAC, as defined by 5 no. attributes and targets.

○ Mudflats and sandflats not covered by seawater at low tide [1140]
○
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Habitat area</td><td>Hectares</td><td>The permanent habitat area is stable or increasing, subject to natural processes.</td></tr>
<tr><td>Community extent</td><td>Hectares</td><td>Maintain the extent of the Mytilus edulis-dominated community, subject to natural processes.</td></tr>
<tr><td>Community structure: Mytilus edulis density</td><td>Individuals/m²</td><td>Conserve the high quality of the <i>Mytilus edulis</i>-dominated community, subject to natural processes</td></tr>
<tr><td>Community distribution</td><td>Hectares</td><td>Conserve the following community types in a natural condition: Fine sand to sandy mud with <i>Pygospio elegans</i> and <i>Crangon crangon</i> community complex; Fine sand with <i>Spio martinensis</i> community complex.</td></tr>
</table></td><td>1.35 km to the northeast and by sea from the Plot N dredge pocket</td></tr>
<tr><td>IE000210</td><td>South Dublin Bay SAC</td><td>Conservation Objectives Specific Version 1.0 (22/08/13)
To maintain the favourable conservation condition of 1 no. Annex 1 habitat type [1140] in the SAC, as defined by 4 no. attributes and targets.

<i>Note</i>: Habitat types [1210], [1310] and [2110] were added as qualifying interests in 2015 and the site’s conservation objectives have not yet been revised to take account of these features. Their objectives from North Dublin Bay SAC have been adopted for this assessment.

○ Mudflats and sandflats not covered by seawater at low tide [1140]</td><td>0 m at Stormwater discharge points south of Plot O.

0 m at landscaped coastal edge along existing pathway of Irishtown Nature Park south of Plot O

2.95 km by sea from dredge pocket of Plot N out to end of Great South Wall and back around other side</td></tr>
</table>

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Habitat area</td><td>Hectares</td><td>The permanent habitat area is stable or increasing, subject to natural processes.</td></tr>
<tr><td>Community extent</td><td>Hectares</td><td>Maintain the extent of the Mytilus edulis-dominated community, subject to natural processes.</td></tr>
<tr><td>Community structure: Mytilus edulis density</td><td>Individuals/m²</td><td>Conserve the high quality of the <i>Mytilus edulis</i>-dominated community, subject to natural processes</td></tr>
<tr><td>Community distribution</td><td>Hectares</td><td>Conserve the following community types in a natural condition: Fine sand to sandy mud with <i>Pygospio elegans</i> and <i>Crangon crangon</i> community complex; Fine sand with <i>Spio martinensis</i> community complex.</td></tr>
</table>
<p>○ Annual vegetation of drift lines [1210]</p>
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Habitat area</td><td>Hectares</td><td>Area increasing, subject to natural processes, including erosion and succession.</td></tr>
<tr><td>Habitat distribution</td><td>Occurrence</td><td>No decline, or change in habitat distribution, subject to natural processes</td></tr>
<tr><td>Physical structure: functionality and sediment supply</td><td>Presence/ absence of physical barriers</td><td>Maintain the natural circulation of sediment and organic matter, without any physical obstructions</td></tr>
<tr><td>Vegetation structure: zonation</td><td>Occurrence</td><td>Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession</td></tr>
<tr><td>Vegetation composition: typical species and subcommunities</td><td>Percentage cover at a representative number of monitoring stops</td><td>Maintain the presence of species-poor communities with typical species: sea rocket (<i>Cakile maritima</i>), sea sandwort (<i>Honckenya peploides</i>), prickly saltwort (<i>Salsola kali</i>) and oraches (<i>Atriplex</i> spp.)</td></tr>
<tr><td>Vegetation composition: negative indicator species</td><td>Percentage cover</td><td>Negative indicator species (including non-natives) to represent less than 5% cover</td></tr>
</table>
</td><td></td></tr>
<tr><td>IE003000</td><td>Rockabill to Dalkey Island SAC</td><td>
<p>Conservation Objectives Specific Version 1.0 (07/05/13)
To maintain the favourable conservation condition of 1 no. Annex 1 habitat type in the SAC, as defined by 3 no. attributes and targets; and of 1 no. Annex II species in the SAC, as defined by 2 no. attributes and targets.</p>
<p>○ Reefs [1170]</p>
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Habitat area</td><td>Hectares</td><td>The permanent area is stable or increasing, subject to natural processes.</td></tr>
<tr><td>Distribution</td><td>Occurrence</td><td>The distribution of reefs is stable or increasing, subject to natural processes.</td></tr>
<tr><td>Community structure</td><td>Biological compiosition</td><td>Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex.</td></tr>
</table>
</td><td>0 m at licensed sea disposal site

5.75 km east by sea from Plot N dredge pocket</td></tr>
</table>

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td></td><td></td><td>

- Harbour porpoise (Phocoena phocoena) [1351]

<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Access to suitable habitat</td><td>Number of artificial barriers</td><td>Species range within the site should not be restricted by artificial barriers to site use.</td></tr>
<tr><td>Disturbance</td><td>Level of imapct</td><td>Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site</td></tr>
</table>

</td><td></td></tr>
<tr><td>IE00204</td><td>Lambay Island SAC</td><td>

Conservation Objectives Specific Version 1.0 (22/07/2013)
To maintain the favourable conservation condition of 2 no. Annex 1 habitat types in the SAC, as defined by various attributes and targets; and of 3 no. Annex II species in the SAC, as defined by various attributes and targets.

- Reefs [1170]

<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Habitat area</td><td>Hectare</td><td>The permanent area is stable or increasing, subject to natural processes</td></tr>
<tr><td>Distribution</td><td>Occurrence</td><td>The distribution of reefs is stable or increasing, subject to natural processes</td></tr>
<tr><td>Community structure</td><td>Biological composition</td><td>Conserve the following community types in a natural condition: Intertidal reef community complex; Laminaria-dominated community complex</td></tr>
</table>

- Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]

<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Habitat length</td><td>Kilometres</td><td>Area stable, subject to natural processes, including erosion.</td></tr>
<tr><td>Habitat distribution</td><td>Occurrence</td><td>No decline, subject to natural processes</td></tr>
<tr><td>Physical structure: functionality and hydrological regime</td><td>Occurrence of artificial barriers</td><td>No alteration to natural functioning of geomorphological and hydrological processes due to artificial structures</td></tr>
<tr><td>Vegetation structure: Zonation</td><td>Occurrence</td><td>Maintain range of sea cliff habitat zonations including transitional zones, subject to natural processes including erosion and succession</td></tr>
<tr><td>Vegetation structure: Vegetation height</td><td>Centimetres</td><td>Maintain structural variation within sward</td></tr>
<tr><td>Vegetation composition: typical species and sub-communities</td><td>Percentage cover at a representative sample of monitoring stops</td><td>Maintain range of sub-communities with typical species listed in the Irish Sea Cliff Survey (Barron <i>et al.</i>, 2011)</td></tr>
<tr><td>Vegetation composition: Negative indictor species</td><td>Percentage</td><td>Negative indicator species (including non-natives) to represent less than 5% cover</td></tr>
</table>

</td><td>16.0 km north of sea disposal site
22.4 km from Plot N dredge pocket</td></tr>
</table>

Site Code	Site Name	QIs, SCIs and Conservation Objectives	Distance from proposed development

Vegetation composition: Bracken and woody species	Percentage	Cover of bracken (*Pteridium aquilinum*) on grassland and/or heath less than 10%. Cover of woody species on grassland and/or heath less than 20%

- Grey seal (Halichoerus grypus) [1364]

Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	The breeding sites should be maintained in a natural condition
Moulting behaviour	Moult haul-out sites	The moult haul-out sites should be maintained in a natural condition
Resting behaviour	Resting haul-out sites	The resting haul-out sites should be maintained in a natural condition
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the grey seal population at the site

- Harbour seal (Phoca vitulina) [1351]

Attribute	Measure	Target
Access to suitable habitat	Number of artificial barriers	Species range within the site should not be restricted by artificial barriers to site use
Breeding behaviour	Breeding sites	The breeding sites should be maintained in a natural condition
Moulting behaviour	Moult haul-out sites	The moult haul-out sites should be maintained in a natural condition
Resting behaviour	Resting haul-out sites	The resting haul-out sites should be maintained in a natural condition
Disturbance	Level of impact	Human activities should occur at levels that do not adversely affect the harbour seal population at the site

- Harbour porpoise (Phocoena phocoena) [1351]

Note: Harbour porpoise was included as a qualifying interest to this European site in spring 2024 by way of an amendment notification[1]. Conservation attributes, measures and targets for harbour porpoise are currently not contained in the published conservation objectives for this European site. For the purposes of this assessment, the same harbour porpoise community is assumed to use the waters of Lambay Island SAC, Rockabill to Dalkey Island SAC and Codling Fault Zone SAC as one region., As such, it is reasonable to assess potential effects on

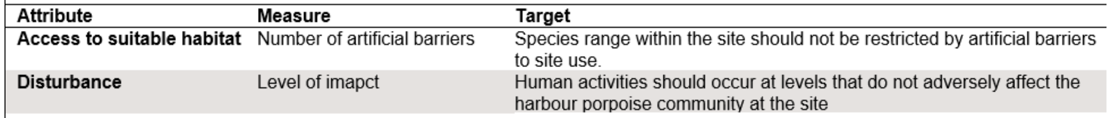
---

[1] https://www.npws.ie/sites/default/files/protected-sites/amendment_notifications/AN000204.pdf

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td></td><td></td><td>
<i>harbour porpoise in this European site against conservation objectives published for harbour porpoise in Rockabill to Dalkey Island SAC.</i>
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Access to suitable habitat</td><td>Number of artificial barriers</td><td>Species range within the site should not be restricted by artificial barriers to site use.</td></tr>
<tr><td>Disturbance</td><td>Level of imapct</td><td>Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site</td></tr>
</table>
</td><td></td></tr>
<tr><td>IE003015</td><td>Codling Fault Zone SAC</td><td>
Conservation Objectives Specific Version 1.0 (15/06/2023)
To maintain the favourable condition of 2 no. Annex 1 habitat types in the SAC, as defined by various attributes and targets; and of 3 no. Annex II species in the SAC, as defined by various attributes and targets.
Submarine structures made by leaking gases [1180]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Area of methane derived authigenic structures (MDAC) features</td><td>Hectare</td><td>The permanent area is stable or increasing, subject to natural processes</td></tr>
<tr><td>Distribution</td><td>Occurrence</td><td>Distribution stable or increasing, subject to natural processes</td></tr>
<tr><td>Physical structure</td><td>Presence and structure</td><td>Maintain the structural integrity of the MDAC features, subject to natural processes</td></tr>
<tr><td>Community structure</td><td>Biological composition</td><td>Conserve the Codling Fault Zone MDACs community complex in a natural condition, subject to natural processes</td></tr>
</table>
Harbour porpoise (Phocoena phocoena) [1351]
<i><u>Note</u>: Harbour porpoise was included as a qualifying interest to this European site in spring 2024 by way of an amendment notification[2]. Conservation attributes, measures and targets for harbour porpoise are currently not contained in the published conservation objectives for this European site. For the purposes of this assessment, the same harbour porpoise community is assumed to use the waters of Lambay Island SAC, Rockabill to Dalkey Island SAC and Codling Fault Zone SAC as one region., As such, it is reasonable to assess potential effects on harbour porpoise in this European site against conservation objectives published for harbour porpoise in Rockabill to Dalkey Island SAC.</i>
</td><td>22.9 km east of sea disposal site
32.5 km from Plot N dredge pocket</td></tr>
</table>

---

[2] https://www.npws.ie/sites/default/files/protected-sites/amendment_notifications/AN003015.pdf

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td></td><td></td><td>

<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Access to suitable habitat</td><td>Number of artificial barriers</td><td>Species range within the site should not be restricted by artificial barriers to site use.</td></tr>
<tr><td>Disturbance</td><td>Level of imapct</td><td>Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site</td></tr>
</table>
</td><td></td></tr>
<tr><td>IE004024</td><td>South Dublin Bay & River Tolka Estuary SPA</td><td>
Conservation Objectives Specific Version 1.0 (09/03/15)
To maintain the favourable conservation condition of –

9 no. overwintering species in the SPA, as defined by 2 no. attributes and targets;
3 no. breeding and passage species of terns, as defined by a wider range of attributes and targets; and
wetland habitats in the SPA as a resource for the regularly-occurring migratory waterbirds that utilise it, as defined by 1 no. attribute and target.

Special Conservation Interests
Light-bellied Brent Goose (<i>Branta bernicla hrota</i>) [A046]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population trend</td><td>Percentage change</td><td>Long term population trend stable or increasing</td></tr>
<tr><td>Distribution</td><td>Range, timing and intensity of use of areas</td><td>No significant decrease in the range, timing, or intensity of use of areas by light-bellied brent goose, other than that occurring from natural patterns of variation</td></tr>
</table>
Oystercatcher (<i>Haematopus ostralegus</i>) [A130]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population trend</td><td>Percentage change</td><td>Long term population trend stable or increasing</td></tr>
<tr><td>Distribution</td><td>Range, timing and intensity of use of areas</td><td>No significant decrease in the range, timing, or intensity of use of areas by oystercatcher, other than that occurring from natural patterns of variation</td></tr>
</table>
Ringed Plover (<i>Charadrius hiaticula</i>) [A137]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population trend</td><td>Percentage change</td><td>Long term population trend stable or increasing</td></tr>
<tr><td>Distribution</td><td>Range, timing and intensity of use of areas</td><td>No significant decrease in the range, timing, or intensity of use of areas by ringed plover, other than that occurring from natural patterns of variation</td></tr>
</table>
</td><td>0 m at ESB structure for breeding terns between turning circle and Plot N where structure is located within Plot N dredge pocket

15 m at ESB structure for breeding terns between turning circle and Plot N where structure is located 15 m from turning circle dredge pocket

Tolka Estuary portion of SPA is 260 m north of Plot N dredge pocket

Sandymount Strand portion of SPA is 1.75 km from dredge pocket of Plot N along Great South Wall and around other side</td></tr>
</table>

Site Code	Site Name	QIs, SCIs and Conservation Objectives	Distance from proposed development

- Knot (*Calidris canutus*) [A143]

Attribute	**Measure**	**Target**
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by knot, other than that occurring from natural patterns of variation

- Sanderling (*Calidris alba*) [A144]

Attribute	**Measure**	**Target**
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by sanderling, other than that occurring from natural patterns of variation

- Dunlin (*Calidris alpina*) [A149]

Attribute	**Measure**	**Target**
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by dunlin, other than that occurring from natural patterns of variation

- Bar-tailed Godwit (*Limosa lapponica*) [A157]

Attribute	**Measure**	**Target**
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by bar-tailed godwit, other than that occurring from natural patterns of variation

- Redshank (*Tringa totanus*) [A162]

Attribute	**Measure**	**Target**
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by redshank, other than that occurring from natural patterns of variation

- Black-headed Gull (*Croicocephalus ridibundus*) [A179]

Site Code	Site Name	QIs, SCIs and Conservation Objectives	Distance from proposed development

Attribute	Measure	Target
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by black-headed gull, other than that occurring from natural patterns of variation

- Roseate Tern (*Sterna dougallii*) [A192]

Attribute	Measure	Target
Passage population: individuals	Number	No significant decline
Distribution: roosting areas	Number; location; area (hectares)	No significant decline
Prey biomass available	Kilogrammes	No significant decline
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase
Disturbance at roosting site	Level of impact	Human activities should occur at levels that do not adversely affect the numbers of roseate tern among the post-breeding aggregation of terns

- Common Tern (*Sterna hirundo*) [A193]

Attribute	Measure	Target
Breeding population abundance: Apparently occupied nests (AONs)	Number	No significant decline
Productivity rate: fledged young per breeding pair	Mean number	No significant decline
Passage population: individuals	Number	No significant decline
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline
Distribution: roosting areas	Number; location; area (hectares)	No significant decline
Prey biomass available	Kilogrammes	No significant decline
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase
Disturbance at breeding site	Level of impact	Human activities should occur at levels that do not adversely affect the breeding common tern population

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Disturbance at roosting site</td><td>Level of impact</td><td>Human activities should occur at levels that do not adversely affect the numbers of roseate tern among the post-breeding aggregation of terns</td></tr>
</table>

- Arctic Tern (*Sterna paradisaea*) [A194]

<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Passage population</td><td>Number of individuals</td><td>No significant decline</td></tr>
<tr><td>Distribution: roosting areas</td><td>Number; location; area (hectares)</td><td>No significant decline</td></tr>
<tr><td>Prey biomass available</td><td>Kilogrammes</td><td>No significant decline</td></tr>
<tr><td>Barriers to connectivity</td><td>Number; location; shape; area (hectares)</td><td>No significant increase</td></tr>
<tr><td>Disturbance at roosting site</td><td>Level of impact</td><td>Human activities should occur at levels that do not adversely affect the numbers of roseate tern among the post-breeding aggregation of terns</td></tr>
</table>

Note: Grey Plover (Pluvialis squatarola) [A140] is proposed for removal from the list of Special Conservation Interests for South Dublin Bay and River Tolka Estuary SPA. As a result, a site-specific conservation objective has not been set for this species.
</td><td></td></tr>
<tr><td>IE004006</td><td>North Bull Island SPA</td><td>
Conservation Objectives Specific Version 1.0 (09/03/15)
To maintain the favourable conservation condition of 17 no. Annex 1 species in the SPA, as defined by 2 no. attributes and targets; and of wetland habitats in the SPA as a resource for the regularly-occurring migratory waterbirds that utilise it, as measured by 1 no. attribute and target

Special Conservation Interests

- Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]

<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population trend</td><td>Percentage change</td><td>Long term population trend stable or increasing</td></tr>
<tr><td>Distribution</td><td>Range, timing and intensity of use of areas</td><td>No significant decrease in the range, timing, or intensity of use of areas by light-bellied brent goose, other than that occurring from natural patterns of variation</td></tr>
</table>

- Shelduck (*Tadorna tadorna*) [A048]

<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population trend</td><td>Percentage change</td><td>Long term population trend stable or increasing</td></tr>
</table>
</td><td>1.35 km to the northeast and by sea from the Plot N dredge pocket</td></tr>
</table>

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Distribution</td><td>Range, timing and intensity of use of areas</td><td>No significant decrease in the range, timing, or intensity of use of areas by shelduck, other than that occurring from natural patterns of variation</td></tr>
</table>
Teal (<i>Anas crecca</i>) [A052]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population trend</td><td>Percentage change</td><td>Long term population trend stable or increasing</td></tr>
<tr><td>Distribution</td><td>Range, timing and intensity of use of areas</td><td>No significant decrease in the range, timing, or intensity of use of areas by teal, other than that occurring from natural patterns of variation</td></tr>
</table>
Pintail (<i>Anas acuta</i>) [A054]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population trend</td><td>Percentage change</td><td>Long term population trend stable or increasing</td></tr>
<tr><td>Distribution</td><td>Range, timing and intensity of use of areas</td><td>No significant decrease in the range, timing, or intensity of use of areas by pintail, other than that occurring from natural patterns of variation</td></tr>
</table>
Shoveler (<i>Anas clypeata</i>) [A056]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population trend</td><td>Percentage change</td><td>Long term population trend stable or increasing</td></tr>
<tr><td>Distribution</td><td>Range, timing and intensity of use of areas</td><td>No significant decrease in the range, timing, or intensity of use of areas by shoveler, other than that occurring from natural patterns of variation</td></tr>
</table>
Oystercatcher (<i>Haematopus ostralegus</i>) [A130]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population trend</td><td>Percentage change</td><td>Long term population trend stable or increasing</td></tr>
<tr><td>Distribution</td><td>Range, timing and intensity of use of areas</td><td>No significant decrease in the range, timing, or intensity of use of areas by oystercatcher, other than that occurring from natural patterns of variation</td></tr>
</table>
Ringed Plover (<i>Charadrius hiaticula</i>) [A137]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population trend</td><td>Percentage change</td><td>Long term population trend stable or increasing</td></tr>
</table>
</td><td></td></tr>
</table>

Site Code	Site Name	QIs, SCIs and Conservation Objectives	Distance from proposed development

Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by ringed plover, other than that occurring from natural patterns of variation

- Golden Plover (*Pluvialis apricaria*) [A140]

Attribute	Measure	Target
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by golden plover, other than that occurring from natural patterns of variation

- Grey Plover (*Pluvialis squatarola*) [A141]

Attribute	Measure	Target
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by grey plover, other than that occurring from natural patterns of variation

- Knot (*Calidris canutus*) [A143]

Attribute	Measure	Target
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by knot, other than that occurring from natural patterns of variation

- Sanderling (*Calidris alba*) [A144]

Attribute	Measure	Target
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by sanderling, other than that occurring from natural patterns of variation

- Dunlin (*Calidris alpina*) [A149]

Attribute	Measure	Target
Population trend	Percentage change	Long term population trend stable or increasing

Site Code	Site Name	QIs, SCIs and Conservation Objectives	Distance from proposed development

Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by dunlin, other than that occurring from natural patterns of variation

- Black-tailed Godwit (*Limosa limosa*) [A156]

Attribute	**Measure**	**Target**
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by black-tailed godwit, other than that occurring from natural patterns of variation

- Bar-tailed Godwit (*Limosa lapponica*) [A157]

Attribute	**Measure**	**Target**
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by bar-tailed godwit, other than that occurring from natural patterns of variation

- Curlew (*Numenius arquata*) [A160]

Attribute	**Measure**	**Target**
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by curlew, other than that occurring from natural patterns of variation

- Redshank (*Tringa totanus*) [A162]

Attribute	**Measure**	**Target**
Population trend	Percentage change	Long term population trend stable or increasing
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing, or intensity of use of areas by redshank, other than that occurring from natural patterns of variation

- Turnstone (*Arenaria interpres*) [A169]

Attribute	**Measure**	**Target**
Population trend	Percentage change	Long term population trend stable or increasing

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Distribution</td><td>Range, timing and intensity of use of areas</td><td>No significant decrease in the range, timing, or intensity of use of areas by turnstone, other than that occurring from natural patterns of variation</td></tr>
</table>
Black-headed Gull (<i>Croicocephalus ridibundus</i>) [A179]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population trend</td><td>Percentage change</td><td>Long term population trend stable or increasing</td></tr>
<tr><td>Distribution</td><td>Range, timing and intensity of use of areas</td><td>No significant decrease in the range, timing, or intensity of use of areas by black-headed gull, other than that occurring from natural patterns of variation</td></tr>
</table>
Wetlands [A999]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Habitat area</td><td>Hectares</td><td>The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 1,713 hectares, other than that occurring from natural patterns of variation.</td></tr>
</table>
</td><td></td></tr>
<tr><td>IE004236</td><td>North-West Irish Sea SPA</td><td>
Conservation Objectives Specific Version 1.0 (19/09/23)
To maintain the favourable conservation condition of 21 no. Annex 1 species in the SPA, as defined by 5 no. attributes and targets

Special Conservation Interests
Manx Shearwater (<i>Puffinus puffinus</i>) [A013]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Breeding population size</td><td>Number</td><td>No significant decline</td></tr>
<tr><td>Spatial distribution</td><td>Hectares, timing, and intensity of use</td><td>Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population</td></tr>
<tr><td>Forage spatial distribution, extent, abundance, and availability</td><td>Location and hectares, and forage biomass</td><td>Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target</td></tr>
<tr><td>Disturbance across the site</td><td>Intensity, frequency, timing, and duration</td><td>The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution</td></tr>
</table>
</td><td>780 m north of licensed sea disposal site

1.80 km east and by sea from the Plot N dredge pocket</td></tr>
</table>

Site Code	Site Name	QIs, SCIs and Conservation Objectives			Distance from proposed development
		Barriers to connectivity	Number; location; shape; area (hectares)	The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA	
		- Cormorant (*Phalacrocorax carbo*) [A017]			
		Attribute	**Measure**	**Target**	
		Breeding population size	Number	Long term population trend within the SPA is stable or increasing	
		Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population	
		Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target	
		Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution	
		Barriers to connectivity	Number; location; shape; area (hectares)	The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA	
		- Shag (*Phalacrocorax aristotelis*) [A018]			
		Attribute	**Measure**	**Target**	
		Breeding population size	Number	Long term population trend within the SPA is stable or increasing	
		Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population	
		Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target	
		Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution	

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Barriers to connectivity</td><td>Number; location; shape; area (hectares)</td><td>The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA</td></tr>
</table>
Lesser Black-backed Gull (<i>Larus fuscus</i>) [A183]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Breeding population size</td><td>Number</td><td>No significant decline</td></tr>
<tr><td>Spatial distribution</td><td>Hectares, timing, and intensity of use</td><td>Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population</td></tr>
<tr><td>Forage spatial distribution, extent, abundance, and availability</td><td>Location and hectares, and forage biomass</td><td>Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target</td></tr>
<tr><td>Disturbance across the site</td><td>Intensity, frequency, timing, and duration</td><td>The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution</td></tr>
<tr><td>Barriers to connectivity</td><td>Number; location; shape; area (hectares)</td><td>The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA</td></tr>
</table>
Roseate Tern (<i>Sterna dougallii</i>) [A192]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Breeding population size</td><td>Number</td><td>No significant decline</td></tr>
<tr><td>Spatial distribution</td><td>Hectares, timing, and intensity of use</td><td>Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population</td></tr>
<tr><td>Forage spatial distribution, extent, abundance, and availability</td><td>Location and hectares, and forage biomass</td><td>Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target</td></tr>
<tr><td>Disturbance across the site</td><td>Intensity, frequency, timing, and duration</td><td>The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution</td></tr>
</table>
</td><td></td></tr>
</table>

Site Code	Site Name	QIs, SCIs and Conservation Objectives	Distance from proposed development
		Barriers to connectivity | Number; location; shape; area (hectares) | The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA	
		- Common Tern (*Sterna hirundo*) [A193]	

Attribute	Measure	Target
Breeding population size	Number	No significant decline
Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population
Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target
Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution
Barriers to connectivity	Number; location; shape; area (hectares)	The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA

- Arctic Tern (*Sterna paradisaea*) [A194]

Attribute	Measure	Target
Breeding population size	Number	No significant decline
Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population
Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target
Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution

Site Code	Site Name	QIs, SCIs and Conservation Objectives			Distance from proposed development
		Barriers to connectivity	Number; location; shape; area (hectares)	The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA	
		- Little Tern (*Sterna albifrons*) [A195]			
		Attribute	**Measure**	**Target**	
		Breeding population size	Number	No significant decline	
		Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population	
		Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target	
		Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution	
		Barriers to connectivity	Number; location; shape; area (hectares)	The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA	
		- Puffin (*Fratercula arctica*) [A204]			
		Attribute	**Measure**	**Target**	
		Breeding population size	Number	Long term population trend within the SPA is stable or increasing	
		Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population	
		Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target	
		Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution	

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Barriers to connectivity</td><td>Number; location; shape; area (hectares)</td><td>The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA</td></tr>
</table>
Red-throated Diver (<i>Gavia stellata</i>) [A001]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Non-breeding population size</td><td>Number</td><td>No significant decline</td></tr>
<tr><td>Spatial distribution</td><td>Hectares, timing and intensity of use</td><td>Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population</td></tr>
<tr><td>Forage spatial distribution, extent, abundance, and availability</td><td>Location and hectares, and forage biomass</td><td>Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target</td></tr>
<tr><td>Disturbance across the site</td><td>Intensity, frequency, timing, and duration</td><td>The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution</td></tr>
<tr><td>Barriers to connectivity and site use</td><td>Number; location; shape; area (hectares)</td><td>The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA</td></tr>
</table>
Great Northern Diver (<i>Gavia immer</i>) [A003]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Non-breeding population size</td><td>Number</td><td>No significant decline</td></tr>
<tr><td>Spatial distribution</td><td>Hectares, timing, and intensity of use</td><td>Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population</td></tr>
<tr><td>Forage spatial distribution, extent, abundance, and availability</td><td>Location and hectares, and forage biomass</td><td>Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target</td></tr>
<tr><td>Disturbance across the site</td><td>Intensity, frequency, timing, and duration</td><td>The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution</td></tr>
</table>
</td><td></td></tr>
</table>

Site Code	Site Name	QIs, SCIs and Conservation Objectives			Distance from proposed development
		Barriers to connectivity and site use	Number; location; shape; area (hectares)	The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA	
		- Common Scoter (*Melanitta nigra*) [A065]			
		Attribute	**Measure**	**Target**	
		Non-breeding population size	Number	No significant decline	
		Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population	
		Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target	
		Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution	
		Barriers to connectivity	Number; location; shape; area (hectares)	The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA	
		- Black-headed Gull (*Chroicocephalus ridibundus*) [A179]			
		Attribute	**Measure**	**Target**	
		Non-breeding population size	Number	No significant decline	
		Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population	
		Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target	
		Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution	

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Barriers to connectivity and site use</td><td>Number; location; shape; area (hectares)</td><td>The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA</td></tr>
</table>

- Common Gull (<i>Larus canus</i>) [A182]

<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Non-breeding population size</td><td>Number</td><td>No significant decline</td></tr>
<tr><td>Spatial distribution</td><td>Hectares, timing, and intensity of use</td><td>Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population</td></tr>
<tr><td>Forage spatial distribution, extent, abundance, and availability</td><td>Location and hectares, and forage biomass</td><td>Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target</td></tr>
<tr><td>Disturbance across the site</td><td>Intensity, frequency, timing, and duration</td><td>The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution</td></tr>
<tr><td>Barriers to connectivity and site use</td><td>Number; location; shape; area (hectares)</td><td>The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA</td></tr>
</table>

- Great Black-backed Gull (<i>Larus marinus</i>) [A187]

<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Non-breeding population size</td><td>Number</td><td>No significant decline</td></tr>
<tr><td>Spatial distribution</td><td>Hectares, timing, and intensity of use</td><td>Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population</td></tr>
<tr><td>Forage spatial distribution, extent, abundance, and availability</td><td>Location and hectares, and forage biomass</td><td>Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target</td></tr>
<tr><td>Disturbance across the site</td><td>Intensity, frequency, timing, and duration</td><td>The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution</td></tr>
<tr><td>Barriers to connectivity and site use</td><td>Number; location; shape; area (hectares)</td><td>The number, location, shape, and area of barriers do not significantly impact the site population's access to</td></tr>
</table>
</td><td></td></tr>
</table>

<table>
<tr><th>Site Code</th><th>Site Name</th><th>QIs, SCIs and Conservation Objectives</th><th>Distance from proposed development</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td></td><td></td><td>the SPA or other ecologically important sites outside the SPA</td></tr>
</table>
Little Gull (<i>Hydrocoloeus minutus</i>) [A862]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Non-breeding population size</td><td>Number</td><td>No significant decline</td></tr>
<tr><td>Spatial distribution</td><td>Hectares, timing, and intensity of use</td><td>Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population</td></tr>
<tr><td>Forage spatial distribution, extent, abundance, and availability</td><td>Location and hectares, and forage biomass</td><td>Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target</td></tr>
<tr><td>Disturbance across the site</td><td>Intensity, frequency, timing, and duration</td><td>The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution</td></tr>
<tr><td>Barriers to connectivity</td><td>Number; location; shape; area (hectares)</td><td>The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA</td></tr>
</table>
Fulmar (<i>Fulmarus glacialis</i>) [A009]
<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th></tr>
<tr><td>Population size</td><td>Number</td><td>Long term SPA population trend is stable or increasing</td></tr>
<tr><td>Spatial distribution</td><td>Hectares, timing, and intensity of use</td><td>Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population</td></tr>
<tr><td>Forage spatial distribution, extent, abundance, and availability</td><td>Location and hectares, and forage biomass</td><td>Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target</td></tr>
<tr><td>Disturbance across the site</td><td>Intensity, frequency, timing, and duration</td><td>The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution</td></tr>
</table>
</td><td></td></tr>
</table>

Site Code	Site Name	QIs, SCIs and Conservation Objectives	Distance from proposed development

Barriers to connectivity	Number; location; shape; area (hectares)	The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA

- Herring Gull (*Larus argentatus*) [A184]

Attribute	Measure	Target
Population size	Number	Long term SPA population trend is stable or increasing
Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population
Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target
Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution
Barriers to connectivity	Number; location; shape; area (hectares)	The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA

- Kittiwake (*Rissa tridactyla*) [A188]

Attribute	Measure	Target
Population size	Number	Long term SPA population trend is stable or increasing
Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population
Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target
Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution

Site Code	Site Name	QIs, SCIs and Conservation Objectives			Distance from proposed development
		Barriers to connectivity	Number; location; shape; area (hectares)	The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA	
		• Guillemot (*Uria aalge*) [A199]			
		Attribute	**Measure**	**Target**	
		Non-breeding population size	Number	No significant decline	
		Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population	
		Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target	
		Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution	
		Barriers to connectivity	Number; location; shape; area (hectares)	The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA	
		• Razorbill (*Alca torda*) [A200]			
		Attribute	**Measure**	**Target**	
		Non-breeding population size	Number	No significant decline	
		Spatial distribution	Hectares, timing, and intensity of use	Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population	
		Forage spatial distribution, extent, abundance, and availability	Location and hectares, and forage biomass	Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target	
		Disturbance across the site	Intensity, frequency, timing, and duration	The intensity, frequency, timing, and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution	

Site Code	Site Name	QIs, SCIs and Conservation Objectives	Distance from proposed development
		Barriers to connectivity — Number; location; shape; area (hectares) — The number, location, shape, and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA	
IE004113	Howth Head Coast SPA	**Site Specific Conservation Objectives (12/10/2022)** To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA ○ Kittiwake (Rissa tridactyla) [A188] *Note: Conservation attributes and targets for the SCI species have not been published in the first order site specific conservation objectives for Howth Head Coast SPA.*	2.6 km north of licensed sea disposal site 8.60 km east-northeast of Plot N
IE004172	Dalkey Islands SPA	**Site Specific Conservation Objectives (12/10/2022)** To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA ○ Roseate Tern (Sterna dougallii) [A192] ○ Common Tern (Sterna hirundo) [A193] ○ Arctic Tern (Sterna paradisaea) [A194] *Note: Conservation attributes and targets for the SCI species have not been published in the first order site specific conservation objectives for Dalkey Islands SPA.*	5.2 km south-southwest of licensed sea disposal site 9.40 km southeast of Plot O

4.2 Impact Pathways

The AASR identified likely significant effects that could not be excluded at the screening stage under four impact pathways, as noted in section 4.1 above. Each is now dealt with in turn.

4.2.1 Habitat Loss

4.2.1.1 Potential Effects

DPC confirms that the area of the 3FM Project (as delineated in red in the planning application drawings) does not encroach upon any European site. This is also discussed in section 4.3.3.1 of the AASR.

At a number of other locations, the AASR identified that the red line boundary of the proposed development runs adjacent to the boundary of European sites, as follows:

- Between the terminus of the red line boundary at Sean Moore Park at the Strand Road end, the red line boundary runs parallel to the boundary of South Dublin Bay SAC for 320m of the active travel path. The boundary of South Dublin Bay and River Tolka Estuary SPA is offset by 12m (on average) seaward on the Mean High-Water Mark (MHWM), along this length.
- Between the turn in the active travel path at Port Park along the shoreline of Sandymount Strand south of Plot O and the Irishtown Nature Reserve, the red line boundary runs parallel to the boundary of South Dublin Bay SAC for 625 m. The boundary of South Dublin Bay and River Tolka Estuary SPA is offset by between 5m and 14m seaward on the MHWM, along this length.
- At Shelley Banks beach, the red line boundary runs parallel to and offset from the boundary of South Dublin Bay SAC by 8m (on average) around the boundary of the NORA oil facilities until it meets the Great South Wall (GSW), for a distance of 450m. The red line boundary and the boundary of South Dublin Bay SAC are separated by the width of Shelley Banks Road at this location. The boundary of South Dublin Bay and River Tolka Estuary SPA is offset by between 2m and 5m seaward along this length.

Whilst there are no permanent works in any portion of a European site, there is always the potential for plant and machinery to stray, or temporary storage of goods or materials to occur, albeit unintentionally, within the boundary of a European site. Any loss of habitat within a European site could undermine the achievement of the conservation targets for habitat area, where the target is for the permanent area to remain stable or increasing, subject to natural processes.

Mitigation measures are required to prevent unintentional encroachment into the Annex I habitats of South Dublin Bay SAC and the wetland habitats of South Dublin Bay & River Tolka Estuary SPA.

4.2.1.2 Mitigation Measures

In advance of the commencement of construction activities, fencing shall be erected along the boundary of the 3FM Project from Sean Moore Park to Irishtown Nature Reserve and signage shall be placed on the fencing at intervals to notify construction operatives that no activities can occur beyond the fence line in the European sites of Sandymount Strand.

4.2.2 Diminution of Water Quality and Habitat Deterioration

4.2.2.1 Potential Effects

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.

At construction phase, increased suspended sediment levels could occur 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, services and drainage installation, and installation of jetty furniture and fender systems, etc;
- Road and bridge construction to link the north and south port areas.
- 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, amenity areas, active travel paths, 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 on the Poolbeg Peninsula and the South Port lands. Operational phase pollution prevention management is well understood and actively managed within the port’s operational and maintenance procedures. The potential sources of operational phase water quality diminution 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).

Indirect habitat deterioration effects upon habitats at operational phase are 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 Plot K
- Removal of the existing caisson pier structure at Plot K
- Excavation and reclamation work at Pigeon house road
- Dredging at the Turning circle
- Piling and dredging at Plot 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; and
- Prevailing water levels and the existing flood risk in Dublin Port and the surrounding area.

4.2.2.1.1 Concrete and Cement Pollution

4.2.2.1.1.1 Demolition of existing buildings & structures

Demolition works will be required, and it is likely that this will include localised breaking out of concrete using a rock breaker mounted on an excavator, particularly the removal of the concrete Nib structure at Berth 45 to facilitate the construction of Plot K. This has the potential to create highly alkaline dust in the absence of mitigation, which in turn could find its way into the water column in the Liffey Estuary Lower and pose a threat of pollution.

4.2.2.1.1.2 Berth Construction and Re-fronting

Fresh concrete and cement are highly alkaline and therefore will affect water quality (particularly in terms of pH) if washed into the water body. The impacts in relation to cement and concrete for berth construction (Plot N), re-fronting (Plot K) and the combi wall at the 47A hardstanding area to facilitate the development of this area by the Codling Wind Park, relate to several elements of work. Concrete will be poured in-situ during construction of jetty concrete decks, bank-seats and access ramps. Precast structures on dolphins and bridge beams will be filled with reinforced concrete. Steel combi-walls will have concrete capping beams and cofferdam voids will be filled with reinforced concrete.

4.2.2.1.1.3 SPAR Road and Bridge

There will be five piers within the Liffey Estuary Lower which will largely align with piers on the Tom Clarke Bridge so as to minimise impact on navigation and river flows. On the northern shore there will be an abutment and the southern end of the bridge will tie into the proposed SPAR Viaduct which will run parallel with the R131. The SPAR Viaduct will also require a number of supporting piers. The piers will be constructed within cofferdams with piling required to bed rock level and a concrete pile cap. The piers will then be cast within the cofferdams on top of the pile cap.

4.2.2.1.1.4 Maritime Village

The potential impacts in relation to cement and concrete relate to the re-fronting of the shoreline at the Maritime Village and the construction of slipways, boat dock, operational areas for harbour, landside marina areas and public areas. Concrete will be poured in-situ during construction of these areas and precast structures will be filled with reinforced concrete. Steel combi-walls will have concrete capping beams and cofferdam voids will be filled with reinforced concrete.

4.2.2.1.1.5 Landside ancillary works

The impacts in relation to cement and concrete for the landside works relate to a range of activities mainly including construction and upgrade of access routes, and installation of underground services and drainage systems associated with the road network and active travel path. The works will also include the demolition of a number of buildings within the existing MTL terminal.

Landside works are relatively small scale and are largely separated from aquatic systems by buffer areas. Demolition of concrete structures has the potential to create highly alkaline dust in the absence of mitigation, which could find its way into the aquatic system and pose a threat of pollution. The scale of demolition required is small and some of the structures for removal are prefabricated units.

4.2.2.1.2 Suspended Sediments and Sedimentation

4.2.2.1.2.1 Demolition of existing marine structures

As described in Section 3, decommissioning and demolition of existing structures such as the Poolbeg Oil Jetty is required to facilitate the construction of the new Lo-Lo container terminal with cargo handling area, imports terminal (Plot N), whilst the Sludge Jetty will be demolished to facilitate the dredging of the proposed ship turning circle in front of Pigeon House Harbour. A small existing concrete nib structure will also be demolished to the east of Berth 45 to facilitate the works in the new Ro-Ro terminal (Plot K). A portion of the hardstand at Berth 47 will also be removed to facilitate the dredging of the turning circle. Buildings in the existing MTL terminal will be demolished to facilitate the construction of Plot K, including a number of portacabin structures and warehousing. Three buildings in the existing Stella Maris and Poolbeg Rowing/Yacht Club site will also require demolition.

The existing Poolbeg Oil Superstructure and sludge jetty will be decommissioned, simultaneously dismantled, and cut into sections using typical mechanical methodology before being removed by barge to a suitably licenced facility. It is anticipated that the existing structures will be decommissioned in a phased manner starting at the northern elevation and working back towards shore. It is envisaged that the *in-situ* sections of the existing jetties will be utilised as a demolition platform as the works progress back towards the shore so that no temporary structures will be required to facilitate demolition. Existing piles may be cut at bed level, removed by barge and disposed of to an appropriately licensed facility. Alternatively jetting equipment may be used to loosen the surrounding soil allowing piles to be extracted using a suspended vibratory hammer fitted with a clamp.

Surface water quality could be impacted during the demolition works outlined above through the generation of sediment plumes during pile removal, or during site clearance by exposing soils/rubble to erosion by rainwater and drainage water run-off from the site.

4.2.2.1.2.2 Berth Construction and Re-fronting

The 3FM Project involves the construction of a new berthage at Plot N along the south side of the navigation channel at the eastern extreme of the Port. The works will also include the removal of the Poolbeg Oil Jetty as outlined above. The berth will be used as the new Lo-Lo container terminal. The open piled quay structure will comprise a composite concrete deck slab (precast and *in situ* concrete elements) which will be supported on steel tubular piles installed in a grid pattern (approximately 6m spacing). The exact spacing of the piles will be subject to detailed design.

The deck slab will be deep enough to support crane rails and will be supported on precast concrete beams which will span between precast pile caps placed on top of the tubular steel piles. A reinforced concrete edge beam will be provided along the front edge of the structure. .

Re-fronting of the existing caissons along Berth 44 and Berth 45 at Plot K will also be undertaken. This will require the installation of a combi wall in front of the existing caissons. A combi-wall comprises tubular steel piles installed at intervals with traditional steel sheet piles filling the space between.

Piling is also required at the SPAR road along the southern bank of the Liffey Estuary Lower, at the SPAR Bridge and for the installation of the Linkspan at the Ro-Ro Terminal (Plot K).

Pile installation operations have the potential to cause a temporary increase in suspended sediment due to disturbance of the riverbed materials causing the resuspension of sediments in the water column leading to localised reduction in water quality.

4.2.2.1.2.3 Capital Dredging and Spoil Disposal

Dredging is required to facilitate creation of the proposed turning circle, and to provide sufficient water depth at the berthing pocket for the Lo-Lo Terminal at Area N as described in Section 3. Dredged depths will range from -8.7m CD to -13m CD.

Significant amounts of dredge material will be removed and deposited at the disposal site on the approaches to Dublin Bay over a relatively extended period. Dredging operations will cause temporary suspension and release of sediments at the loading sites. Dumping operations will also give rise to temporary sediment plumes at the licensed disposal site at the approaches to Dublin Bay. Individual loading operations are of relatively short duration and intermittent in nature and the works area is limited. While it is proposed to dispose of most of the dredge spoil at the licensed disposal site which is naturally dispersive for fine sediments, the Marine Institute has considered the top 1.0m of material to be dredged at the Maritime Village to contain widespread levels of Class 2 material making it unsuitable for disposal at sea. This equates to c.70,000m^3 or 6% of the total volume required to be dredged. The underlying sediments were considered suitable for disposal at sea by the Marine Institute.

4.2.2.1.2.4 SPAR Road and Bridge

There are a number of sections of the SPAR Road that have the potential to generate increased suspended sediment in run-off from the construction areas:

- The northern section and southern sections of the SPAR road predominantly within Dublin Port Company Lands - Construction works associated with the road construction can give rise to mobilisation and release of sediments during excavation and exposure of unprotected soils and subsoils, stockpiling and the construction of associated infrastructure. This could potentially result in an increase in suspended sediments concentrations in run-off from the site.
- The Spar Bridge across the Liffey Estuary Lower downstream of the Tom Clarke Bridge – As with the berth construction pilling and cofferdams will be required for the construction of the bridge piers and abutments. Pile installation operations have the potential to cause a temporary increase in suspended sediment due to disturbance of the riverbed materials causing the resuspension of sediments in the water column leading to the localised reduction in water quality.
- The Spar viaduct with twelve piers (including abutments) on the south bank of the river linking the SPAR Bridge with the southern SPAR road at the Maritime Village. AS with the SPAR Bridge the piling required for the piers could potentially result in increase in suspended solids;

4.2.2.1.2.5 Maritime Village

The development of the Maritime Village will require reconfiguration of the existing modified coastline through the removal of some of the existing reclaimed land in the Lower Liffey Channel and limited areas of new reclamation to facilitate the construction of the Maritime village.

4.2.2.1.2.6 Landside ancillary works

Landside construction works are ancillary works required to serve the marine side works. They consist of construction of ramps and deck structures to access linkspans, services and drainage installation, and installation of jetty furniture and fender systems. Other relatively minor boundary and access works are also proposed such as a segregated commuter active travel link which is to be provided connecting the proposed North Wall Square and proposed Liffey-Tolka Project to Sean Moore Park and Sandymount.

Construction works can give rise to mobilisation and release of sediments during excavation and exposure of unprotected soils, stockpiling, and the construction of southern port road infrastructure and active travel link. This could potentially result in an increase in suspended sediment concentrations in run-off from the site.

4.2.2.1.3 Sediment Modelling

Whilst it is clear that pollution prevention measures must be applied to reduce the risk of accidental pollution, the degree to which elevated levels of suspended sediments will occur must be considered further as the marine waters of Dublin Port, the Lower Liffey and Inner Dublin Bay are a turbid environment in the absence of any additional suspended sediments as a result of activities associated with 3FM Project.

MIKE 21 & MIKE 3 Flow Model flexible mesh hydrodynamic modelling software developed by DHI, was used to develop a range of two dimensional and three-dimensional numerical models to represent:

- The pre-project scenario (in this case, post-Alexandra Basin Redevelopment (ABR) Project and MP2 Project); and
- The post-project scenario with the 3FM Project works in place.

These models were used in conjunction with hydrographic survey data and site-specific water quality monitoring data to assess the construction and operational impacts of the 3FM Project in the context of the following coastal processes:

- The dispersion and settlement of sediment plumes generated during dredging operations;
- The dispersion of sediment material disposed of at the offshore dump site;
- The tidal regime;
- Sediment dynamics and the morphological response of the seabed within Dublin Port;
- The inshore wave climate; and
- Flood risk to the surrounding areas.

The effects of the 3FM Project on these coastal processes was then quantified by means of 'difference plots', i.e., post-project minus pre-project conditions. As such, the extent and magnitude of potential effects as a result of the 3FM Project can be clearly identified and compared against baseline conditions. A breakdown of dredging requirements for 3FM Project is shown in Table 4.3.

Table 4.3: Breakdown of dredging requirements for the 3FM Project

Element of Work	Dredge Level (m CD)	Dredge Requirements (m^3)
Poolbeg marina – capital dredging	-3.00	195,000
Plot K – Localised scour protection	Between -11.0 - -8.7	7,500
Turning circle – capital dredging	-10.0	420,000
Wharf N – capital dredging	-13.0	490,500
Total volume to be dredged		**1,113,000**

The modelling assessment is contained at Appendix A to the NIS.

Particle Size Analysis described in Section 13.2.3 of Appendix A indicated that the material to be dredged as part of the 3FM Project is comprised of three discrete fractions with mean diameters of 200 µm, 20 µm and 3 µm, with each fraction constituting approximately 1/3 of the total volume of sediment to be dredged.

Extensive water quality monitoring using real time turbidity measurements during previous dredging campaigns (Dumping at Sea Permits S0024-01 AER 2017 through to AER 2022) has shown that during disposal of dredged fine sands at the licensed disposal site, the fine sand falls rapidly to the bottom and any sediment plume is short lived and is not dispersed widely. However, sediments to be dredged in the 3FM Project are finer and contain a substantial silt fraction.

Therefore, plume modelling was undertaken for the silt fractions with silt losses of 1% at the dredger head being introduced as a sediment source in the bottom layer of the model. The other key parameters relating to the dredging simulations presented in the modelling assessment are set out in Table 13.5 of Appendix A.

As the Liffey channel in Dublin Port is influenced by several fresh-water river inflows and by thermal inputs from various discharging assets, stratification of the water column can occur under certain tidal conditions in the Liffey channel particularly in the central section of the harbour. Therefore, the plume modelling simulations were undertaken using the MIKE 3 Hydrodynamic model described in Section 13.2.3 of Appendix A. This model was coupled with the Sediment Transport module and included temperature and salinity effects. For the purposes of sediment dispersion modelling, i.e., the assessment of dredging operations, the Tolka, Liffey and Dodder river flows were taken as the winter average flows (Table 13.2 of Appendix A).

The flow and temperature characteristics for the power station and other assets that discharge into Dublin Port, and which were represented in the model are shown in Table 13.7 of Appendix A. These variables are based on licensed maximum discharge characteristics as described in relevant Integrated Pollution Control (IPC) licenses issued by the Environmental Protection Agency (EPA) and verified through consultation with relevant stakeholders that operate these assets.

Four individual simulations were run to simulate the dredging operations at Poolbeg marina, Plot K, the Turning Circle and at Plot N. Each simulation was run for one month to represent the full dredging operation in each area.

4.2.2.1.3.1 Dredging at Poolbeg Marina

The dispersion of silts during ongoing dredging is illustrated by a series of plume diagrams that show the suspended sediment concentration of silt in the water column resulting from the dredging operations. Figure 13.18 to Figure 13.21 of Appendix A represent the dispersion of silt material at times of low water, mid flood, high water and mid ebb at a time during the simulated dredging campaign when the suspended sediment concentrations may be expected to be at their highest values (i.e., when the dredger is active at the site).

These figures show that the suspended sediment concentration plumes are confined to the southern half of the navigation channel at all times. The sediment concentrations of the plumes are generally less than 75 mg/l beyond the immediate dredge area. The lateral extent of the 10mg/l plume envelope is generally less than 600m under most tidal conditions but can reach c.900m during certain spring mid-flood conditions. Suspended sediment plumes did not extend beyond the corner of Capital Dock during the 1 month simulation period.

Monitoring of the Liffey and Tolka Estuaries between East Link Bridge and the entrance to the Port at Poolbeg Lighthouse has been undertaken by the ABR and MP2 Projects. Measurements of turbidity at the North Bank Light (adjacent to the Tolka Estuary) over the period 2017 – 2022 have ranged from 0 to 163 NTU with a 95th percentile value of 15.0 NTU and a mean of 3.9 NTU (n=169,576) . This equates to a suspended solids range of 0 to 400 mg/l with a 95th percentile value of 37.5 mg/l and a mean of 9.75mg/l. While there is a relatively small and very local predicted increase in suspended solids due to dredging at the Poolbeg Marina, this falls within the background range measured close to this location during normal Port operations.

The predicted deposition of the silt fractions lost to the water column during the dredging of Poolbeg Marina at the end of a simulated one-month dredging campaign is presented in Figure 13.22 of Appendix A. This Figure shows that there is virtually no sediment material deposited outside of the dredge area and that the deposition of sediment is generally confined to within the immediate area of the dredging operation where deposition levels can reach up to 128g/m^2. It should be noted that dredging proceeds until the specified design depth is reached and any material deposited within the dredge area will be removed by the dredger until the specification is met.

The estimated natural sediment load from the upstream Liffey catchment is estimated at about 200,000 tonnes per annum (DPC Maintenance Dredge AER 2022, Dumping at Sea Permit S0004-02). If dispersed over the Port area between East Link and Poolbeg Light and the Tolka Estuary this is roughly equivalent to a natural sediment load of 30 kg/m^2 in any year. The small level of deposition predicted as a result of dredging at Poolbeg Marina is therefore highly unlikely to pose any risk through siltation.

On the basis of this analysis, it can be concluded that the dredging operations required for Poolbeg Marina will not result in any significant impact to either the water quality in terms of suspended sediments, or the nearby Annex I habitats and wetlands of the European sites in terms of suspended sediments.

4.2.2.1.3.2 Dredging at Plot K

The impact of dredging at Plot K on suspended sediment concentrations is shown by a series of plume diagrams. Figure 13.23 to Figure 13.26 of Appendix A represent the dispersion of silt material at times of low water, mid flood, high-water and mid ebb at a time during the dredging operation when the suspended sediment concentrations may be expected to be at their highest values (i.e., when the dredger is active at the site).

It will be seen from these figures the suspended sediment concentration plumes are confined to the southern half of the navigation channel. The sediment concentration of the plumes is generally less than 35 mg/l beyond the immediate dredge area. As set out in the previous section, this is a relatively small and very local predicted increase in suspended solids due to the dredging works and is well within the background range experienced at this location during normal port operations. The lateral extent of the 10 mg/l plume envelope is generally less than 500 m under most tidal conditions.

The predicted deposition of the silt fractions lost to the water column following the dredging campaign at Plot K is presented in Figure 13.27 of Appendix A. This Figure shows that the volume of material deposited following the dredge operations is generally less than 1.0 g/m^2 and that the deposition of sediment is generally confined to within the immediate area of the dredging operation. By comparison with natural background sediment loads (as described above) such a small level of deposition is highly unlikely to pose any risk through siltation and no further mitigation is required. Again, any material deposited within the dredge area will be removed by the dredger until the specification is met.

On the basis of this analysis, it can be concluded that, when considered in terms of background conditions, the dredging operations required for Plot K will not result in any significant impact to either the water quality in terms of suspended sediments, or the nearby Annex I habitats and wetlands of the European sites in terms of suspended sediments.

4.2.2.1.3.3 Dredging at the Turning Circle

The impact of dredging at the Turning Circle on suspended sediment concentrations is shown by a series of plume diagrams. Figure 13.28 to Figure 13.31 of Appendix A represent the dispersion of silt material at times of low water, mid flood, high-water and mid ebb at a time during the dredging operation when the suspended sediment concentrations may be expected to be at their highest values (i.e., when the dredger is active at the site).

It will be seen from these figures that the concentration of suspended sediment plumes is greater in this area relative to suspended sediment concentrations associated with dredging works at Poolbeg Marina and Plot K. This can be attributed to shallow water depths close inshore at Pigeon House. Even with shallow water depths, the suspended sediment concentration plumes are confined to the southern half of the navigation channel. The sediment concentration of the plumes is generally less than 25 mg/l beyond the immediate dredge area.

As set out previously, this is a relatively small and very local predicted increase in suspended solids due to the dredging works and is well within the background range experienced during normal Port operations. The lateral extent of the 10 mg/l plume envelope is generally less than 500 m under most tidal conditions.

The predicted deposition of the silt fractions lost to the water column following the dredging campaign at the Turning Circle is presented in Figure 13.32 of Appendix A. This Figure shows that the volume of material deposited following the dredge operations is generally less than 32 g/m^2 and that the deposition of sediment is generally confined to within the immediate area of the dredging operation. By comparison with natural background sediment loads (as described above) such a small level of deposition is highly unlikely to pose any risk through siltation and no further mitigation is required.

On the basis of this analysis, it can be concluded that, when considered in terms of background conditions, the dredging operations required for the Turning Circle will not result in any significant impact to either the water quality in terms of suspend sediments, or the nearby Annex I habitats and wetlands of the European sites in terms of suspended sediments.

4.2.2.1.3.4 Dredging at Plot N

The impact of dredging at Wharf N on suspended sediment concentrations is shown by a series of plume diagrams. Figure 13.33 to Figure 13.36 of Appendix A represent the dispersion of silt material at times of low water, mid flood, high water and mid ebb at a time during the dredging operation when the suspended sediment concentrations may be expected to be at their highest values (i.e., when the dredger is active at the site).

It will be seen from these figures the suspended sediment concentration plumes are confined to the southern half of the navigation channel. The sediment concentration of the plumes is generally less than 30 mg/l beyond the immediate dredge area. As set out in the previous section, this is a relatively small and very local predicted increase in suspended solids due to the dredging works and is well within the background range experienced at this location during normal port operations. The lateral extent of the 10mg/l plume envelope is generally less than 750 m under most tidal conditions.

The predicted deposition of the silt fractions lost to the water column following the dredging campaign at Wharf N is presented in Figure 13.37 of Appendix A. This Figure shows that the volume of material deposited following the dredge operations is generally less than 16.0g/m^2 and that the deposition of sediment is generally confined to within the immediate area of the dredging operation. By comparison with natural background sediment loads (as described above) such a small level of deposition is highly unlikely to pose any risk through siltation and no further mitigation is required. Again, any material deposited within the dredge area will be removed by the dredger until the specification is met.

On the basis of this analysis, it can be concluded that, when considered in terms of background conditions, the dredging operations required for Wharf N will not result in any significant impact to either the water quality in terms of suspend sediments, or the nearby Annex I habitats and wetlands of the European sites in terms of suspended sediments.

4.2.2.1.3.5 Disposal of Dredged Material at Sea

Model simulations were run for the disposal of the dredged material over the course of a complete lunar month, which includes the full range of spring and neap tidal flow conditions. The characteristics of the sediment modelled in this simulation are equivalent to those used in the dredging simulations described previously.

The sediment material was introduced into the surface of the model as a point source that moved across the dump site area during the disposal operation. The model then simulated the dispersion, settlement and re-erosion of each fraction of the silt in response to the tidal currents throughout the model area.

The coarser fraction of the sediment, i.e., the sand fraction that had a mean grain size of 200 µm, was found to behave differently relative to the two finer silt fractions that had mean grain diameters of 20 µm and 3 µm. The sand fraction remained on the dump site, whereas the two finer silt fractions were carried away by the tidal currents.

The results of the simulations are given in terms of maximum total suspended sediment concentrations envelope in Figure 13.39 of Appendix A, which depicts the maximum level of the suspended sediment concentration which occurs in each cell at any time during the simulation and is thus an envelope covering all the sediment plume excursions. It will be seen from Figure 13.40 of Appendix A that the sediment plume outside the area of the dump site is less than 200 mg/l and does not extend further than 750 m to the north or south of the dump site. At its closest point, the North-West Irish Sea cSPA is located 780 m to the north of the dump site. The sediment plume does not reach the cSPA. The plume does however occur within the Rockabill to Dalkey Island SAC.

Rockabill to Dalkey Island SAC is an enormous site (in excess of 27,000 ha) but the Annex I reef habitat for which it is designated accounts for less than 1% of the site and occurs at a number of locations throughout the European site. The seabed at the disposal site is not in itself a location of Annex I reef habitat and is not a location of an Annex I habitat QI of the European site.

The intertidal reef community complex is recorded on the south coast of Howth, where the exposure regime of the complex ranges from exposed to moderately exposed reef. Exposed reef is also 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 subtidal reef community complex is recorded off the islands within the site and also off the coast between Lambay Island and Rush Village. The exposure regime here ranges from moderately exposed reef at the Muglins to exposed reef over the remainder of the site. The coastlines of Howth Head, Dalkey Island and Ireland’s Eye are 3.3 km, 5.1 km and 7.5 km respectively from the proposed disposal site. Lambay Island is 16km north of the proposed disposal site and Rockabill is approximately 30 km to the north. As such, the sediment plume does not reach the Annex I reef habitats of the Rockabill to Dalkey Island SAC.

On the basis of this analysis, it can be concluded that the disposal operations associated with the 3FM Project will not result in any significant increases to the background level of suspended sediments and will not, therefore, impact the existing water quality in the greater Dublin Bay, or the Annex I habitats and wetlands of the European sites in terms of suspended sediments.

It should be noted that all of the modelling simulations were based on a set of assumptions and model parameter inputs. These model assumptions must be adhered to for the modelling predictions to remain valid. As such, these model assumptions are prescribed as mitigation measures.

4.2.2.2 Mitigation Measures

In the absence of mitigation, the construction of some elements of the 3FM Project has the potential to result in temporary diminution of water quality which could prevent or delay achieving the conservation objectives for wetland habitats in the South Dublin Bay & River Tolka Estuary SPA and North Bull Island SPA, and marine waters within and surrounding the North-West Irish Sea cSPA, Howth Head Coast SPA and Dalkey Islands SPA. Accidental pollution could also prevent or delay achieving the conservation objectives for Annex I mudflats and sandflats in North Dublin Bat SAC, South Dublin Bay SAC and reef habitats of Rockabill to Dalkey Island SAC.

Similarly, with no mitigation the 3FM Project has the potential to prevent or delay achieving the conservation objectives of these SCIs and QIs during the operation stage, mainly as a result of maintenance dredging operations and the possibility of contaminated run-off entering the aquatic environment.

With these considerations in mind, detailed mitigation has been incorporated into the engineering design of the 3FM Project to minimise its potential impact on the water environment. Extensive mitigation is also proposed during construction and operation phases. Such mitigation includes control of surface water drainage and treatment of site run-off before discharge to the estuary, and best practice measures in relation to all construction activities to control these pressures at source.

4.2.2.2.1 Construction Phase Mitigation Measures

4.2.2.2.1.1 Construction Phase Best Practice Measures

Mitigation measures will be implemented by the contractor and will include the requirements for best practice and adherence to the following relevant Irish guidelines and recognised international guidelines:

- Good practice guidelines on the control of water pollution from construction sites developed by the Construction Industry Research and Information Association (CIRIA, 2001);
- Netregs Guidance for Pollution Prevention series (GPP), Pollution prevention guidelines (PPGs) in relation to a variety of activities developed by the Environment Agency (EA), the Scottish Environmental Protection Agency (SEPA) and the Northern Ireland Environment Agency (NIEA);
    - GPP2: Above Ground oil storage tanks
    - GPP3: Use and design of oil separators in surface water drainage
    - GPP5: Works and maintenance in or near water
    - GPP6: Working at construction and demolition sites
    - GPP8: Safe Storage and disposal of used oils
    - GPP13: Vehicle washing and cleaning
    - GPP20: Dewatering underground ducts and chambers
    - GPP21: Pollution incident response planning
    - GPP22: Dealing with spills
- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (Inland Fisheries Ireland, 2016);
- International Convention for the Prevention of Pollution From Ships, 1973, as modified by the Protocol of 1978 (MARPOL) for domestic waste discharges to the environment;
- International Marine Organisation guidelines; and
- Control of Substances Hazardous to Health (COSHH) Handling of Hazardous Materials.

4.2.2.2.1.2 Suspended Sediment and Sedimentation

Suspended sediment, including all soils, sands and rubble, is the single main pollutant to the aquatic environment generated at construction sites and largely arises from the erosion of exposed soils and sediments by surface water runoff. The adoption of appropriate erosion and sediment controls during construction is essential to prevent sediment pollution.

4.2.2.2.1.2.1 Demolition of existing buildings and structures, berth construction and construction of landside ancillary works

As indicated above these demolition and construction works have the potential to result in a localised impact on water quality.

The mitigation and control measures to address the impact from suspended sediments associated with these activities will follow sound design principals and good working practices as listed in the Netregs (Northern Ireland Environment Agency and the Scottish Environment Protection Agency) Pollution Prevention Guidelines. In addition to the requirements of best practice and relevant guidelines, the following mitigation measures will be implemented by the contractor during the construction phase.

In addition to the mitigation measures referenced in the documents listed above, the following sediment control measures will be installed where necessary;

- 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.

4.2.2.2.1.2.2 Capital Dredging and Spoil Disposal

The Dublin Port Company completed a winter capital dredging season in October 2022 as part of the MP2 Project. This dredging campaign was fully compliant with the requirements of all the development consents, as confirmed by high resolution environmental monitoring results reported in the Annual Environmental Report submitted to the Office of Environmental Enforcement (OEE) in March 2023. Further capital dredging for the MP2 Project was completed in March 2024. The monitoring included year-round real-time measurement of water quality parameters in the Liffey Estuary at four monitoring stations chosen to represent ambient surface water quality in the Liffey Estuary Lower and in the Tolka Estuary water bodies. This was supplemented by sediment plume and hydrographic monitoring that validated Plume Dispersal Modelling, as reported in the Year 7 Environmental Monitoring Report for the ABR and MP2 Projects (RPS, 2023).

A Dredging Management Plan was developed for the MP2 Project and is set out in the *MP2 Project Construction Environmental Management Plan (CEMP) Rev A, November 2021*. The mitigation for dredging operations in the 3FM Project has been informed by the MP2 Project and the ABR Project monitoring and experience working in the same locations. The following key relevant mitigation measures will apply to each dredging campaign in the 3FM Project:

- Loading will be carried out by a backhoe dredger or trailing suction hopper dredger (TSHD).

- The capital dredging activity 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.
- No over-spilling from the vessel will be permitted while the dredging activity is being carried out within the inner Liffey Channel.
- The TSHD pumps will be switched off while the drag head is being lifted and returned to the bottom as the dredger turns between successive lines of dredging to minimise the risk of fish entrainment.
- The dredger's hopper will be filled to a maximum of 4,100 cubic metres (including entrained water) to control suspended solids released at the dumping site. This is equivalent to a maximum quantity per trip of 2,030 tonnes (wet weight).
- A documented Accident Prevention Procedure will be put in place prior to commencement.
- A documented Emergency Response Procedure will be put in place prior to commencement.
- A full record of loading and dumping tracks and record of the material being dumped will be maintained for each trip.
- Dumping will be carried out through the vessel's hull.
- 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.
- When any dredging is scheduled to take place within a 500m radius of power station intakes, the relevant stakeholders will be notified so that precautionary measures can be taken if deemed necessary.

4.2.2.2.1.3 Concrete and Cement Pollution

4.2.2.2.1.3.1 Demolition of existing buildings and structures, berth construction and re-fronting, maritime village construction and construction of landside ancillary works

The impacts in relation to cement and concrete for the 3FM Project include, demolition of buildings and structures, construction of piles and foundations for the berthing areas, quay walls etc., installation of the concrete berthing area areas (to be poured in-situ), and construction of landside ancillary works.

The principal risks and related mitigation measures are:

- Breaking of concrete (associated with structure demolition) has the potential to emit alkaline dust into the receiving environment. A barrier between the dust source and the sensitive receptor (the water body in this case) will be erected to limit the possibility of dust and falling debris from contacting the receptor.
- Concrete use and production shall adhere to control measures outlined in Guidance for Pollution Prevention (GPP5): Works and maintenance in or near water (2017). Any on-site concrete production will have the following mitigation measures: bunded designated concrete washout area; closed circuit wheel wash etc.; and initial siting of any concrete mixing facilities such that there is no production within a minimum of 10 metres from the aquatic zone.

- The use of concrete in close proximity to water bodies requires a great deal of care. Fresh concrete and cement are very alkaline and corrosive and can cause serious pollution in water bodies. It is essential to ensure that the use of wet concrete and cement in or close to any water body is carefully controlled so as to minimise the risk of any material entering the water, particularly from shuttered structures and cofferdams or the washing of equipment.
- Where concrete is to be placed under water or in tidal conditions, specific fast-setting mix is required to limit segregation and washout of fine material / cement. This will normally be achieved by having either a higher-than-normal fines content, a higher cement content or the use of chemical admixtures.

4.2.2.2.1.4 General Construction Works

The risk of water quality impacts associated with works machinery, infrastructure and on-land operations (for example leakages/spillages of fuels, oils, other chemicals and waste-water) will be controlled through good site management and the adherence to codes and practices which limit the risk to within acceptable levels. The following measures will be implemented during construction:

- A detailed works specific Construction Environmental Management Plan (CEMP) will be prepared by the contractor which will meet the minimum requirements of the draft CEMP (under separate cover) and will include detail in respect of every aspect of the works in order to minimise potential impacts and maximise potential benefits associated with the works;
- 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;
- The use of oils and chemicals on-site requires significant care and attention. The following procedures will be followed to reduce the potential risk from oils and chemicals:
    - Fuel, oil and chemical storage will be sited on an impervious base within a bund and secured. The base and bund walls must be impermeable to the material stored and of adequate capacity. The control measures in GPP2: Above Ground Oil Storage Tanks and GPP 26 “Safe storage – drums and intermediate bulk containers” will be implemented to ensure safe storage of oils and chemical.
    - The safe operation of refuelling activities shall be in accordance with GPP 7 “Safe Storage – The safe operation of refuelling facilities”.
- Contingency Planning: A project specific Pollution Incident Response Plan will be prepared by the contractor consistent with DPC's Environmental Emergency Plan and will be in accordance with GPP 21 Pollution Incident Response Planning. Whilst a major incident is highly unlikely to occur in circumstances where the mitigation measures are implemented, the finalisation of the draft CEMP is considered to be best practice. The contractor's Environmental Manager and DPC will be notified in a timely manner of all incidents where there has been a breach in agreed environmental management procedures. Suitable training will be provided by the contractor to relevant personnel

detailed within the Pollution Incident Response Plan to ensure that appropriate and timely actions is taken.

4.2.2.2.2 Operational Phase Mitigation Measures

4.2.2.2.2.1 Channel Maintenance Dredging Works

Maintenance dredging is an ongoing requirement in the port and new licences will be required to cover maintenance of the areas newly dredged in capital dredging works under the 3FM Project. Conditions set in any Dumping at Sea Permit will prescribe strict environmental protection measures. Maintenance dredging will implement comprehensive mitigation measures as set out below:

- Loading will be carried out by a backhoe dredger or trailing suction hopper dredger (TSHD).
- No over-spilling from the vessel will be permitted while the dredging activity is being carried out within the inner Liffey Channel.
- The TSHD pumps will be switched off while the drag head is being lifted and returned to the bottom as the dredger turns between successive lines of dredging to minimise the risk of fish entrainment.
- The dredger's hopper will be filled to a maximum of 4,100 cubic metres (including entrained water) to control suspended solids released at the dumping site. This is equivalent to a maximum quantity per trip of 2,030 tonnes (wet weight).
- Full time monitoring of Marine Mammals within 500m of loading and dumping operations will be undertaken in accordance with the measures contained in the Guidance to Manage the Risk to Marine Mammals from Man-Made Sound Sources in Irish Waters (NPWS 2014).
- A documented Accident Prevention Procedure will be put in place prior to commencement.
- A documented Emergency Response Procedure will be put in place prior to commencement.
- A full record of loading and dumping tracks and record of the material being dumped will be maintained for each trip.
- Dumping will be carried out through the vessel's hull.
- 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.
- When any dredging is scheduled to take place within a 500m radius of power station intakes, the relevant stakeholders will be notified so that precautionary measures can be taken if deemed necessary.

4.2.2.2.2.2 Washwater from Exhaust Gas Cleaning System (EGCS)

DPC will continue to enforce the Marine Notice (Notice to Mariners (No. 26 of 2021) – Prohibition on the Discharge of Exhaust Gas Scrubber Wash Water) prohibiting the discharge of EGCS effluent from existing and new vessels resulting from the 3FM Project into Dublin Port jurisdictional waters until such time as EGCS may be conclusively proven not to impact water or sediment quality. This will ensure that new and larger vessels using the port as a result of the greater capacity offered by the 3FM Project will not have the potential to impact on the water quality of the Lower Liffey Estuary, Dublin Bay or the Tolka Estuary.

4.2.2.2.2.3 General Operational Activities

Storm water runoff will be collected in a dedicated storm water drainage system and will not be permitted to discharge directly to the marine environment from new jetties, and hardstand areas.

The surface water drainage system will consist, *inter alia*, of heavy-duty gullies cast into the reinforced concrete deck, with concrete pipes cast into the in-situ concrete deck structure. These pipes will carry the storm water to an appropriate full retention oil separator for the port operations at Plot, K, Plot N and Plot O which will trap oils and silt prior to being discharged into the harbour waters through a non-return flap valve.

Drainage from the new SPAR Road, bridge and viaduct will be via by-pass oil interceptors given the reduced risk associated with these areas. Sustainable Urban Drainage Systems (SuDs) are not proposed due to limited space and the industrial nature of the operations.

A readily and safely accessible monitoring chamber will be provided on the storm water pipeline as appropriate to allow for inspection and sampling of the storm water being discharged.

The oil interceptors on the surface water drainage network will be selected and sized based on the pollution prevention guideline: “Use and design of oil separators in surface water drainage systems: GPP3 and BS EN 858 which is the European Standard for the design, performance, testing, marking and quality control of separators within the EU. All separators must comply with this standard. In accordance with GPP3 a class 1 bypass separator will be required for general road and car parking areas of the site whilst a class 1 full retention separator will be required for the HGV parking and loading areas within Plot K, Plot N and Plot O.

Foul water from the proposed development will be serviced by a dedicated foul sewer system which will connect to the Uisce Éireann sewer network in the vicinity of the works, the Rathmines to Pembroke 1,500 mm sewer. Part of this sewer will require diversion around Plot K which will be undertaken in advance of the operation of the 3FM Project. The additional loading from the development can be accommodated within the Ringsend Agglomeration without any significant impact on the existing operations in the agglomeration or the ability to achieve the required discharge emission limit values under the wastewater discharge licence.

The 3FM Project, when complete, will be subject to the port’s existing Environmental Management System (EMS) which is accredited to the Port Environmental Review System (PERS) which has gained Dublin Port designation as an ‘Ecoport’ at European level.

The EMS comprehensively identifies environmental aspects and impacts relating to Dublin Port including Tenant operations. Regular review of environmental aspects is required and will facilitate incorporation of any 3FM Project-specific issues that may arise with implementation of mitigation, as necessary. The EMS is supported by a comprehensive suite of Standard Operating Procedures (SOP) providing mitigation of all environmental aspects identified and mechanisms to ensure effective implementation. SOPs have been prepared for oil and chemical spill responses, mineral oil handling, waste handling, monitoring and maintenance of surface water interceptors and handling of drain cleaning waste. Controls are in place for transport, handling and storage of hazardous materials, ship cargo, dry bulk material, surface water runoff, fuelling and bunkering of vessels and ship discharges. Site audits promote best practice and ensure compliance with the EMS requirements.

4.2.3 **Underwater Noise and Disturbance**

4.2.3.1 Harbour Porpoise in Dublin Bay

Dedicated harbour porpoise surveys off the coast of 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 SACs off the southwest coast of Ireland which were designated for *inter alia* harbour porpoise.

A survey of the 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 220 km^2 and approximates in location and areal coverage to the subsequently designated Rockabill to Dalkey SAC (273 km^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 estimated 2021 trend in harbour porpoise 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. It should be noted that widespread decline in harbour porpoise density is not restricted to Dublin Bay. 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 QIs, namely Roaringwater Bay and Islands SAC in Cork and Blasket Islands SAC in 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).

4.2.3.1.1 Dedicated Monitoring by Dublin Port Company

Dublin Port's Alexandra Basin Redevelopment (ABR) Project began construction in 2016. This was the first of three major projects 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 used 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.

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. The great majority of sightings were outside Dublin Harbour with increased number of sightings further east, closer to the dredge spoil grounds (**Figure 4.2**), although in 2022 there were five sightings of harbour porpoise within the breakwater walls of Dublin Harbour (**Figure 4.3**). Some of these were duplicate sightings as Marine Mammal Observers (MMOs) on two dredging vessels operating simultaneously observed the same individual.

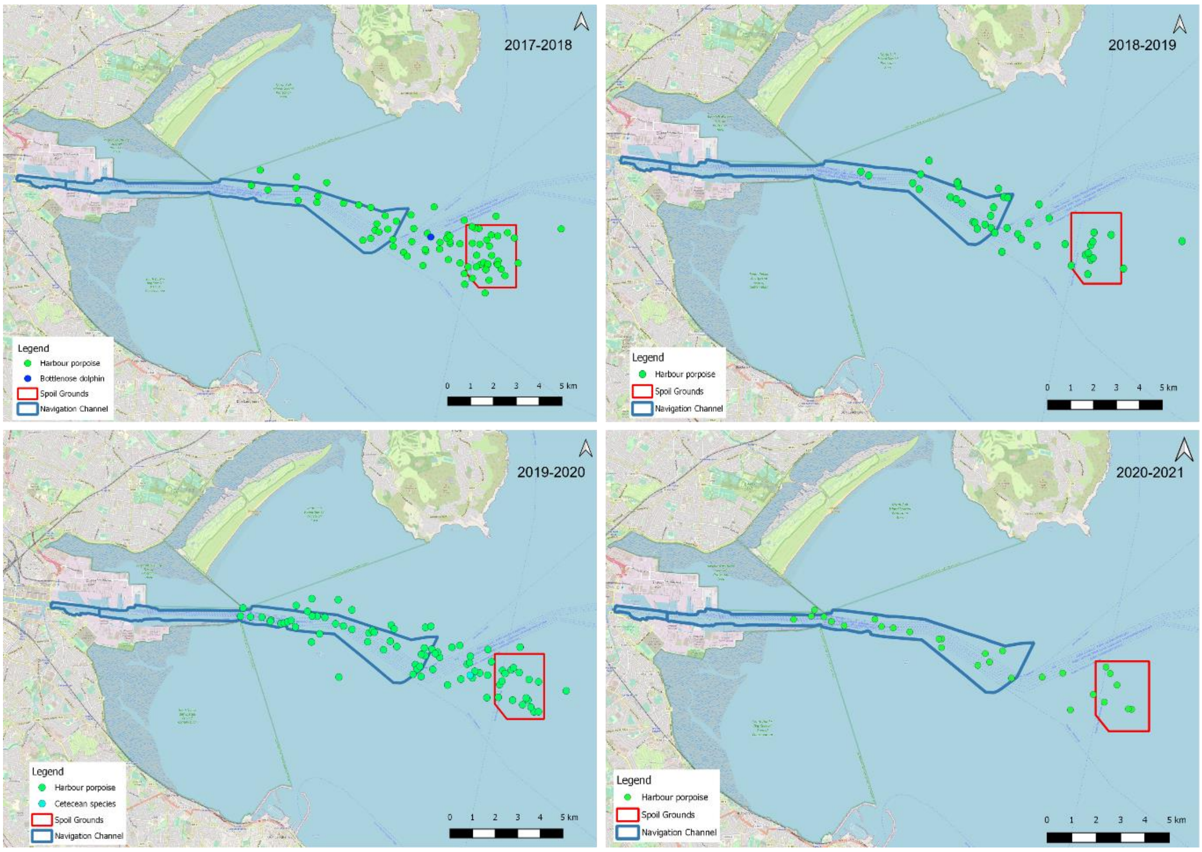


Figure 4.2: Cetacean sightings – ABR capital dredging programme (2017-2021)

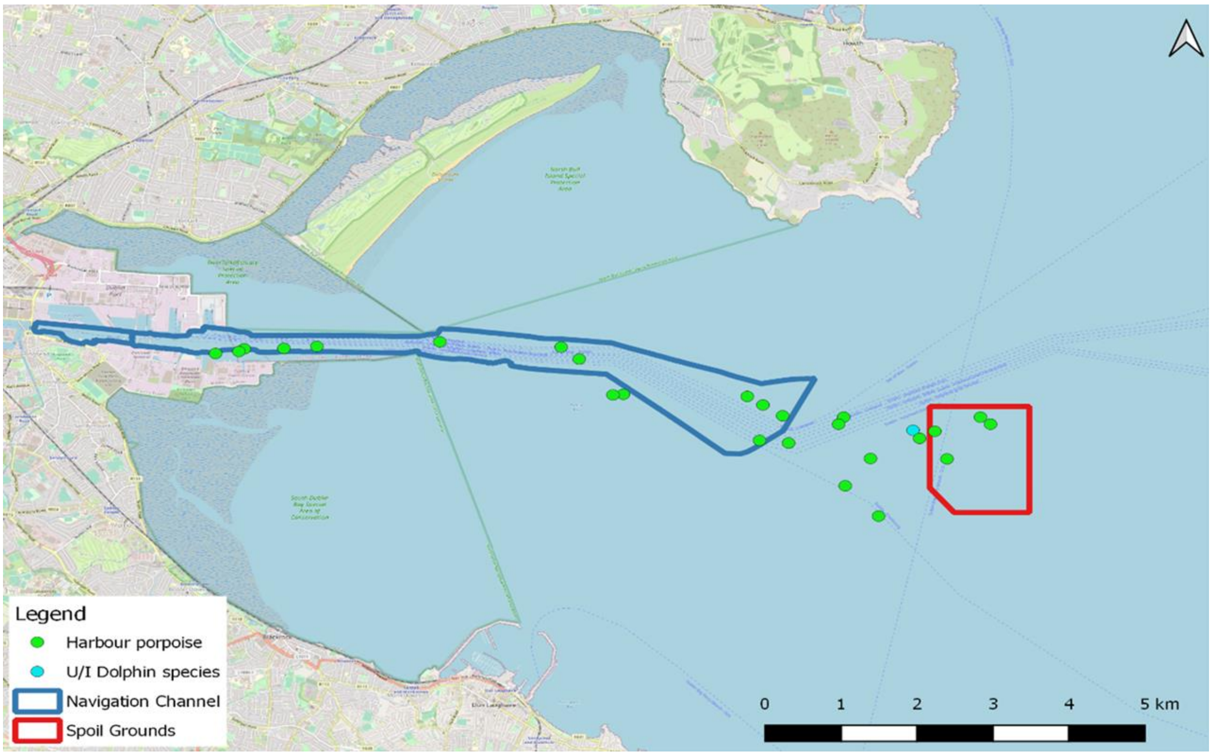


Figure 4.3: Cetacean sightings – MP2 capital dredging campaign (2022)

This monitoring clearly shows that harbour porpoise uses the marine area of Dublin Port, the navigational channel and the dump site within the Rockabill to Dalkey Island SAC.

4.2.3.2 Potential Effects

The principal activities giving rise to elevated underwater noise levels during construction phase of 3FM Project are piling and dredging. During operational phase underwater noise will arise from vessel traffic and annual maintenance dredging.

- Piling activity required to strengthen the quay walls at the proposed Ro-Ro Terminal (Plot K) and the Maritime Village will have a similar underwater noise profile to that carried out previously under the ABR Project, i.e. the construction of a combi-wall using vibro-piling, impact piling and sheet piling.
- The open-piled wharf proposed to form the Lo-Lo Terminal (Plot N) requires tubular piles, similar to the king piles used for the ABR Project.
- Smaller diameter piles will be required at the finger berth marina, while two larger diameter locating piles will be required to secure the proposed ramp at the Ro-Ro Terminal (Plot K).
- Further piling is required to support the SPAR Bridge and the suspended deck linking the bridge to the site of Poolbeg Marina.

- Two types of dredging activity are proposed, Backhoe Dredging and Trailing Suction Hopper Dredging (TSHD). The process has a similar underwater noise profile to work carried out previously at Dublin Port.

These activities are a source of potential effect, as the noise produced during piling and dredging could potentially cause disturbance, displacement and auditory injury or harm. This possibility must be investigated for harbour porpoise as they are susceptible to ensonification in the marine environment. The introduction of additional man-made sound has the potential to result in disturbance or injury, by affecting a mammals' ability to feed, avoid predators, communicate, and navigate the marine environment (Nieukirk *et al,* 2004; Richardson, *et al.*, 2013). The impacts on these mammals include short-term behavioural changes; temporary or permanent auditory damage; and mortality (Southall *et al*., 2019). However, if the frequency resulting from the underwater sound source does not exceed the hearing thresholds of the marine species, they may not experience any effect from this exposure (Carroll *et al.* 2017).

4.2.3.2.1 Hearing Sensitivity

Hearing sensitivity varies between marine mammals, and therefore they have varying sensitivities to noise and susceptibility to noise-induced impacts (NOAA, 2018). Moreover, their reactions to sound have been shown to depend on sound source level, propagation conditions, ambient noise and individual differences (such as age, sex, habitat and previous habituation to noise) (Richardson *et al.*, 1995).

In order to assess the impacts of underwater noise on these species, they are classed into functional hearing groups (Southall *et al.,* 2007; Southall *et al.,* 2019). National Oceanic and Atmospheric Administration (NOAA) Fisheries have produced marine mammal acoustic technical guidance, which provides thresholds for the onset of PTS and TTS in marine mammal hearing for all underwater sound sources. These are based on the assumption that, outside of their hearing ranges, it is unlikely that a species will experience an auditory impact. The hearing weighting function is designed to represent the sensitivity for each group within which acoustic exposures can have auditory effects. The categories includes:

- **High Frequency (HF) cetaceans:** Marine mammal species such as dolphins, toothed whales, beaked whales and bottlenose whales (e.g. bottlenose dolphin)
- **Very High Frequency (VHF) cetaceans:** Marine mammal species such as true porpoises, river dolphins and pygmy/dwarf sperm whales and some oceanic dolphins, generally with auditory centre frequencies above 100 kHz) (e.g. harbour porpoise)
- **Phocid Carnivores in Water (PCW):** True seals, earless seals (e.g. harbour seal and grey seal)

The classification of each species according to these criteria is displayed below in **Table 4.4**. The most sensitive species likely to be present in the survey area is harbour porpoise, which has an estimated auditory band width of 275 Hz to 160 kHz.

Table 4.4: Functional marine hearing groups for marine mammals and basking shark potentially present in the survey areas

Species	Hearing Group	Estimated auditory band width
Harbour porpoise	VHF	275 Hz to 160 kHz
Harbour seal	PCW	50 Hz to 86 kHz
Grey seal	PCW	50 Hz to 86 kHz
Bottlenose dolphin	HF	150 Hz to 160 kHz

Hearing group classification and estimated auditory band width taken from NOAA Marine Mammal Acoustic Technical Guidance (NOAA, 2018) and from Southall, et al (2019) Marine Mammal Noise Exposure Criteria.

4.2.3.2.2 Potential for Injury

The zone of injury in this appraisal is classified as the distance over which a marine mammal can suffer Permanent Threshold Shift (PTS) leading to non-reversible auditory injury. Injury thresholds are based on a dual criteria approach using both un-weighted LP (maximal instantaneous SPL) and marine mammal hearing weighted LE. The hearing weighting function is designed to represent the sensitivity for each group within which acoustic exposures can have auditory effects.

Both the criteria for impulsive and non-impulsive sound are relevant for this study given the nature of the sound sources used during the survey. The relevant PTS and TTS criteria proposed by Southall *et al*. (2019) are summarised in **Table 4.5**.

Table 4.5: PTS and TTS onset acoustic thresholds (Southall et al., 2019)

Hearing Group	Parameter	Impulsive [dB]		Non-impulsive [dB]	
		PTS	TTS	PTS	TTS
High frequency (HF) cetaceans	LP, (unweighted)	230	224	-	-
	LE, (MF weighted)	185	170	198	178
Very high frequency (VHF) cetaceans	LP, (unweighted)	202	196	-	-
	LE, (HF weighted)	155	140	173	153
Phocid carnivores in water (PCW)	LP, (unweighted)	218	212	-	-
	LE, (PW weighted)	185	170	201	181

4.2.3.2.3 Potential for Disturbance

Scientific literature shows that responses to disturbance vary between and within species' and depend on the individual characteristics (body size, condition, sex and personality) and extrinsic factors (environmental context, repeated exposure, prior experience and acclimatisation) (Harding, et al., 2019). These factors will affect whether an individual exhibits an aversive response to sound, particularly in an area with high sound levels related to human activities.

Typically, a 'strong disturbance' is one which has the potential to disturb a marine mammal (or fish) or marine stock in the wild by causing disruption of behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (NMFS, 2005; JNCC, 2010). The United States (US) National Marine Fisheries Service (NMFS) (NMFS, 2005) define strong disturbance in all marine mammals as Level B harassment and for impulsive sound suggests a threshold of 160 dB re 1 µPa (root mean square (rms)).

This threshold meets the criteria defined by JNCC (2010a) as a 'non-trivial' (i.e., significant) disturbance and is equivalent to the Southall et al., (2007) severity score of five or more on the behavioural response scale. Outside of this threshold, behavioural responses are considered trivial, and unlikely to significantly impact the marine animal, or its population status in the wild.

For example, these responses often include minor changes in swimming speed, direction and/or dive profile, modification of vocal behaviour and minor changes to respiratory rate (Southall, *et al.*, 2007). For mild disturbance, a precautionary level of 140 dB re 1 µPa (rms) is used to indicate the onset of low-level marine mammal disturbance effects for all mammal groups for impulsive sound.

For vessel noise (continuous sound), NMFS (2005) guidance sets the marine mammal level B harassment threshold for continuous noise at 120 dB re 1 µPa (rms), which sits approximately mid-way between the range of values identified in Southall *et al.* (2007).

Based upon NMFS criteria, disturbance thresholds in this assessment for marine mammals were 120 dB SPL and 160 dB $L_{E\ \text{single impulse}}$ or 1-second L_E for non-impulsive and impulsive sound, respectively. Criteria for the onset of behavioural effects for fish were 150 dB SPL for fish with no swim bladder (basking sharks) for both impulsive and non-impulsive sound sources, and up to 189 dB SPL for other fish species. For fish species these behavioural changes could include the elicitation of a startle response, disruption of feeding, or avoidance of an area. The document notes that levels exceeding this threshold are not expected to cause direct permanent injury but may indirectly affect the individual fish (such as by impairing predator detection) (Hastings, 2002; Worcester, 2006; WSDOT, 2011) It is also noted that non- impulsive thresholds can often be lower than ambient noise for coastal waters with some human activity, meaning that ranges determined using this limit will tend to be higher than actual ranges.

4.2.3.2.4 Noise Modelling

To understand the implications of the marine activities associated with 3FM Project giving rise to elevated underwater noise, on the conservation objectives for harbour porpoise, and associated implications on fish being prey items of both marine mammals and seabirds, an underwater noise modelling assessment was undertaken, and this is included at Appendix B to the NIS. The assessment uses marine mammal injury criteria published in Southall *et al.,* (2019), which utilised the same hearing weighting curves and thresholds as presented in the preceding regulations document NMFS (2018) (and prior to that, Southall *et al.* (2007)) with the main difference being the naming of the hearing groups and introduction of additional thresholds for animals not covered by NMFS (2018).

For avoidance of doubt, the naming convention used in Appendix B is based upon those set out in Southall *et al*. (2019), and consequently, the assessment utilises criteria which are applicable to both NMFS (2018) and Southall *et al.* (2019).

The induction of temporary or permanent tissue damage and a Temporary Threshold Shift (TTS) in hearing sensitivity, which can have negative effects on the ability to use natural sounds (e.g. to communicate, navigate, locate prey) for a period of minutes, hours or days may constitute such an injury. It is therefore considered that anthropogenic sound sources with the potential to induce TTS in a receiving marine mammal contain the potential for both disturbance and poses a risk to the fecundity of the animal and thus to a part of the local population. Permanent Threshold Shift (PTS) is a permanent hearing injury and is thus a serious impact even with no prolonged or repeated exposure.

The NMFS (2018) and Southall *et al.* (2007 & 2019) guidelines define TTS as a 6 dB shift in the hearing threshold. Although animals are able to recover fully from TTS, particularly as they move away from a source, hearing loss may become permanent if TTS occurs over a sustained period of time (and exceeds the PTS threshold), and if hearing does not return to pre-impact levels. Thus, the distinction between TTS and PTS depends on whether there is complete recovery of the individual's hearing or not.

This assessment considers the potential for a permanent injury to occur by considering the anthropogenic noise in relation to the energy thresholds that could lead to TTS. The impact from peak pressure (LP) levels has also been considered, but the ranges are much smaller than for SEL (even for a single blow) and are therefore not included further in the assessment. Thus, as per the NPWS guidance, this assessment considers whether there is the potential for injury to occur.

The most likely response of a marine mammal to noise levels that could induce TTS is to flee from the ensonified area (Southall *et al.,* 2007) and subsequently the onset of TTS can be referred to as the fleeing response. This is therefore a behavioural response that overlaps with disturbance ranges and animals exposed to these noise levels are likely to actively avoid hearing damage by moving away from the area.

4.2.3.2.4.1 Construction Noise Modelling

The underwater noise from each of the piling scenarios set out in Table 12-2 6 of Appendix B have been modelled. Each of the piling operations have been assessed according SEL. All piling locations were modelled using dBSea. From previous measurement analysis, the peak source level and third octave band information for 1.2 m diameter piling is known. As outlined in Appendix B, piling noise level is proportional to pile diameter. As piling will occur in similar circumstances and location to the measurements, the extrapolation of source levels has been simplified to a simple ratio of diameters or piling energy. In the case of this model the pile diameter was used to extrapolate the source levels by using a correction factor. This correction factor is added to the 1.2 m diameter pile third octave band information and the subsequent levels were summed to obtain the new source level of the new pile size. When calculating the SEL of an impulsive source, the crest factor is an important factor to consider, as its exclusion can lead to overestimating levels. The crest factor is the dB difference between the peak value and the average value of a signal and is subtracted from the SEL source level. From measurements made previously, the crest factor was calculated for each measured location. A crest factor of 30 dB was chosen for the underwater noise model at Appendix B, which is a conservative estimate.

4.2.3.2.4.2 Operational Noise Modelling

Operational phase was also modelled, whereby a vessel source was used to model the shipping traffic as part of the operational phase of the 3FM Project. This source uses third octave band levels found in Abrahamsen (2012) which describe the noise emissions of a vessel travelling at 8 knots. This type of vessel at this speed is an accurate representation of the average shipping traffic arriving at and leaving Dublin Port. Only the SEL level type is necessary to model due to the non-impulsive nature of shipping noise. Two scenarios were modelled: one with the vessel source placed in the port area, and one with the vessel further east in the navigation channel to cover two typical scenarios.

4.2.3.2.4.3 Modelling Results

Figures showing underwater noise risk range maps and modelling result tables presented in the noise modelling results in Appendix B give an overview of the maximum range to limits for various activities modelled and the radius at which Temporary Threshold Shift (TTS) or Recoverable injury to fish may occur. Where “typical ranges/levels” is used this means median to 90th percentile covering all the relevant sites included in that summary. Individual results for all modelled locations and activities are presented in section 12.2.10 of Appendix B.

Results are generally presented as two scenarios based on showing impact of either:

a) **“Short Duration”:**
  - A single blow (impact piling)
  - A one-second exposure (dredging, sheet piling and vessel noise).

This is “instantaneous” impact, in the sense that an animal cannot swim away to avoid the noise.

b) **“Long Duration” - One hours’ activity:**
  - 1200 blows (impact piling)
  - 3600 seconds (dredging, sheet piling and vessel noise).

This is cumulative impact, and the subsea modelling authors have taken the view that an animal can leave the area in under an hour (1 m/s for 3600 seconds is 3.6 km – enough to leave the port area.)

4.2.3.2.4.3.1 TTS Model Predicted Ranges

Short duration model predictions for TTS show that fish have a negligible TTS risk range for a single blow, with the PCW group having typical TTS risk ranges of 140 - 300 m. The VHF group has typical TTS risk ranges of 1,400 – 2,000 m, with a single location, the Ro-Ro ramp showing a TTS risk range to 2,700 m along the dredged channel (extending to the entrance to Dublin Port, between the North Bull Wall and the Great South Wall). There is large variation in the modelled risk ranges due to variation in pile size, depth (2-10 m) and underwater geometry near the various sources (confined or more open) leading to a wide range on transmission losses in different directions.

For one second exposure none of the assessed hearing groups had TTS risk ranges >5m for Dredging or Vessel noise. The PCW group had TTS risk range of <20 m for Sheet piling and the VHF group <180m.

Long duration model predictions for TTS show that risk ranges for TTS for an hour for fish is typically 140 – 220 m, with a maximal risk range of 300 m. Risk ranges for the OCW group after an hours’ exposure typically extend to 800 – 1,100 m.

The risk ranges for both the PCW and VHF group are limited by the extend of the port area and the North and South wall at the inlet to the Dublin Port. Both groups are likely to have their TTS threshold exceeded throughout the modelled area, even in the shallower parts between the dredged channel and Bull Island (only during high tide).

For one hour of continuous TTS noise exposure, none of the groups show measurable exceedances for the Vessel noise.

For dredging, TTS ranges for fish is less than 5 m while the PCW and VHF group show risk range of 30 m and 90 m respectively, for one hours' exposure to dredging.

For sheet piling, fish show TTS risk ranges of approximately 5 m. The PCW group have TTS risk ranges to 2,200 – 2,400 m for sheet piling and the VHF group's risk ranges are again limited by the port enclosed area, with ranges extending to Dublin Port, again, between North Bull Wall and Great South Wall.

4.2.3.2.4.3.2 PTS Model Predicted Ranges

Short duration model predictions for PTS show that fish have a risk range less than 5 m for single blows (their PTS limit is similar to or above the source level). The PCW group had some instances of significant PTS risk ranges (one at 100 m), but risk ranges generally around 30 m. The VHF group has significant PTS risk associated with the impact piling with single blow PTS risk to 500 m for the RoRo ramp for animals in the dredged channel. Typical risk ranges are 250 - 500 m. There is large variation in the modelled risk ranges due to variation in pile size, depth (2-10 m) and underwater geometry near the various sources (confined or more open) leading to a wide range on transmission losses in different directions.

For one second exposure none of the assessed hearing groups had PTS risk ranges >5 m for Dredging or Vessel noise.

Long duration model predictions for PTS show that for 1 hour/1200 blow simulations, the risk ranges for fish are seen as negligible with maximal risk ranges of 150 m and 300 m respectively. For the PCW group animals will have to leave the dredged channel or port area to evade PTS risk, with typical risk ranges of 1,200 – 1,600 m. For the VHF group the shown risk ranges extent to the limits of the modelled area and the PTS threshold is exceeded for all areas inside the port walls.

For one hour of continuous PTS noise exposure, none of the assessed hearing groups had PTS risk ranges >5m for dredging or vessel noise. The PCW group had PTS risk range of <250 m for sheet piling and the VHF group <1,200 m.

In summary, the results of modelling show:

- TTS Limits for the VHF group will be exceeded to ranges up to 2,700 m (PTS 500 m) for single blows, meaning that a very large area should be free from porpoises before impact piling starts as animals cannot simply flee to avoid exceeding limits. For one hour's activity (impact piling or vibro piling) any VHF group animal will have PTS limits exceeded if remaining inside the port (as limited by the North and South wall).
- The PCW group (seals) will have limits exceeded to significant ranges for an hour's exposure, with TTS risk throughout the port area (PTS risk to approximately 1 km).
- The Fishes group and OCW group (otter) have little to no risk of exceeding their TTS (or PTS) limits during impact piling unless stationary and close to the piling for longer durations (30 - 60 minutes). For the largest pile at the Ro-Ro ramp, the Fishes group TTS range for 1 blow is less than 5 m, for 10 min/200 blows the TTS range is approximately 50 m, for 30 min/600 blows the

TTS range is approximately 100 m and for 60 minutes/1200 blows the TTS range is approximately 300 m.

4.2.3.3 Implications for Conservation Objectives

The results of the subsea modelling in Appendix B show (and underwater noise risk range maps illustrate) that elevated levels of underwater noise capable of disturbance and injury do not occur outside of the Bull Walls and do not occur within any SAC designated for marine mammals.

As harbour porpoise is known to occur in the navigational channel and marine waters of Dublin Port, and as the model prediction reveal that TTS and PTS risk ranges occur within the Bull Walls, in accordance with the principles in relation to *ex situ* effects, mitigation must be applied to prevent the achievement of the conservation objective for disturbance to the harbour porpoise community.

In relation to SPA sites, modelled noise levels for impact piling show that the risk range extends into the Tolka Estuary portion of South Dublin Bay & River Tolka Estuary SPA behind Berth 53 on the northern side of the river. This risk range is however for harbour porpoise (in the VHF group) and not for fish. Elevated levels of underwater noise capable of disturbance and injury to fish being the prey species of seabirds, will not occur unless those fish are stationary and close to the piling for longer durations (30 - 60 minutes). This means that there will be no underwater noise effect on the prey species of the seabird SCIs in South Dublin Bay & River Tolka Estuary SPA (the terns), nor on the prey species of the SCIs of Howth Head Coast SPA, Dalkey Island SPA or the North-West Irish Sea cSPA.

4.2.3.4 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 adverse 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 mitigation measures proposed for each potentially significant impact are described below.

4.2.3.4.1 Construction Phase Mitigation Measures

4.2.3.4.1.1 Piling and Dredging Noise Mitigation

Non-piling windows (Table 7-2-26) have been proposed for fish in the accompanying EIAR primarily to prevent impacts on migrating salmon. This will have indirect benefits for marine mammals in terms of reduced foraging impact, and will also reduce the potential marine mammal exposure periods, and so are proposed here also, in **Table 4.6**.

Piling will also only occur between 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 about 39% of that period. During this piling operational period there will also be further significant periods when no piling noise will be generated due to pile set up and station moving, and other operational needs. This will allow extensive unimpeded use of the harbour area by harbour porpoise throughout project construction. Piling noise will be largely contained within the inner port area due to the North and South Bull Walls and the restricted harbour opening. Therefore, no piling related mitigation is required in relation to the wider Dublin Bay area.

Table 4.6: Piling periods denoted by blank rectangles and non-piling windows denoted by orange coloured rectangles

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SPAR bridge			🟧	🟧	🟧							
SPAR Viaduct			🟧	🟧	🟧							
Marina (pontoon piles)			🟧	🟧	🟧							
Area K Berth 45			🟧	🟧	🟧		🟧	🟧				
Area K Ro-Ro ramp locating piles			🟧	🟧	🟧		🟧	🟧				
Turning circle and temporary works piling							🟧	🟧				
Area N outer piles x 5 rigs							🟧	🟧				
Area N inner piles x 5 rigs												
ESB dolphin							🟧	🟧				

Trained and experienced marine mammal observers (MMOs) will implement NPWS Guidelines (2014) during all piling operations. This entails ensuring no marine mammals are within specified monitoring zones prior to start of piling, and a ramp-up procedure when starting impact piling, with 30 seconds inter-blow intervals and lower energy start-up before gradually building up to the necessary maximum output over a period of 20-40 minutes.

Normal monitoring zones are 500 m for dredging and demolition works, and 1,000 m for piling. An extended monitoring zone will be implemented for harbour porpoise during piling at Area N, Area K and ESB Dolphin sites. This 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.

Acoustic monitoring of marine mammals both in the Port and in Dublin Bay will identify any disturbance or displacement of marine mammals to allow adaptive management of mitigation if required. A static acoustic monitoring network using F-PODs, previously implemented for the ABR and MP2 Projects, will continue to operate during the 3FM Project and for two years afterwards at the dump site and at a control site in Dublin Bay to provide information on cetacean activity at these sites.

In addition, passive acoustic monitoring using LIDO and SoundTrap devices will operate in Dublin Port, and in Dublin Bay. LIDO can provide information on background and shipping noise, including linking events to specific vessels. This approach allows particularly noisy vessels to be identified so that appropriate measures outlined in the IMO guidelines (2014) may be taken to control noise emissions from those vessels and support compliance with the Marine Strategy Framework Directive. The SoundTrap is capable of continuous low band recording that can be used to analyse the local soundscape, while simultaneously a high frequency click detector operates, and a snippet extractor takes wideband recordings around the detected clicks.

Trained and experienced marine mammal observers (MMOs) will implement NPWS Guidelines (2014) during all dredging operations. This entails ensuring no marine mammals are within a specified monitoring zone of 500 m prior to start of dredging.

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 500 m 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.

4.2.3.4.1.2 Mitigation of Sediment Plumes from Dredging (Loading and Disposal)

Refer to section 4.2.2.2.1.2.2.

4.2.3.4.1.3 Demolition of structures

Demolition of existing structures will be very local and of relatively short duration. The potential impact on marine mammals due to demolition has been assessed as minor adverse for seals, reflecting their greater use of Dublin Port, and negligible for harbour porpoise.

Mitigation will be through implementation of NPWS (2014) Guidelines, and an appropriate monitoring zone of 500 m. This will ensure that marine mammals are not in the vicinity before demolition works are permitted to commence.

4.2.3.4.1.4 Vessel Collision with Marine Mammals

Additional mitigation will include effort watches by MMOs to ensure marine mammals are remote from ongoing dredging activities. Once normal dredging operations have commenced 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 500 m 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.

4.2.3.4.1.5 Release of Pollutants

Refer to section 4.2.2.2.1.

4.2.3.4.2 Operational Phase Mitigation

4.2.3.4.2.1 Increased vessel traffic/size (noise and collision)

Mitigation in the form of background noise monitoring and characterising the local soundscape to inform an adaptive management approach will be implemented. Passive acoustic monitoring using LIDO and SoundTrap devices will operate in Dublin Port, and in Dublin Bay. LIDO can provide information on background and shipping noise, including linking events to specific vessels. This approach allows particularly noisy vessels to be identified so that appropriate measures outlined in the IMO guidelines (2014) may be taken to control noise emissions from those vessels and support compliance with the Marine Strategy Framework Directive. The SoundTrap is capable of continuous low band recording that can be used to analyse the local soundscape, while simultaneously providing information on marine mammal activity in the area.

International Maritime Organization (IMO) guidelines (Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life, 2014) provide strategies for underwater noise reduction from ships, including operational modifications, noise control at source such as redesign of propellors, closing potential noise paths, and using mass, insulation or buffering to block noise. Many of the vessels entering Dublin Port are of modern design and are generally quieter than older vessels. Future innovations and advances, and retrofitting of older vessels are actively promoted and will further reduce noise emissions. It is anticipated that lowering of individual ship noise levels will continue throughout the period of the 3FM Project.

4.2.4 Aerial Noise and Disturbance

Waterbird species can be vulnerable to aerial noise and visual triggers of disturbance. All of the SPAs considered in this exercise are designated for waders or waterbirds falling into that category. Some sites such as the South Dublin Bay & River Tolka Estuary SPA are immediately adjacent to the proposed 3FM Project, whereas others such as North of Bull Island SPA, North-West Irish Sea cSPA, Howth Head Coast SPA and Dalkey Islands SPA occur at greater distances where the prospect of noise or visual disturbance caused by the proposed 3FM Project diminishes significantly.

Construction and operation the proposed 3FM Project will involve a range of activities emitting aerial noise and associated movement of people, vehicles and vessels. There is a potential for disturbance to the overwintering SCIs of South Dublin Bay & River Tolka Estuary SPA and North Bull Island SPA from construction noise and the presence of construction operatives and their plant at the eastern end of the Port in the marine area of the Lower Liffey, dredging activity in the river channel and boundary works along the southern edge of the Poolbeg peninsula adjacent to the Sandymount Strand part of South Dublin Bay & River Tolka Estuary SPA.

The proposed construction works will be undertaken over period of approximately 15 years, with existing port operations continuing during the construction period. The overwintering SCIs of South Dublin Bay & River Tolka Estuary SPA and North Bull Island SPA forage on Sandymount Strand adjacent to aspects of the proposed 3FM construction works.

At low tide, waders and gulls are distributed throughout the intertidal wetlands of the SPA - on the mudflats in the inner estuary and the sandflats in the outer estuary. Most waterbirds are distributed in the inner, muddier parts of the site. However, as the tide rises, the amount of intertidal foraging area is dramatically reduced, and ultimately disappears and the majority of waterbirds leave this part of the estuary. Those that remain during the high tide period include gulls, Black Guillemots, Red-breasted Mergansers, Great Crested Grebes and Cormorants. Waterbird use of South Dublin Bay is strongly constrained by tidal conditions, and as mentioned above all non-swimming birds, or those that forage in shallow water, are typically forced to leave this part of the estuary as the tide rises.

At operational phase, there is also the potential for disturbance to the overwintering SCIs of these same SPAs from normal operational port activities in the 3FM Project area and from recreation and amenity users of the Active Travel Path, Port Park and Coastal Park.

Tern breeding sites within Dublin Port are indicated by yellow dots in **Figure 4.1**. They feed during the day in the wider Dublin Bay area including the Tolka Estuary and Liffey Channel and evening observations of terns arriving to their roosting areas indicated that most flew in from an easterly and south-easterly direction suggesting that the birds were feeding in the shallow waters of the Kish/Bray and Burford Banks. They also occasionally forage in the wake of ships moving through the port where prey items are brought to the surface by the movement of the ships.

The mean foraging range of Roseate Tern is listed in the South Dublin Bay & River Tolka Estuary SPA Conservation Objectives document (NPWS, 2015) as 12.3 km (mean max. 18.28 km; max. 30 km). The mean foraging range of Common Tern is listed as 8.67 km (mean max. 33.81 km; max. 37 km). The mean foraging range of Arctic Tern is listed as 11.75 km (mean max. 12.24 km; max. 20.6 km). Key prey items for all species are noted as comprising small fish, with crustaceans and other invertebrates also listed for Arctic and Common Terns.

4.2.4.1 Potential Effects of Disturbance

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 sound of construction 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. 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).

Disturbance often implies a short-term or temporary effect that is unlikely to impact upon the individuals or populations of waterbirds concerned. However, it is a term that covers a wide range of responses in waterbirds. Waterbirds are defined as “birds that are ecologically dependent on wetlands’’ (Ramsar Convention 1971). Disturbance is any situation in which human activities cause a bird to behave differently from the behaviour it would be reasonably expected to exhibit without the presence of that activity. In the estuarine environment, disturbance can manifest in a number of forms of varying severity depending on the nature, duration and intensity of the disturbance source:

- Birds looking up or heads raised, temporarily stopping feeding or roosting
- Birds moving away from the cause of the disturbance by walking or swimming before resuming previous activity
- Birds taking flight and landing somewhere in the same feeding area or roosting site
- Birds taking flight and leaving their preferred foraging or roosting area completely

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 for a colony of a different species, the Crested Tern *(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 85 dB(A). A scanning behaviour involving bead-turning was the minimum response, and this, or a more intense response, was observed in nearly all birds at all levels of exposure. However, an intermediate response, an alert behaviour, demonstrated a strong positive relationship with increasing exposure. It was suggested that visual stimulus is likely to be an important component of aircraft noise disturbance (Brown 1990). The proposed development will not be visible from the tern colony.

Wright *et al.* (2010) investigated the effects of impulsive noise on water birds and reported that disturbance at levels above 65.5dB(A) are more likely to result in behavioural response of some kind rather than no response. At above 72.25dB(A) flight with abandonment of the site became the most likely outcome of the disturbance.

Cutts *et al*. (2009) considered impacts to birds utilising the Humber Estuary and summarised the general thresholds due to the potential effects of construction disturbance on birds. Noise up to 50dB(A) is found to have no effect whereas noise between 50dB(A) and 85dB(A) causes head turning, scanning behaviour, reduced feeding and movement to nearby areas. Above 85dB(A), response includes preparing to fly away, flying away and possibly leaving the area **(Figure 4.4**). The authors in that study recommend that ambient construction noise levels should be restricted to below 70dB(A). Birds will habituate to regular noise below this level (Cutts *et al*. 2009).

IECS (2007) showed that birds were found in general, to accept a wide range of steady state noise level from 55dB(A), up to 85dB(A), therefore complete exclusion within up to 250m 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 (within 100m) 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.

A study was undertaken on the effects of piling noise and vibration disturbance in 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 caused by piling activity may also have been due to the increased presence of people.

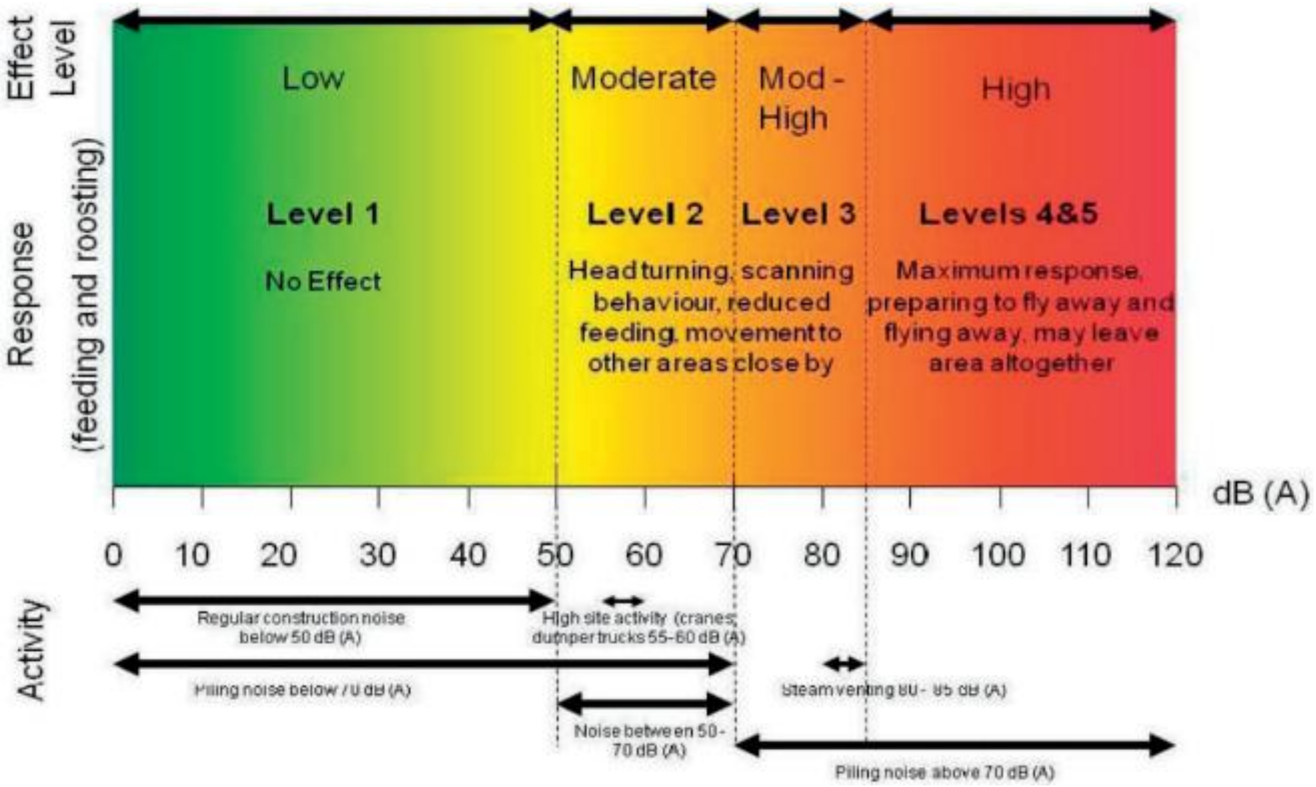


Figure 4.4: Waterbird response to construction disturbance (from Cutts et al. 2009)

Phalan and Nairn (2007) reported on disturbance to waterbirds in South Dublin Bay. Waterbird numbers, human activities and disturbance events were systematically recorded at Irishtown in South Dublin Bay over a three-month period in the winter of 2000/2001. Birds feeding in the study area generally seemed habituated to people, dogs and vehicles that moved predictably along paths, and even to low-flying aircraft.

A review of the impacts of capital and maintenance dredging in the Tamar estuary, in south-west England, was published by Widdows *et al.* (2007). This estuary is a SPA under the EU Birds Directive which requires annual maintenance dredging as well as occasional capital dredging for new installations. Maintenance dredging here involves annual removal of between 5,000 and 200,000 tonnes of dry sediment per year. During two periods of capital dredging in the Tamar, the amount of sediment dredged was between 500,000 and 700,000 tonnes per year. Annual estimates for ten species of wildfowl and waders were analysed over several decades in the Tamar Estuary. There were no significant correlations between overwintering bird numbers and dredging activity. Declines in Teal and Wigeon over 30 years were related to milder winters which changed the migratory patterns of these species. An assessment of the ecological impacts of maintenance dredging noise in the Plymouth Sound and Estuaries European Marine Site reached similar conclusions (Debut Services, 2011)

Another source of disturbance to waterbirds would be the activity of construction workers close to the shoreline. Waders using Mutton Island in Galway Bay were studied over a period of 5 years, during and after the construction of a major sewage treatment plant which was situated between 150 m and 200 m 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 were higher towards the end of the period as human disturbance decreased due to controls on access to the island and because of a high wall around the construction site which screened construction workers from the birds (Nairn, 2005).

At breeding seabird colonies, such as those which occur on some structures in Dublin Port, a response to disturbance can be a moderate response such as a heads up. A greater response is flushing (i.e. the entire colony flying away from the nests). Repeated flushing during incubation or chick-rearing periods can lead to egg or chick loss because of displacement from the breeding site, egg breakage or predation. Effects of flushing on birds that are not attending eggs or chicks include disruption of courtship, nest site defence and prospecting activities.

4.2.4.2 Surveys undertaken to inform the Appraisal

4.2.4.2.1 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 areas, 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 1.85 metres 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 supplemented by late winter counts in early 2024. 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 4.5**).

Since there is no guidance on VP survey protocols for the Republic of 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)

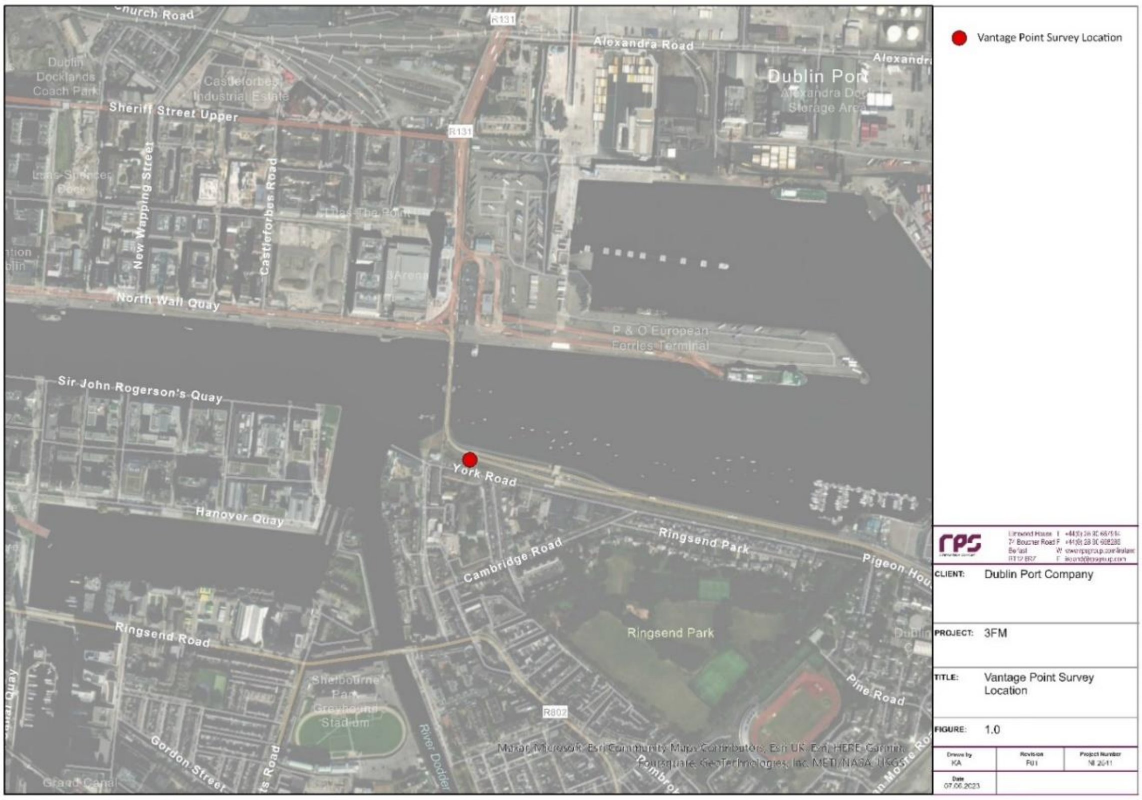


Figure 4.5: Vantage Point Survey Location

4.2.4.2.2 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 4.6**) 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.

Following review of TTTC survey results, SCI waterbird species of South Dublin Bay & River Tolka Estuary SPA and North Bull Island SPA were observed to also use an area outside of any SPA on the Lower Liffey next to the Great South Wall within the ESB Poolbeg cooling water channel and at a weir at the end of the cooling water channel. The Ringsend WwTP outfall also discharges within the ESB cooling water channel.

This is at the eastern end of where it is proposed to locate a new Lo-Lo container terminal (in Dublin Port Masterplan Area N).

Figure 4.6: Through-the-tide-cycle Count Survey Area

Further TTTC surveys were then conducted in the following 2023/24 overwintering period by three surveyors to simultaneously observe numbers of SCI species at (1) this location, (2) south of the Poolbeg peninsula in the wetlands of South Dublin Bay & River Tolka Estuary SPA between the Great South Wall and Irishtown Nature Reserve, and (3) north of Bull Island Bridge in North Bull Island SPA to better understand the numbers of SCI birds present at the Great South Wall in relative context to numbers within the SPA sites at any given time.

4.2.4.2.3 Breeding Tern Disturbance Monitoring

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 4.1**).

- 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 120 m on the north side of the Great South Wall, and approximately 750 m east of the base of the Great South Wall.

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 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 33.4 m from the CDL concrete dolphin and 47.3 m from the SPA Platform. The construction of the western end of a new Lo-Lo container terminal in 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 Berth 47A Hardstand area and the second on the Sludge Jetty, which give unrestricted views of the tern sub-colonies on the CDL concrete dolphin and SPA Platform (**Figure 4.7**).

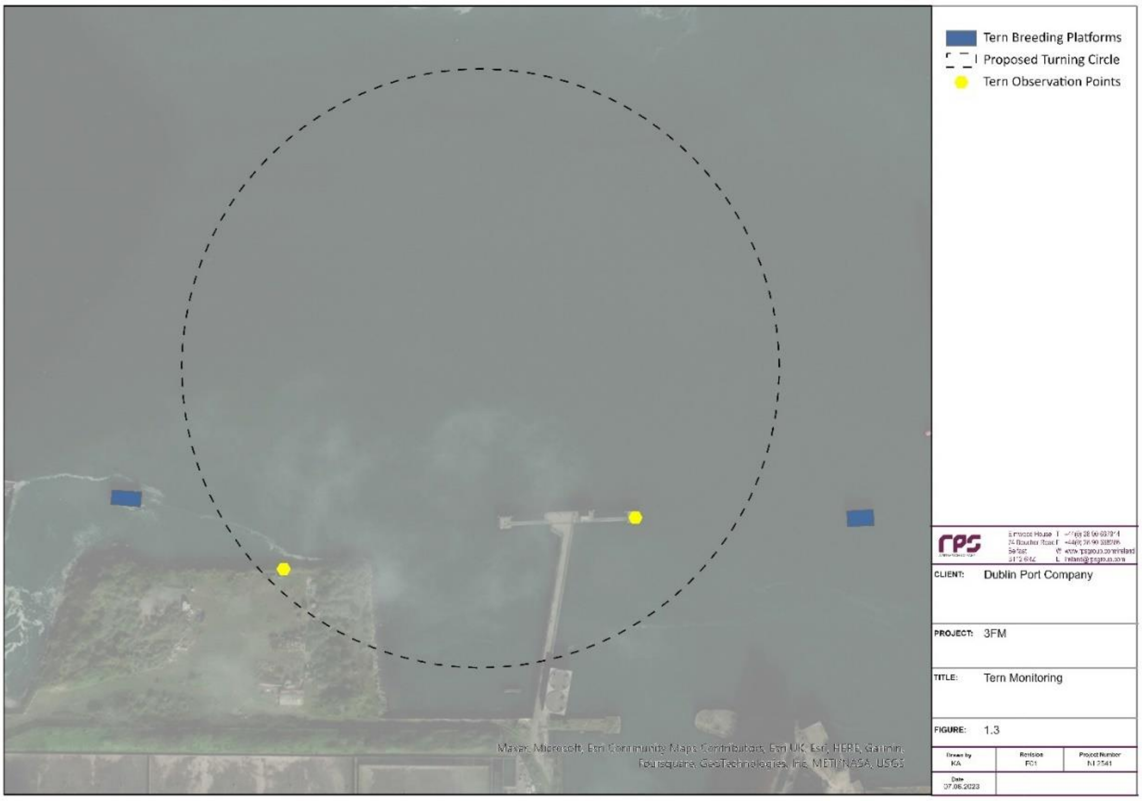


Figure 4.7: Tern Colony Monitoring Locations

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.

4.2.4.2.4 Poolbeg / Great South Wall Disturbance Survey

Once it had been established that SCI waterbird species of South Dublin Bay & River Tolka Estuary SPA and North Bull Island SPA were using the area on the Lower Liffey next to the Great South Wall within the ESB Poolbeg cooling water channel, an opportunity arose to undertake observations during dredging works associated with already permitted development within Dublin Port. To observe potential disturbance behaviours during dredging which was also a key activity of the proposed 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 4.8**).

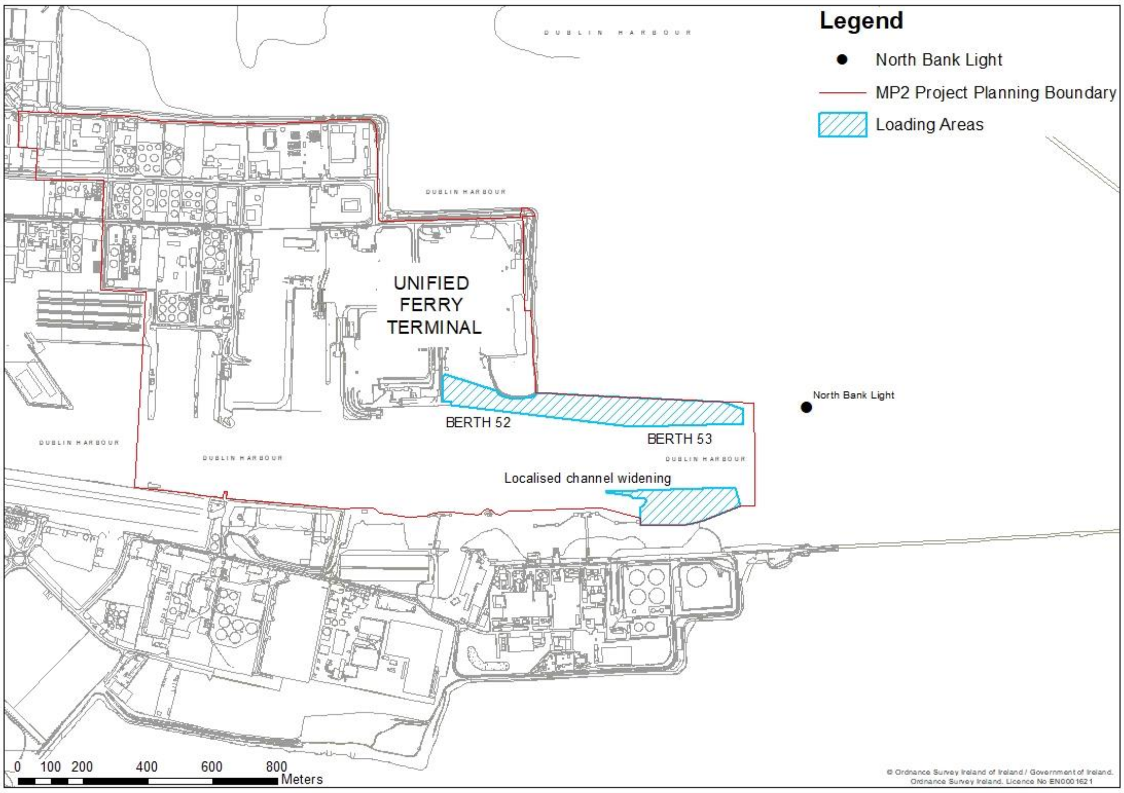


Figure 4.8: Locations dredged in October to December 2022 shown by blue hatched areas

Surveys took place in October and 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 4.8**. Dredging was by barge mounted backhoe 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 areas sampled 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.

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
- Species affected and number disturbed
- Reaction
- 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) and sources of disturbance were also assigned a code.

4.2.4.3 Implications for Conservation Objectives

Results of all the bird surveys are presented in Appendix C to the NIS.

4.2.4.3.1 Construction Effects 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.

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).

4.2.4.3.1.1 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 150 m and 200 m 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 October-November 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 significant numbers for most of the 12- 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.

For SCI species of South Dublin Bay & River Tolka Estuary, there will be no significant decrease in the range, timing or intensity of use of areas by the target species, other than that occurring from natural patterns of variation.

For SCI species of North Bull Island SPA, there will be no significant decrease in the range, timing or intensity of use of areas by the target species, other than that occurring from natural patterns of variation.

For SCI species of the North-West Irish Sea cSPA, the intensity, frequency, timing, and duration of disturbance will not occur at levels that significantly impact the achievement of targets for population size and spatial distribution.

4.2.4.3.1.2 Noise Impacts

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 4.4**). 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).

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, was undertaken and is presented as Appendix D to the NIS. This airborne noise modelling 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.

SCI species of birds in all parts of the South Dublin Bay & River Tolka Estuary SPA, are expected to rapidly habituate to noise from pile driving operations and there will be no significant decrease in the range, timing or intensity of use of areas by the target species, other than that occurring from natural patterns of variation.

For SCI species of North Bull Island SPA, there will be no significant decrease in the range, timing or intensity of use of areas by the target species, other than that occurring from natural patterns of variation.

For SCI species of the North-West Irish Sea cSPA, the intensity, frequency, timing, and duration of disturbance will not occur at levels that significantly impact the achievement of targets for population size and spatial distribution.

4.2.4.3.2 Construction Effects on Breeding Seabirds

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.

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 650 m x 150 m open pile Lo-Lo wharf. This will entail the driving of 216 tubular piles of 1.626 m diameter toward the outer face of the wharf and 2,275 tubular piles of 1.219 m in diameter to form the bulk of the support for this structure.

4.2.4.3.2.1 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.

Nonetheless, the conservation objectives for all three tern species in South Dublin Bay & River Tolka Estuary include a target for disturbance at their breeding site, that human activities should occur at levels that do not adversely affect the breeding common tern population. Additionally for common tern, to achieve the conservation objectives for the species, there must be no significant decline in breeding population abundance (apparently occupied nests (AONs)) or productivity rate (fledged young per breeding pair). Given the scale of the works proposed in proximity to the breeding sites of the tern colony, mitigation must be prescribed to prevent the attainment of the conservation objectives for these breeding SCI species.

4.2.4.3.2.2 Noise Impacts

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 an adverse 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 4.2.3. This assessment finds that noise from piling is very unlikely to lead to more than a slight, short-term impact at a population level in marine, estuarine resident and migratory species of fish. Effects of underwater noise on the prey species of seabirds is therefore 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 (refer Appendix D), and are due to demolition and dredging works in their immediate vicinity. This is 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.

Noise measurements taken at Dublin Port for the previous MP2 Project in 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 site at the piling exclusion zone of 75m distance.

The conservation objectives for all three tern species in South Dublin Bay & River Tolka Estuary include a target for disturbance at their breeding site, that human activities should occur at levels that do not adversely affect the breeding common tern population. It is considered that the effects of construction noise shall not prevent or delay the achievement of the conservation objectives for the three tern SCI species of South Dublin Bay & River Tolka Estuary SPA.

4.2.4.3.3 Operational Phase Effects

Potential impacts arising during the operational phase of the proposed 3FM Project consist of 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.

4.2.4.3.3.1 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 operational use of the Dublin Port estate 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 operational phase. The portion of South Dublin Bay & River Tolka Estuary SPA to the south of the 3FM development 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 3FM during operation will be negligible and not significant at population level.

For SCI species of South Dublin Bay & River Tolka Estuary, there will be no significant decrease in the range, timing or intensity of use of areas by the target species, other than that occurring from natural patterns of variation.

For SCI species of North Bull Island SPA, there will be no significant decrease in the range, timing or intensity of use of areas by the target species, other than that occurring from natural patterns of variation.

4.2.4.3.3.2 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 as potentially important for feeding waders but it is not within South Dublin Bay & River Tolka Estuary SPA. The intertidal area comes close to the proposed Area 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 proposed 3FM Project, and will still be accessible, it is likely that its western portion may become less unattractive to feeding waterbirds given the proximity and height of the Lo-Lo terminal once constructed.

In 2023, NPWS published a 'Comparison of Ireland's Special Protection Area and Important Bird Area Networks' (NPWS, 2023). This area is not included as an important bird area in Figure 41c of that report, which illustrates South Dublin Bay & River Tolka Estuary SPA with the boundary of the latest version of the associated IBA. This area is also not a coded Dublin Bay I-WeBS count sub-site but is included in the survey areas for the Dublin Bay Birds Project (DBBP) 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 (refer Appendix D) 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 (e.g. Vernon, 1972) and it is reasonable 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 ESB Poolbeg cooling water and Ringsend WwTP effluent which both discharge out the cooling water channel.

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 Lo-Lo terminal 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.

For SCI species of South Dublin Bay & River Tolka Estuary, there will be no significant decrease in the range, timing or intensity of use of areas by the target species, other than that occurring from natural patterns of variation.

For SCI species of North Bull Island SPA, there will be no significant decrease in the range, timing or intensity of use of areas by the target species, other than that occurring from natural patterns of variation.

4.2.4.3.3.3 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. The majority of birds passed at heights above 20 m (77%). Only 11% were below 5 m 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 31.5 m, and a running surface that is 1.85 m 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 20 m in general, the likelihood of bird collision with the structure is low and the risk is negligible and not significant.

For SCI species of South Dublin Bay & River Tolka Estuary, the SPAR bridge will not delay or prevent achievement of the conservation target for the long-term population trend for the non-breeding SCIs to remain stable or increasing

For SCI species of North Bull Island SPA, the SPAR bridge will not delay or prevent achievement of the conservation target for the long-term population trend for the non-breeding SCIs to remain stable or increasing

4.2.4.4 Mitigation Measures

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.

The programme to monitor winter wetland birds shall include area OUL63 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.

Where known Black Guillemot nesting sites are likely to be unavailable to birds in the following season due to 3FM 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.

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.

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.

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.

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.

No rock breaking shall take place during demolition of the Sludge Jetty within 75 m of tern sub-colonies at CDL or ESB Platform during May and June.

No piling shall take place within 75 m of tern sub-colonies at CDL or ESB Platform during May and June. At the beginning of each working day or following any break lasting 30 minutes or longer, all piling will be subject to a soft start, to allow birds to become habituated to the increasing noise levels.

Capital Dredging for the turning circle shall take place outside the tern breeding season (i.e. 1st April – 30th July).

The existing Sand Martin colony at the western side of the mouth of Pigeon House Harbour will remain untouched by 3FM works. Any works proposed in the vicinity will be planned so as to minimise disturbance during the bird breeding season. In addition, a 4 m high screen will be erected between demolition works in the vicinity of Pigeon House Harbour and the Sand Martin colony to prevent disturbance of birds. The screen shall be in place prior to start of the nesting season (by mid-April) if demolition is planned during the nesting season.

4.2.5 **Effectiveness of Mitigation Measures**

4.2.5.1 Evidence of Effectiveness

The Annual Environmental Monitoring Reports** required under EPA Dumping at Sea Permit S0024-01 summarise environmental monitoring works undertaken during construction of ABR Project to confirm the efficacy of the mitigation measures implemented as part of construction phase of ABR.

** 1st AER available at http://www.epa.ie/licences/lic_eDMS/090151b280601fc9.pdf
2nd AER available at http://www.epa.ie/licences/lic_eDMS/090151b2806845db.pdf

4.2.5.1.1 Water Quality

In agreement with the competent authority, monitoring stations were established in the Port to provide detailed information on relevant water quality parameters. They measure real time water quality and continuously relay the data to a shore-based location for compliance assessment. Trigger levels of dissolved oxygen (falling below 6 mg/l) and peak suspended solids (rising more than 100 mg/l above background levels) that initiate investigations have been set.

High frequency water quality monitoring at three locations in the port has shown water quality to be satisfactory during the period reported. Occasional low dissolved oxygen and high turbidity values were recorded but these were of no environmental significance and did not reflect any environmental effects of construction activities associated with the ABR Project.

Data collected during a maintenance dredging campaign provides evidence that the disposal of dredge material at the disposal site had no measurable effect on water quality outside the dumpsite, or even within the dump site at relatively short distances away from the spot where the dredger released its load. The same measures proposed in the ABR Water Quality Management Plan and the MP2 Water Quality Management Plan are proposed in a 3FM Project Water Quality Management Plan.

4.2.5.1.2 Marine Mammals

Part of the environmental monitoring being undertaken as part of compliance with ABR and MP2 project consents includes visual and acoustic monitoring of marine mammals. This also falls under the reporting procedure of the EPA Annual Environmental Report (AER) associated with Dumping at Sea Permit S0024-01.

In 2018, MMOs carried out 24 pre-start watches and 1,134 monitoring watches in advance of the start of dredging operations. Monitoring effort-watches were carried out during all transits of the dredging vessel between the loading sites and the disposal site.

A total of 105 mitigation measures were instigated by the MMOs during dredging operations, which all related to marine mammals being present in the Monitoring Zone. On the majority of occasions (102 out of 105) the dredge vessel relocated to a loading or dumping site where marine mammals were not present within the 500m Monitoring Zone. On the remaining three occasions, operations were permitted to commence once the animal had left the Monitoring Zone for a period of more than 30 minutes.

This demonstrates that the Marine Mammal Management Plan (MMMP) implemented for construction of the ABR Project contains mitigation that is effective. The same measures proposed in the ABR MMMP and MP2 MMMP are to be applied in the 3FM MMMP.

4.2.5.2 Implementation of Mitigation Measures

Mitigation measures set out in the CEMP will form part of the Contract Documents for the construction stage to ensure that the appointed contractor undertakes the works required to implement the mitigation measures.

DPC has an established liaison group for the MP2 Project which includes representatives of DPC, the Contractor, Dublin City Council (DCC) and The Department of Housing, Local Government and Heritage Foreshore Unit. The group meets at quarterly intervals each year with an agenda and minutes taken of the meetings. It is proposed that this liaison group will be maintained to provide environmental oversight of the construction phase of the 3FM Project also.

DPC will appoint a suitably qualified person to the role of Environmental Facilities Manager (Environmental Clerk of Works) to monitor the 3FM Project construction works. The Environmental Facilities Manager will have the authority to:

- review method statements;
- oversee work;
- provide instruction to the Contractor(s); and
- require the temporary cessation of works, where necessary.

The Environmental Facilities Manager will provide monthly reports to the members of the liaison group. The Environmental Facilities Manager will work closely with the Contractor's site supervisors to monitor activities and ensure that all relevant environmental legislation is complied with and that the requirements and implementation of the mitigation measures and relevant management plans of the CEMP are implemented.

4.3 Conclusion of the Stage 2 Appraisal

Having regard to the relevant legislative requirements and methodology, a Stage 1 Screening appraisal was undertaken as to whether or not the proposed 3FM Project is likely to have a significant effect on European sites, as described in detail in the AASR.

LSEs could not be excluded at screening stage for the following European sites, without further evaluation and analysis, or the application of measures intended to avoid or reduce the harmful effects of the proposed development on the sites concerned, and hence these European sites were “screened in” for Stage 2 Appropriate Assessment:

- The possibility of likely significant Underwater Noise and Disturbance effects on:
  - the Harbour porpoise community of:
    - Rockabill to Dalkey Island SAC;
    - Codling Fault Zone SAC;
    - Lambay Island SAC;
  - the Grey seal population of Lambay Island SAC;
  - the Harbour seal population of Lambay Island SAC;
- The possibility of likely significant Water Quality and Habitat Deterioration effects on:

  - Mudflats and sandflats not covered by seawater at low tide in North Dublin Bay SAC;
  - Mudflats and sandflats not covered by seawater at low tide in South Dublin Bay SAC;
  - Annual vegetation of drift lines in South Dublin Bay SAC;
  - Reefs in Rockabill to Dalkey Island SAC;
  - Reefs in Lambay Island SAC;
  - Submarine structures made by leaking gases in Codling Fault Zone SAC;
  - the intertidal wetland areas of the Tolka Estuary as a resource for the regularly occurring migratory waterbirds of:
    - South Dublin Bay & River Tolka Estuary SPA;
    - North Bull Island SPA; and
  - the prey resources available for the seabird Special Conservation Interest species of:
    - South Dublin Bay & River Tolka Estuary SPA;
    - North Bull Island SPA;
    - Howth Head Coast SPA
    - Dalkey Island SPA; and
    - North-West Irish Sea cSPA
  - the prey resources available for the marine mammal Qualifying Interest species of:
    - Rockabill to Dalkey Island SAC
    - Lambay Island SAC; and
    - Codling Fault Zone SAC
- The possibility of likely significant Aerial Noise and Visual Disturbance effects on:
  - the breeding waterbird Special Conservation Interest species of South Dublin Bay & River Tolka Estuary SPA;
  - the non-breeding waterbird Special Conservation Interest species of South Dublin Bay & River Tolka Estuary SPA; and
  - the non-breeding waterbird Special Conservation Interest species of North Bull Island SPA.

As set out in this NIS, a subsequent Stage 2 Appropriate Assessment appraisal of the implications of the proposed 3FM Project on European sites in view of their conservation objectives was then undertaken so as to enable the competent authorities to determine if the proposed development would adversely affect the integrity of any European site.

Having considered the further investigation and analysis, which is set out in the NIS, the conclusion of this Stage 2 Appropriate Assessment appraisal is that the competent authorities can conclude, based on best scientific knowledge, that there will be no adverse effects upon the integrity of any European site consequent upon the implementation mitigation measures prescribed in this NIS. Accordingly, the competent authorities can conclude, beyond reasonable scientific doubt, that the construction and operation of the 3FM Project, whether considered alone or in combination with other plans and projects, will not adversely affect the integrity of any European site.

APPENDICES

Appendix A: Sediment Plume Assessment

13 MATERIAL ASSETS - COASTAL PROCESSES

13.1 Introduction

This chapter assesses the potential impact of the 3FM Project on the coastal processes in the Dublin Port and Dublin Bay areas and includes information about the tidal regime, the inshore wave climate and sediment dispersion to enable the competent authority to assess the potential impacts on coastal processes.

The assessment presented in this chapter is based on the project description detailed in Chapter 5 of this EIAR. Additional technical information of relevance to this chapter can also be found in the following appendices:

- Appendix 13-1 – Detailed description of hydraulic modelling software.
- Appendix 13-2 – Model calibration and validation.
- Appendix 13-3 – Dispersion of thermal plume modelling validation report.
- Appendix 13-4 – Cumulative impact of sediment deposition and dispersion with activities permitted under (S0004-03 and S0024-02)
- Appendix 8-2 - Particle Size Analyses (*used to inform the sediment transport modelling*).

13.2 Assessment Methodology

13.2.1 Modelling Methodology

RPS used the MIKE 21/3 hydrodynamic numerical modelling software package developed by DHI, to address potential coastal processes issues. This was achieved by developing a range of two dimensional and three dimensional numerical models to represent:

- The pre-project scenario (in this case, post-Alexandra Basin Redevelopment (ABR) Project and MP2 Project); and
- The post-project scenario with the 3FM Project works in place.

These models were used in conjunction with hydrographic survey data and site specific water quality monitoring data to assess the construction and operational impacts of the 3FM Project in the context of the following coastal processes:

- The dispersion and settlement of sediment plumes generated during dredging operations;
- The dispersion of sediment material disposed of at the offshore dump site;
- The tidal regime;
- Sediment dynamics and the morphological response of the seabed within Dublin Port;
- The inshore wave climate;
- Dispersion of thermal plumes relating to industrial activities within Dublin Port; and
- Flood risk to the surrounding areas.

The impact of the 3FM Project on these coastal processes has been quantified by using difference plots throughout this chapter, i.e., post-project minus pre-project conditions. As such, the extent and magnitude of potential impacts as a result of the 3FM Project can be clearly compared against baseline conditions. To conclude the assessment, mitigation measures are proposed to reduce impacts, where appropriate. This enables a “with mitigation” assessment to be made of any residual impact as a result of the construction and operational phases of the 3FM Project and/or in combination with other projects in the vicinity of Dublin Port.

13.2.2 Coastal Process Modelling Software

A suite of coastal process models, based on the MIKE software developed by DHI, was used to assess the potential impact of the 3FM Project on the coastal processes within Dublin Port and Bay. The MIKE system is a state of the art, industry standard, modelling system, based on a flexible mesh approach. This software was developed for applications within oceanographic, coastal and estuarine environments.

A brief synopsis of the MIKE system and modules used for this assessment is outlined below whilst a full description can be found in Appendix 13-1:

1. **MIKE 21 & MIKE 3 Flow Model FM system** - Using these flexible mesh modelling systems, it is possible to simulate the mutual interaction between currents, waves and sediment transport by dynamically coupling the relevant modules in both two and three dimensions. Hence, a full feedback of the bed level changes on the waves and flow calculation can be included.

2. **The Hydrodynamic module** – Simulates water level variations and flows in response to a variety of forcing functions in lakes, estuaries and coastal regions. The HD Module is the basic computational component of the MIKE 21 and MIKE 3 Flow Model systems providing the hydrodynamic basis for the Sediment Transport and Spectral Wave modules

   The Hydrodynamic module solves the two/three-dimensional incompressible Reynolds averaged Navier-Stokes equations subject to the assumptions of Boussinesq and of hydrostatic pressure. Thus, the module consists of continuity, momentum, temperature, salinity and density equations. When being used in three dimensions, the free surface is taken into account using a sigma coordinate transformation approach whereby the vertical layer is divided into a discrete number of layers fixed proportionally to water depth.

3. **The Spectral Wave module** – Simulates the growth, decay and transformation of wind-generated waves and swell in offshore and coastal areas and accounts for key physical phenomena including wave growth by wave action, dissipation, refraction, shoaling and wave-current interaction.

4. **The Sediment Transport module** - Simulates the erosion, transport, settling and deposition of sediment in marine and estuarine environments and includes key physical processes such as forcing by waves, flocculation and sliding. The module can be used to assess the impact of marine developments on erosion and sedimentation patterns by including common structures such as jetties, piles or dikes.

5. **The Mud Transport module –** Simulates the erosion, transport, and deposition of *cohesive* sediments in water bodies. This multi-fraction, multi-layer model incorporates wave dynamics, salt-flocculation, and sediment consolidation and can be used to assess the spreading and behaviour of dispersion of sediment using built-in dredging module.

13.2.3 Coastal Process Models and Data Sources

The models used to assess the impact of the 3FM Project on the coastal processes were developed from RPS' present-day Dublin Bay model.

RPS' present-day Dublin Bay model was created using flexible mesh technology to provide detailed information on the coastal processes around Dublin Port and Dublin Bay. The model uses mesh sizes varying from 250,000 m^2 (equivalent to 500 m x 500 m squares) at the outer boundary of the model down to a very fine 32 m^2 (equivalent to *c.*6 m x 6 m squares) within the vicinity of the proposed development The bathymetry of this model was developed using data gathered from hydrographic surveys of the Dublin Port and Tolka estuary which have been regularly undertaken since 2017 and supplemented by data from the Irish National Seabed Survey, INFOMAR and other local surveys collated by RPS for the Irish Wave and Water level Study (ICWWS, 2020). The extent, mesh structure and bathymetry of this model is illustrated in Figure 13.1.

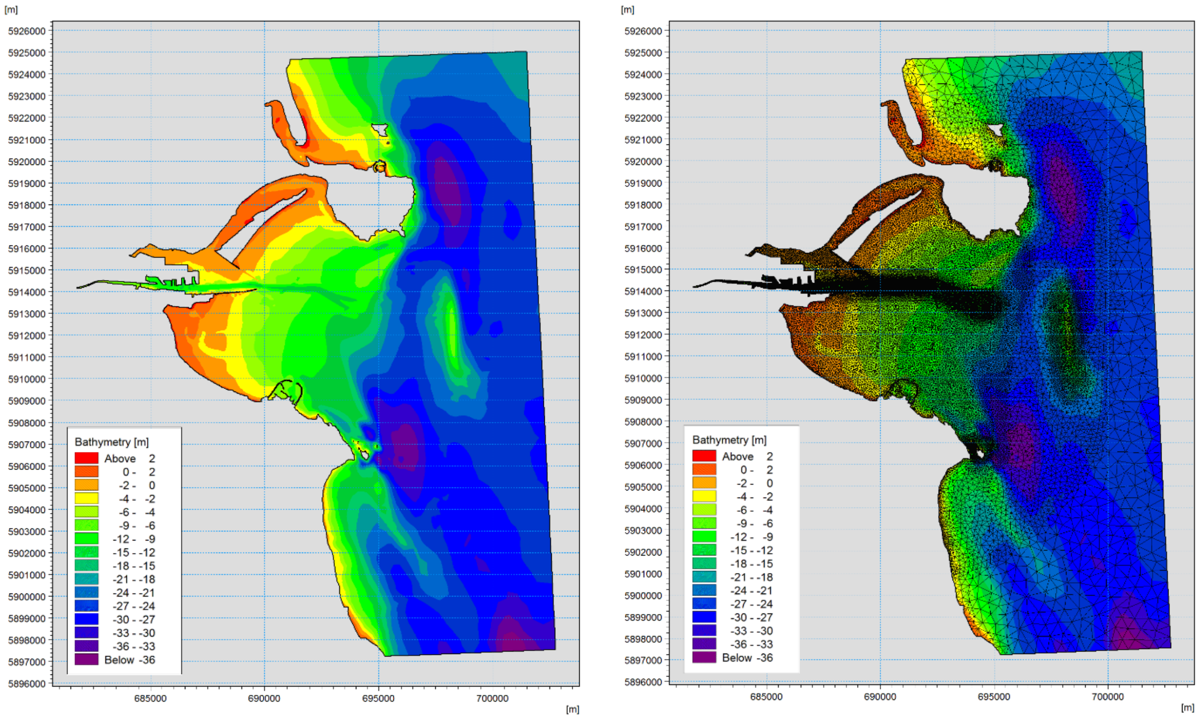


Figure 13.1: Extent and bathymetry (left) and mesh structure (right) of the Dublin Bay model

The Dublin Bay model was then updated to produce a 2D version of the model that represented the pre-3FM Project scenario (in this case, this represents the post-ABR Project and MP2 Project layout within Dublin Port). The Dublin Bay model was further updated to produce a second 2D version of the model which represented Dublin Port post implementation of the 3FM Project. As such the post-project scenario model had updated bathymetry at the SPAR, Maritime Village, Area K, Turning Circle and Area N.

Importantly, the post-project scenario model also included the extensive pile configuration Area N. In line with DHI guidance, each individual pile was represented using the "structure" function in MIKE. The effect of these structures is modelled as sub-grid structures by an additional volume force to the momentum equation in the column of cells where the structure is located. A drag-law is used to capture the increasing resistance imposed by the piers as the flow speed increases. The detailed representation of piles in the vicinity of Area N is illustrated in Figure 13.5.

These two-dimensional models were used to appraise the impact of the 3FM Project on the existing tidal regime, the inshore wave climate and the dumping and dispersion of dredge material at the licensed offshore disposal site. However, as the coastal processes within Dublin Port are highly three-dimensional owing to the freshwater input from the Rivers Liffey, Tolka and Dodder, it was necessary to develop 3D versions of the pre and post-project scenario models. These 3D models were also used to assess the potential impact of the 3FM Project on the dispersion of thermal plumes generated by various assets that discharge into, or abstract water from the inner Liffey channel.

As illustrated in Figure 13.2, the offshore boundary of the 3D versions of the pre and post-project scenario models extended from the Ben of Howth to Dalkey and includes the Dublin Bay area. These 3D models were comprised of up to six discrete vertical sigma layers and were used to assess the sediment plumes generated during the various dredging operations within Dublin Port and the operational performance of the 3FM Project.

The bathymetry of the pre and post-project scenario models in the Dublin Port area is illustrated in Figure 13.3 and Figure 13.4 respectively. A summary of the models that were developed for the 3FM Project assessment and their purpose is summarised in Table 13.1.

Table 13.1 Summary of the numerical models developed for the 3FM Project assessment and their purpose

Numerical Model	2D Version	3D Version
Present day Dublin Bay	• Initial Calibration	• Thermal plume dispersion Calibration
Pre-project scenario (Dublin Port with ABR and MP2 Projects in place)	• Tidal regime • Wave climate • Sediment disposal	• Tidal regime • Thermal plume dispersion
Post-project scenario (Dublin Port with ABR, MP2 and 3FM Projects in place)	• Tidal regime • Wave climate • Sediment disposal	• Tidal regime • Dredging & dispersion • Operational performance of the 3FM Project • Thermal plume dispersion

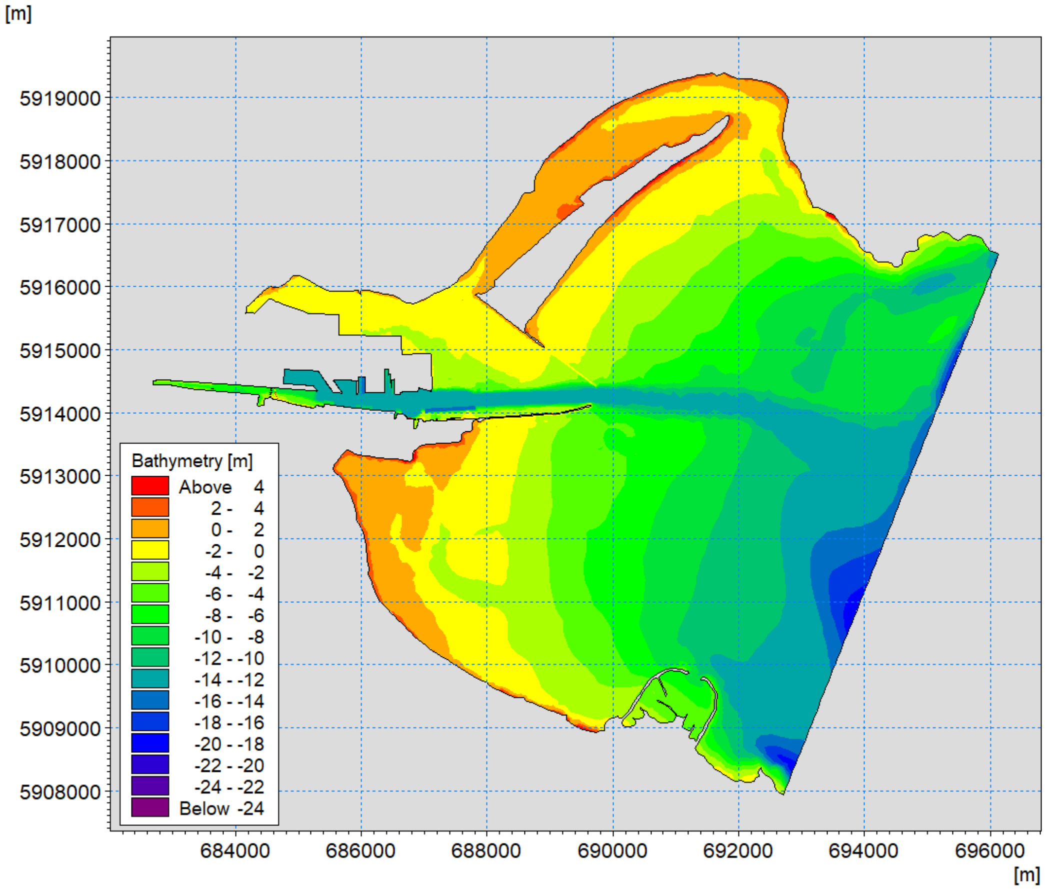


Figure 13.2: Extent and bathymetry of the 3D Dublin Port post 3FM Project model

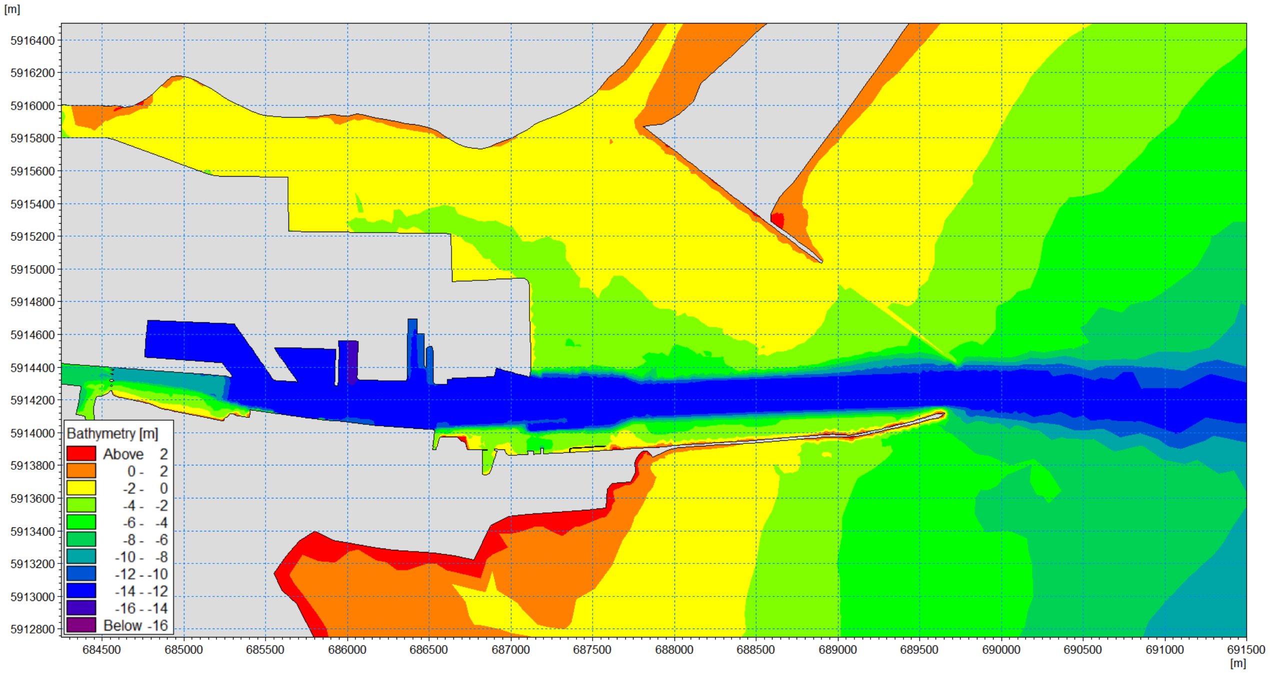


Figure 13.3: Bathymetry of the Dublin Port pre 3FM Project (post ABR & MP2 Project) model – levels illustrated to Mean Sea Level

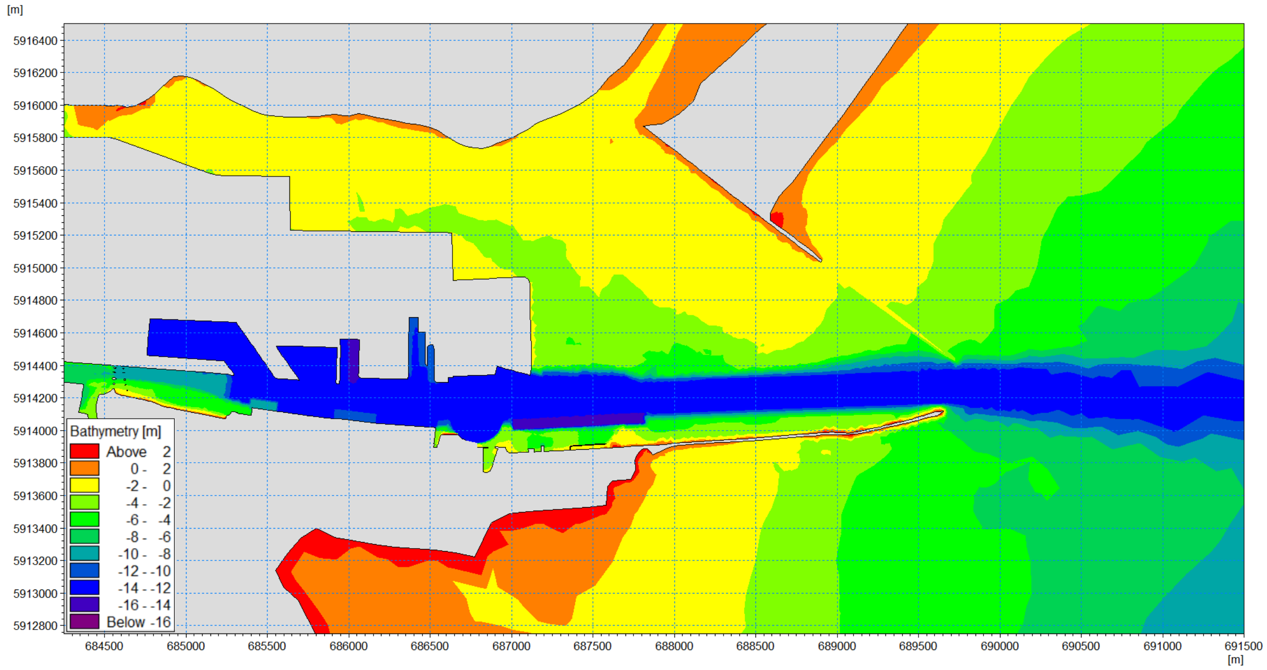


Figure 13.4: Bathymetry of the Dublin Port post 3FM Project model including all dredged pockets – levels illustrated to Mean Sea Level

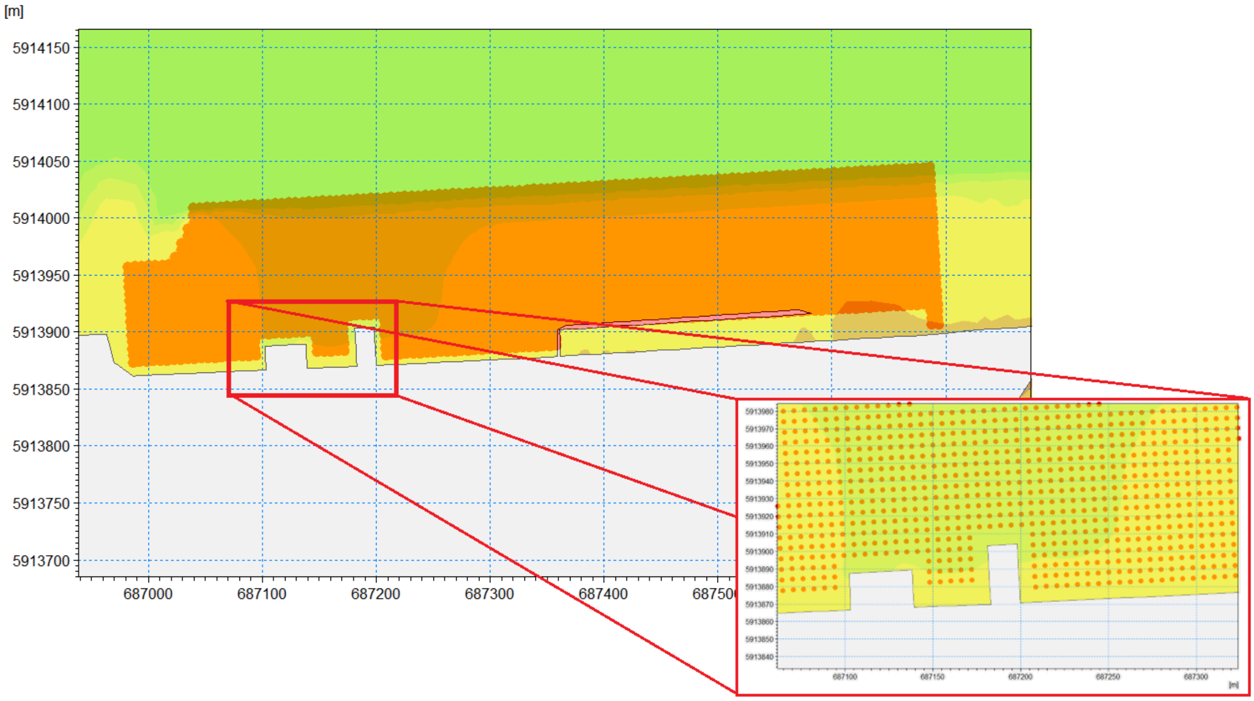


Figure 13.5: Detailed representation of >2500 pile structures in the vicinity of Area N

In addition to the extensive bathymetric surveys of Dublin Port and the Tolka estuary area, a comprehensive sediment survey of the Tolka estuary was undertaken by Hydrographic Surveys Ltd in December 2017. Additional bathymetry and particle size survey information was subsequently collected by Hydromaster between 2022 and 2023. The outputs of the Particle Size Analyses (PSA), which were used to inform the input parameters for the sediment transport simulations, are presented in Appendix 8-2.

Tidal current meter and surface elevation data recorded by multiple Acoustic Doppler Current Profilers (ADCPs) instruments that were deployed over various hydrographic surveys was used to calibrate and validate the present-day Dublin Bay model. This calibration process is described in full detail in Appendix 13-2.

Current velocities have also been continuously recorded at the centre of the dump site between September 2017 and April 2021. These recordings have also been used to validate the Dublin Bay model reported in the Annual Environmental Report (AER) 2022 to the EPA under Dumping at Sea Permit S0024-02.

The model verification process confirmed that the present Dublin Bay model provides a very good representation of the coastal processes in the Dublin Port and Dublin Bay areas.

Prior to assessing the potential impact of the 3FM development, the thermal plume model was calibrated based on the present-day scenario. This calibration process is described in full detail in Appendix 13-3. ESB supplied three thermal plume survey reports to enable model verification and therefore increase confidence in the outcomes of the numerical modelling studies. The thermal plume model development and calibration process was independently audited by DHI and determined to be fit for the purpose of undertaking a comparative study to evaluate the impacts of the proposed development of 3FM on existing thermal discharges and intakes in Dublin Port (see Section 13.5.2.3 and Appendix 13-3).

13.2.3.1 Boundary Conditions

The tidal boundary conditions for the 2D pre-project and post-project scenario models were taken from RPS' Irish Seas Tidal Surge Model (ISTSM). This model was developed using flexible mesh technology with the mesh size (model resolution) varying from circa 24 km along the offshore Atlantic boundary to circa 200 m around the Irish coastline. The extent and bathymetry of the ISTSM tidal surge model is presented in Figure 13.6. RPS also utilised their Irish Coastal Protection Strategy Study (ICPSS) east coast wave model to gather wave boundary data for the Dublin Bay model to ensure that the hydrodynamic influence of the offshore Kish and Codling banks were accounted for in the model. The extent and bathymetry of the ICPSS east coast wave model is presented in Figure 13.6.

Tidal boundary condition data for the 3D models were taken from the 2D pre-project and post-project scenario models.

All open sea boundaries were applied to the model as Flather boundaries whereby temporarily and spatially varying water level and current velocities are specified along the boundary. Flather boundaries are one of the most efficient boundary condition methods to downscale coarse model simulations to higher resolution areas as it avoids instabilities commonly associated with water level boundaries.

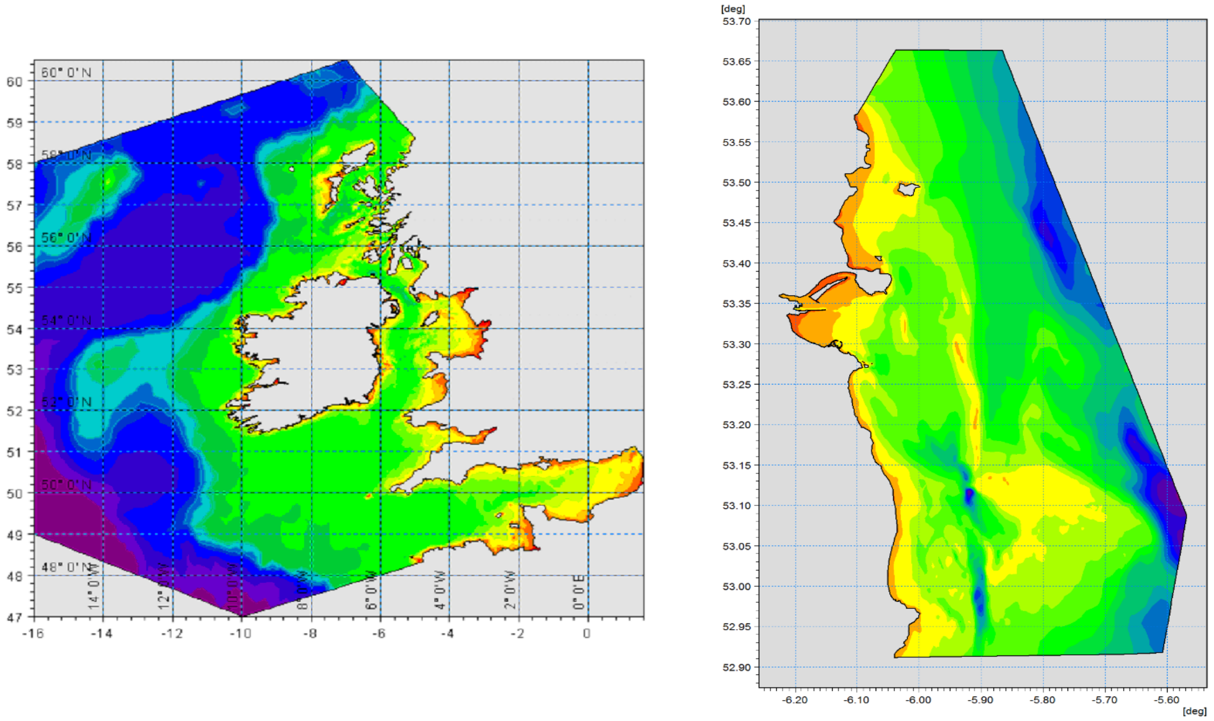


Figure 13.6 Extent and bathymetry of the ISTSM tidal surge model (left) and east coast wave model (right)

13.2.3.2 River Flows

The mean annual river flow values presented Table 13.2 in for the Liffey, Dodder and Tolka were used in the numerical model simulations of the tidal regime. Mean winter river flows were used to model the dispersion and fate of sediment plumes arising from the capital dredging works as dredging works are to be restricted to winter months only. Both the mean winter and annual river flows used for various rivers are presented in Table 13.2.

Table 13.2 Mean annual discharge rates from the Liffey, Dodder and Tolka used in the coastal process models

Source	Wet weather discharge rate (m^3/s)	Dry weather discharge rate (m^3/s)
Liffey	25.0	2.0
Dodder	4.0	0.5
Tolka	3.0	0.5

13.3 Receiving Environment

In this section of the environmental appraisal, the following processes were considered based on a pre-3FM Project scenario (Dublin Port with the ABR & MP2 Projects in place):

- **Tidal regime:** Current speeds and direction.
- **Wave patterns:** Significant wave heights and directions.
- **Dispersion:** Dispersion of sediments and of thermal plumes associated with assets discharging into or abstracting water from Dublin Port.

This assessment was undertaken with reference to both the simulated model data and, where applicable, hydrographic survey data (see Section 13.2.3) and site-specific water quality monitoring data made available by Dublin Port Company's Environmental Monitoring Programme (ongoing for the ABR & MP2 Projects).

13.3.1 Tidal Regime within Dublin Port (Baseline scenario)

The MIKE 21 Hydrodynamic module described in Section 13.2.3 was used in conjunction with the pre-3FM Project scenario (Dublin Port with the ABR & MP2 Projects in place) 2D model to derive baseline tidal regime information within Dublin Port.

Typical tidal flow patterns for a spring ebb and spring flood tide are presented in Figure 13.7 and Figure 13.8 These tidal flow diagrams illustrate that the current speeds in the central navigation channel are marginally higher during mid-ebb conditions relative to mid-flood conditions owing to the contribution of flow from the Liffey, Dodder and Tolka.

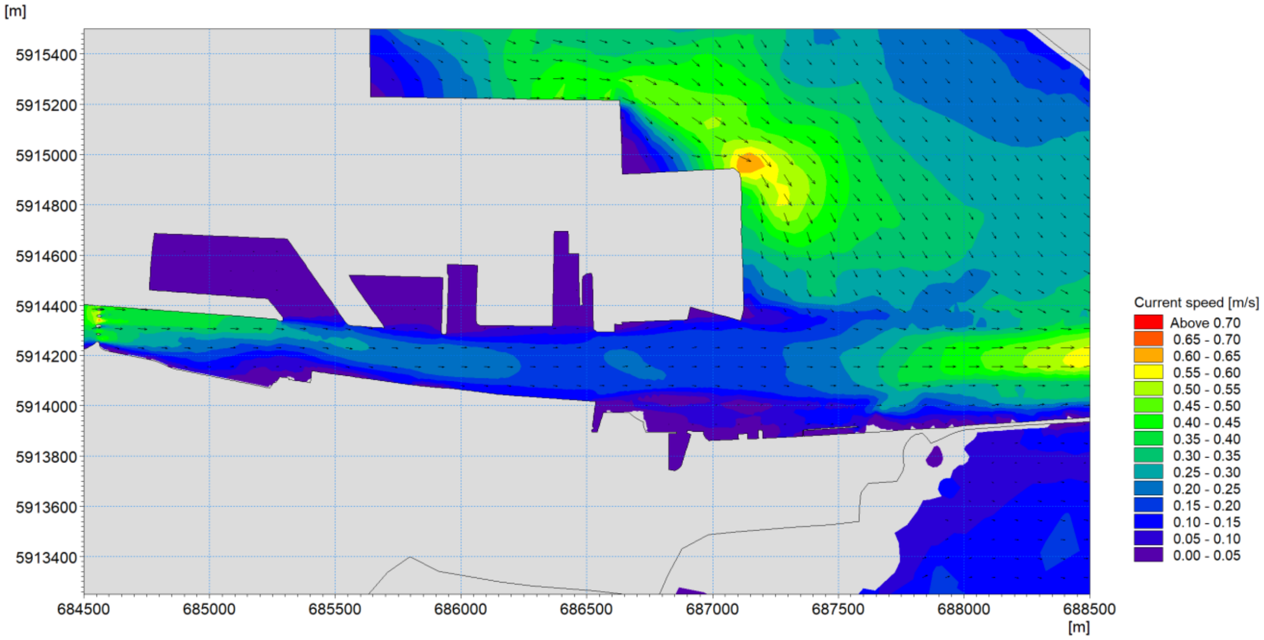


Figure 13.7: Typical spring mid ebb tidal flow patterns – Pre-3FM Project

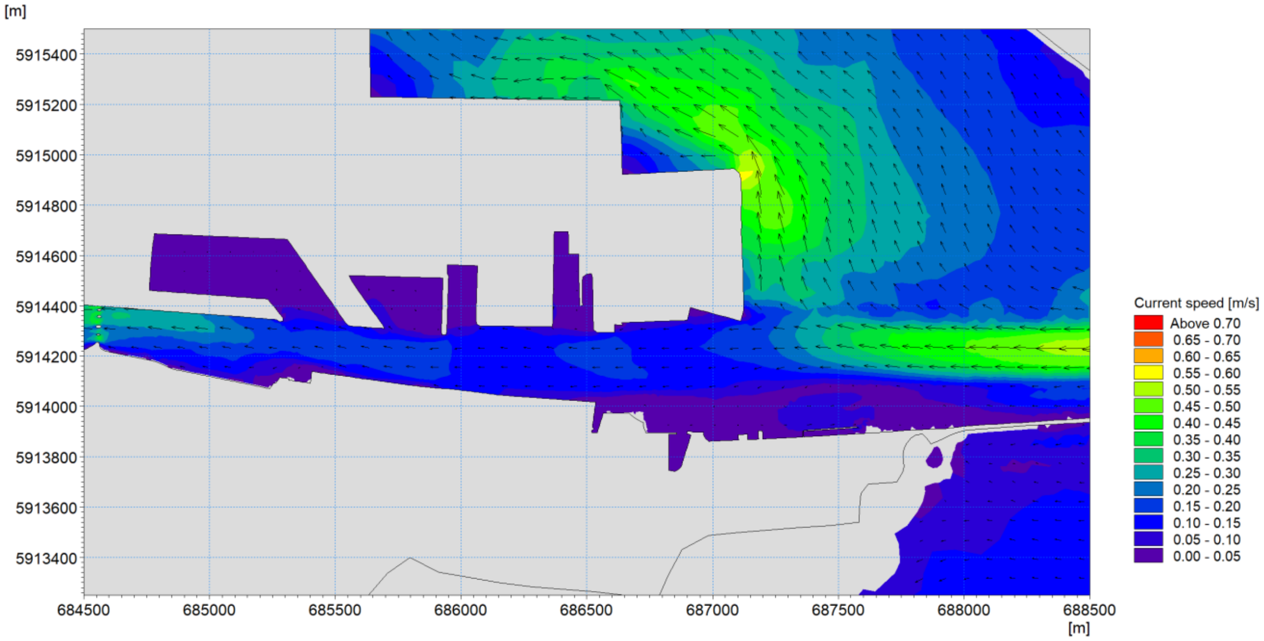


Figure 13.8: Typical spring mid flood tidal flow patterns – Pre-3FM Project

13.3.2 Wave Climate within Dublin Port (Baseline scenario)

Offshore wave data for points at 5.66ºW, 55.50ºN and 5.66ºW, 55.25ºN were taken from the UK Met Office European wave model used as a source to select the largest event for each of the north east, east and south east directions. The three hourly data included wind wave and swell wave components in the form of the significant wave height, mean wave period, peak wave period and mean wave directions. The offshore wave climate data used in the wave transformation simulations are summarised in Table 13.3.

The MIKE 21 Spectral Wave module described in Section 13.2.3 was used in conjunction with the pre-3FM Project scenario 2D model to transform the offshore wave conditions for the north easterly, easterly and south easterly storm events into the nearshore. These offshore wave conditions are summarised in Table 13.3.

It should be noted that the Spectral Wave module was considered the most appropriate method to assess the inshore wave climate as the alternative Boussinesq wave harbour disturbance model does not account for wind wave generation. This a particularly important factor for much of the inner Port area whereby the wave climate is often dominated by wind waves generated over short fetches.

Figure 13.9, Figure 13.10 and Figure 13.11 present the inshore wave heights in Dublin Bay at spring high tide during north easterly, easterly and south easterly storm events respectively. It will be seen from these figures that based on these simulations the largest waves that propagate into Dublin Port occur during easterly storm events at spring high water.

The wave was continuously recorded at the centre of the dump site between September 2017 and April 2021. These recordings have also been used to validate the predictions of storm waves entering Dublin Bay (reported in the Annual Environmental Report (AER) 2022 to the EPA under Dumping at Sea Permit S0024-02.

Table 13.3 Offshore wave climate data used to simulate the inshore wave climate

Storm Event	Significant wave height (m)	Peak wave period (s)	Mean wave direction (ºN)
North Easterly	4.6	8.9	29
Easterly	5.5	8.2	98
South Easterly	5.4	10.4	148

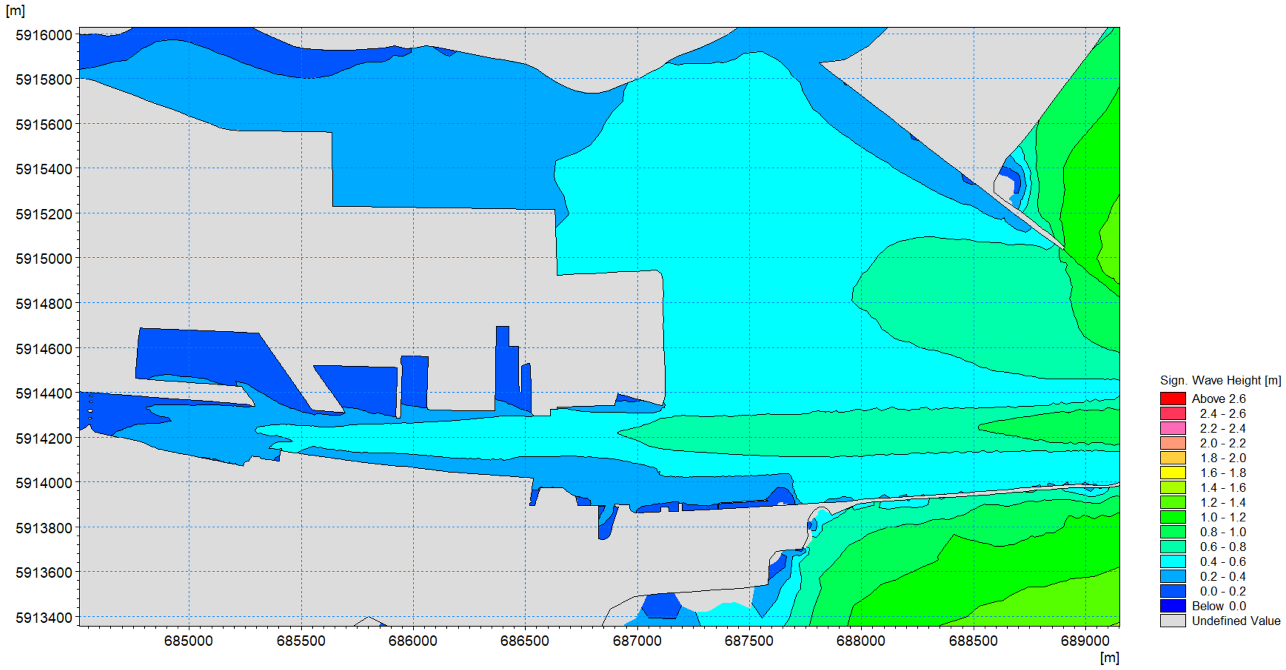


Figure 13.9: North Easterly storm wave heights at spring high water – Pre-3FM Project

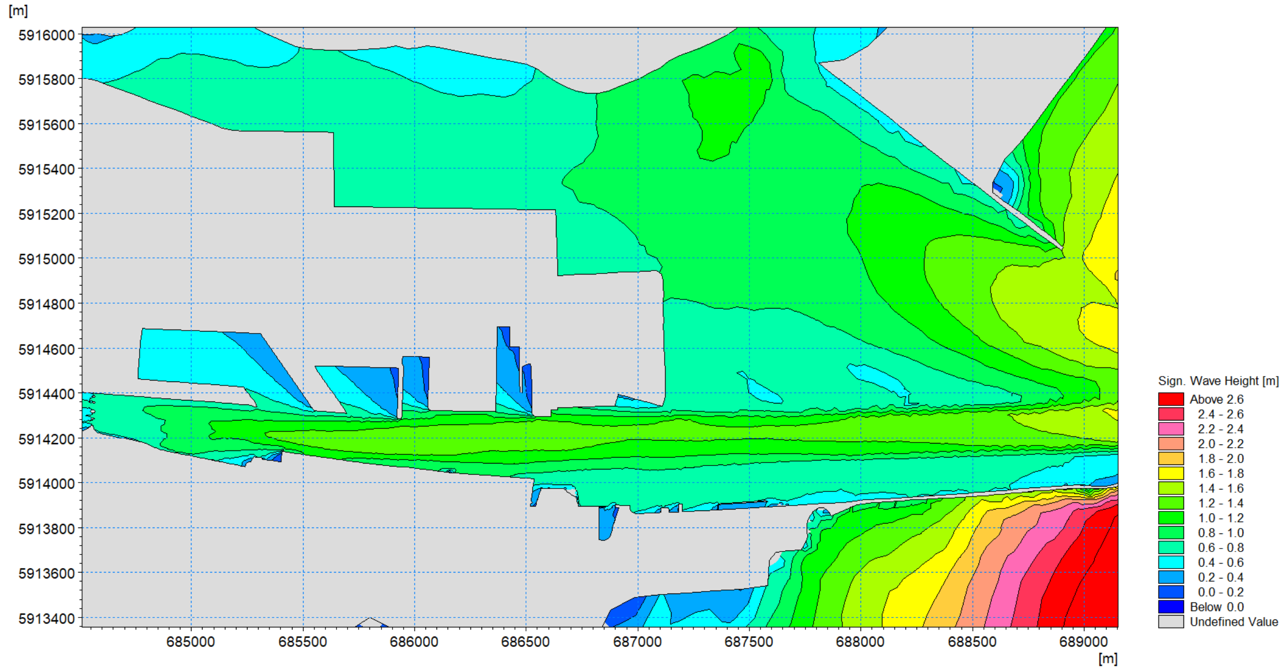


Figure 13.10: Easterly storm wave heights at spring high water – Pre-3FM Project

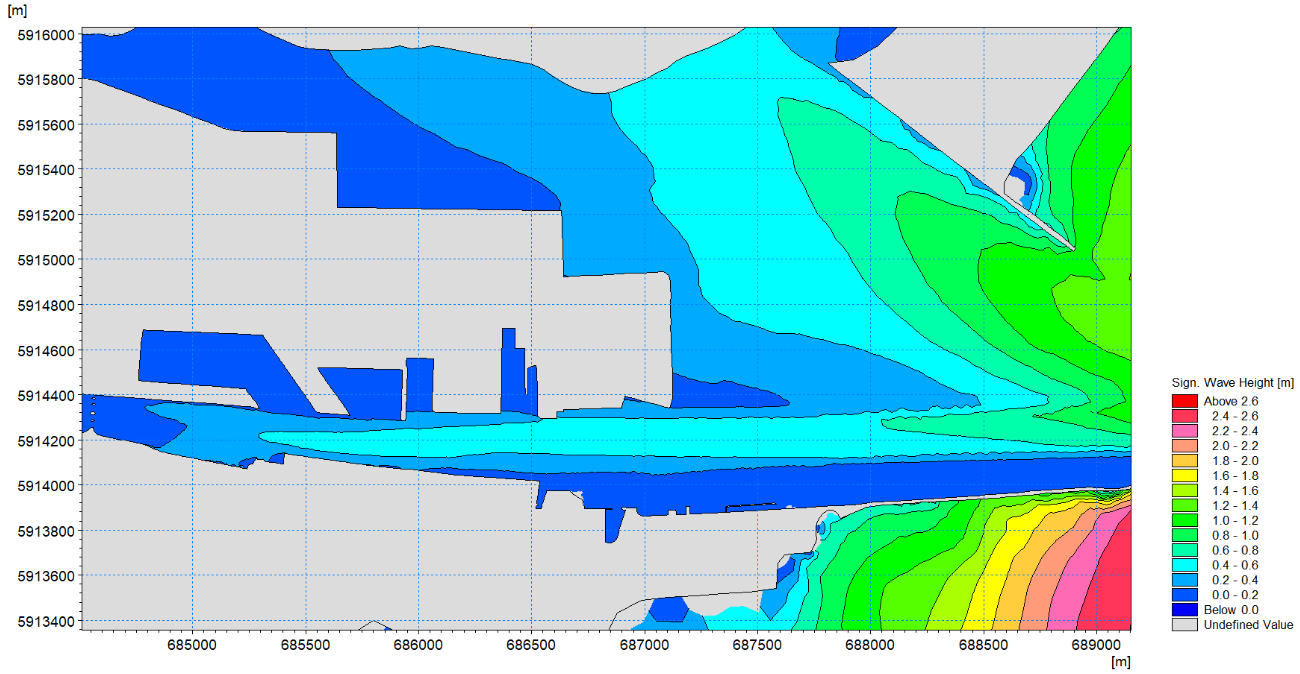


Figure 13.11: South Easterly storm wave heights at spring high water – Pre-3FM Project

13.3.3 Dispersion within Dublin Port (Baseline scenario)

The surrounding waters of Dublin Port are of vital to the operation of several regionally important industrial plants. Water is abstracted from the Liffey by four power plants within the Dublin Port area: the North Wall Station; Synergen – Dublin Bay Power Plant; Covanta Waste to Energy Plant and Poolbeg Power Station. The location of the various power station intake systems is illustrated in Figure 13.12.

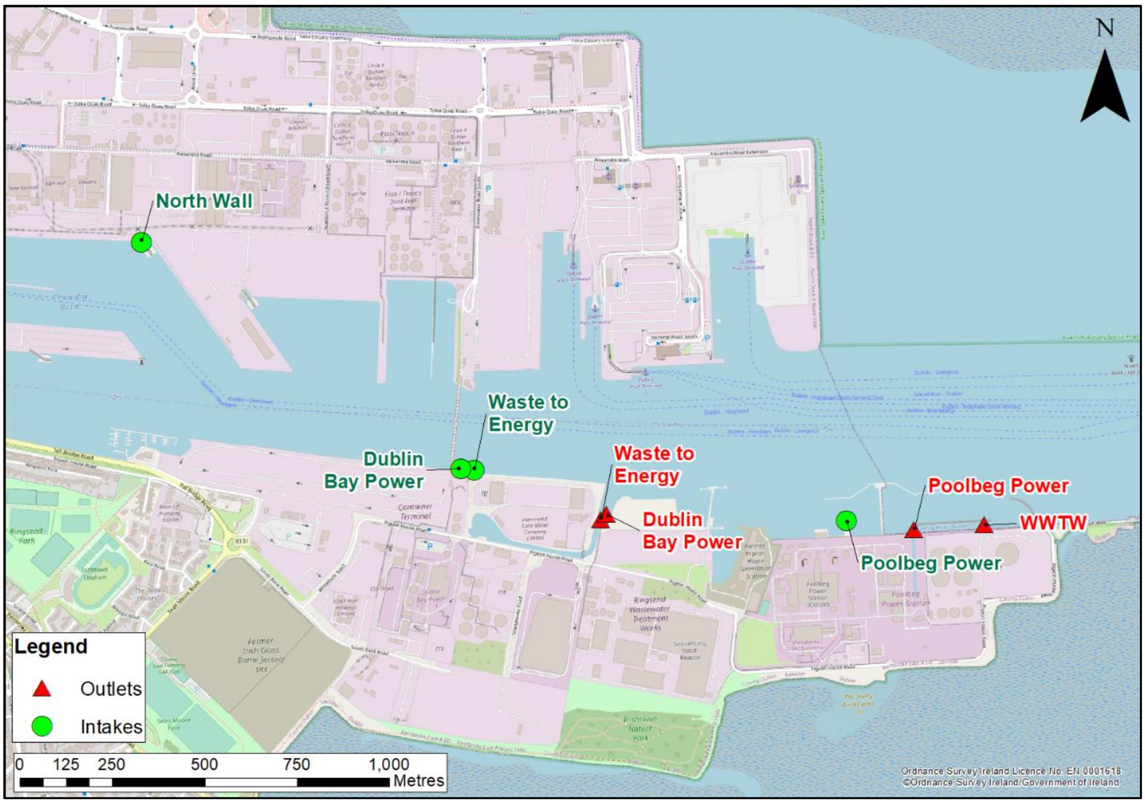


Figure 13.12: Indicative locations of relevant intakes/outfalls within Dublin Port

Water is abstracted as part of the electricity generation process and/or for cooling water components. Any change to the thermal properties of the water abstracted from the Liffey therefore has the potential to impact upon the plant's cooling system which may result in environmental or operational impacts.

The MIKE 3 Hydrodynamic module described in Section 13.2.3 was used in conjunction with the pre-3FM Project scenario (Dublin Port with the ABR & MP2 Projects in place) 3D model to derive baseline thermal plume dispersion information within Dublin Port.

The flow and temperature characteristics for the assets illustrated in Figure 13.12 that discharge into Dublin Port and which were represented in the model are shown in Table 13.4[1]. These variables are based on *measured* maximum discharge characteristics as verified through consultation with relevant stakeholders that operate these assets.

For the purposes of this assessment, the Tolka, Liffey and Dodder river flows were taken as dry weather, low flow conditions (see Table 13.2) as it is during these conditions when least mixing of effluents occur and temperature increases within the water column can be greatest.

Table 13.4 Measured maximum discharge characteristics for relevant assets in Dublin Port

Source	Discharge m^3/s	∆T degree C	Outlet	Intake
Dublin Bay Power	6.40	+7.60	Spillway	Mid depth
Waste to Energy	3.90	+8.72	Spillway	Mid depth
Poolbeg Power Station	9.00	+6.96	Impoundment with weir	Mid depth
Wastewater Treatment	6.05	+3.00	Impoundment with weir	n/a

Typical thermal plume patterns for the mid–flood, high water, mid-ebb and low water phases of a typical spring tide and spring flood tide are presented in Figure 13.13 through to Figure 13.16. It should be noted that these plots represent thermal plumes in the near surface layer of the water column. Given that warm water is less dense than colder water and therefore floats to the surface, these plots represent a realistic worst case scenario. The depth averaged thermal plumes would therefore be considerably lower than presented in these Figures.

It will be seen from Figure 13.13 through to Figure 13.16 that the increase in surface water temperatures above baseline (i.e., 12°C) is generally less than 4°C within the vicinity of both the Waste to Energy and Poolbeg outfall assets.

It is important to note that these thermal plume plots are based on dry weather, low flow conditions (see Table 13.2). As such, the dispersion of thermal plumes during normal or winter flow conditions would be much more confined to the southern half of the navigation channel.

The dispersion of suspended sediments, associated with construction activities such as dredging and disposal, were also modelled, using the MIKE 3 Hydrodynamic module, to assess any impacts on the sediment transport regime.

---

[1] Note that the *licensed* maximum discharge characteristics for these assets is presented in Table **13.7**.

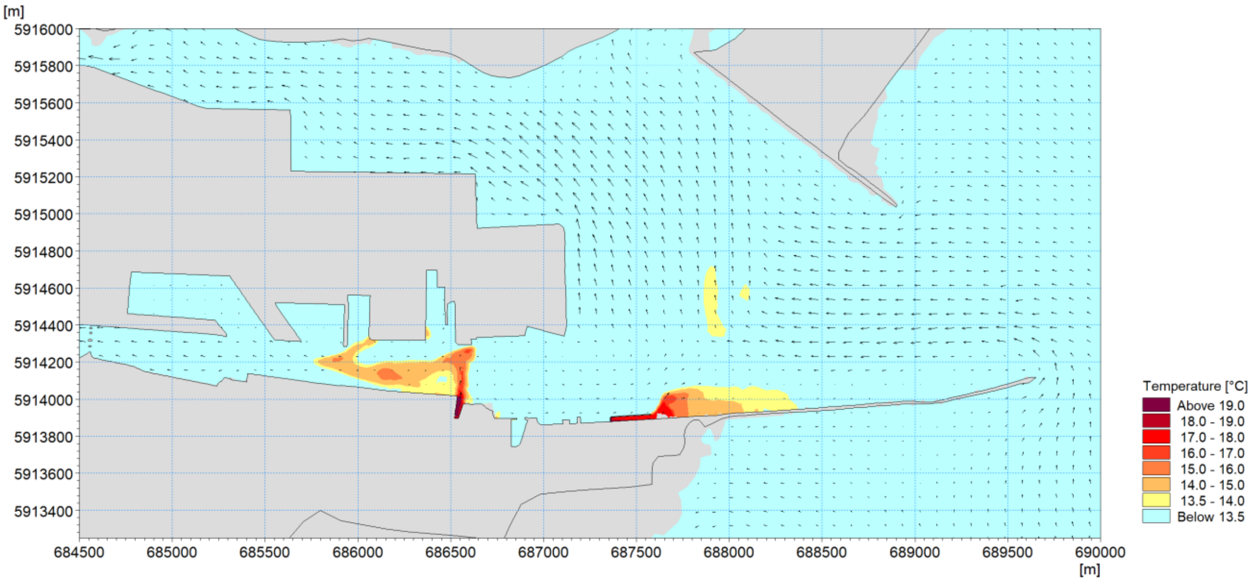


Figure 13.13: Near surface thermal plume envelopes during a typical spring mid flood tide – Pre-3FM Project

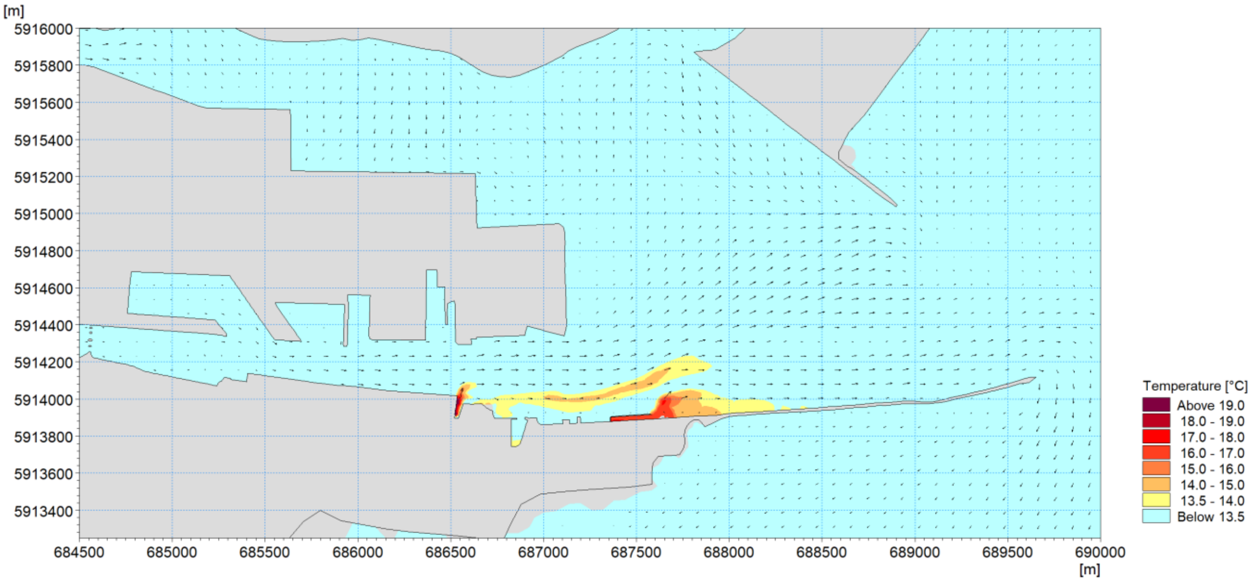


Figure 13.14: Near surface thermal plume envelopes during a typical spring high tide – Pre-3FM Project

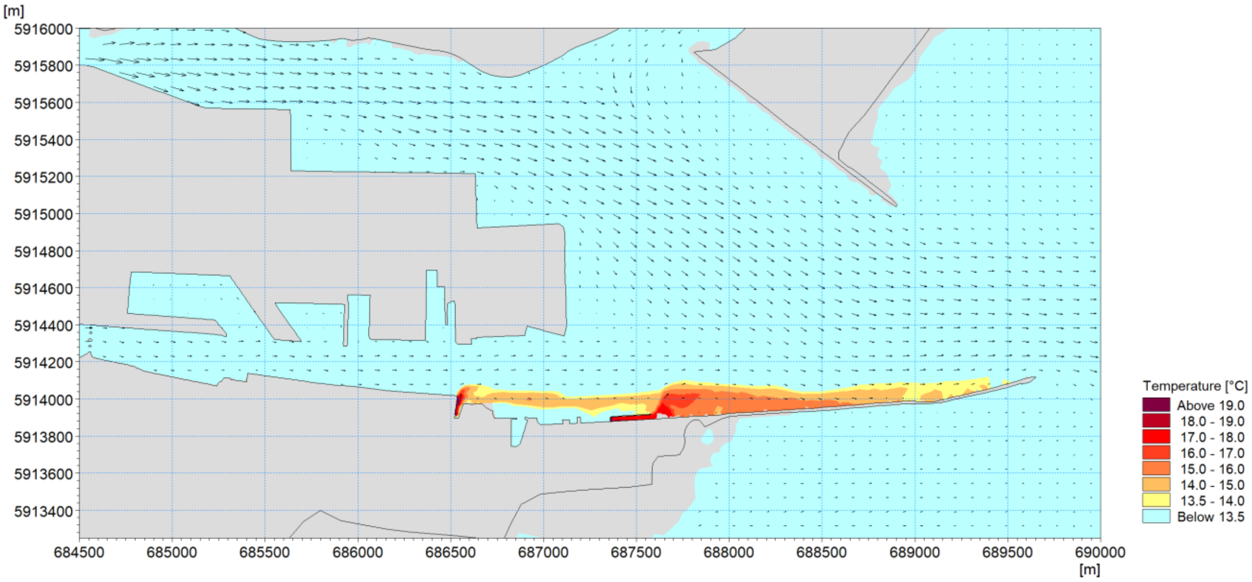


Figure 13.15: Near surface thermal plume envelopes during a typical spring mid ebb tide – Pre-3FM Project

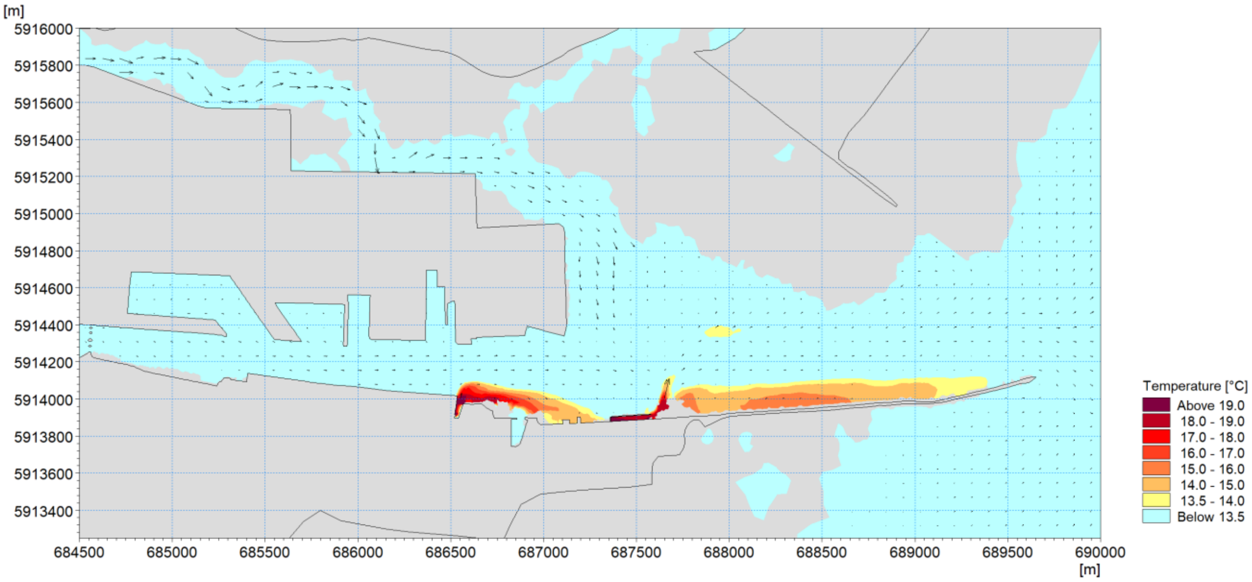


Figure 13.16: Near surface thermal plume envelopes during a typical spring low tide – Pre-3FM Project

13.4 Likelihood of Impacts

The impact on coastal processes arising from the 3FM Project is assessed in relation to the construction phase of the project and the subsequent operational phase. Various elements of construction and operation and the types of impacts on the tidal, wave and sediment transport regimes that they could potentially result in are identified for assessment in the following sections.

The assessment has been informed by a robust numerical modelling programme and, where applicable, hydrographic survey data (see Section 13.2.3) and site-specific water quality monitoring data made available by Dublin Port Company's Environmental Monitoring Programme (ongoing for the ABR & MP2 Projects).

13.4.1 Construction Phase Impacts

The major elements of the construction programme are outlined in Chapter 5. In context of coastal process, the elements of the 3FM Project that have the potential to result in construction phase impacts are outlined below:

- Capital Dredging and Disposal at Sea:
  - Capital dredging works within the navigation channel at:
    - Maritime village & SPAR viaduct.
    - Area K (new Ro-Ro terminal)
    - Turning circle
    - Area N (new Lo-Lo terminal for exports)
  - Disposal of dredge spoil at the dumping site

Temporary impacts on water quality have the potential to occur during the construction phase of the works. Mobilised suspended sediment release through capital dredging and disposal activities are the principal potential sources of environmental impact. The potential impacts from the increase in background suspended sedimentation concentrations and deposition levels as a result of the capital dredging and disposal operations during the construction phase are assessed in Section 13.5.1.

The proposed piling works at Area N are not expected to result in an increase of suspended sediments given that all piles will be driven as opposed to augured. Similarly, the locating piles which are required to secure the positions of the temporary ramp structures at the Turning Circle and Berth 46 will not impact coastal processes owing their streamlined form and close proximity to quay lines whereby current velocities are relatively low.

To accommodate users of the existing 100 berth floating marina during the construction of the Maritime Village, temporary moorings on a chain system will be established on the north side of the navigation channel at North Wall Quay near Berth 18. The impact of this temporary marina on coastal process will be commensurate to that of the existing structure and has therefore not been considered further in this chapter.

13.4.2 Operational Phase Impacts

Port development consisting of the construction of structures and/or changes in the configuration of the seabed bathymetry through capital dredging works has the potential to impact on coastal processes. In context of the 3FM Project, the following elements have the potential to impact on coastal processes:

- Installation of SPAR abutments
- Dredging and re-development at the Maritime village
- Dredging at Area K
- Removal of the nib structure and construction of a Ro-Ro linkspan ramp 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

The operational phase impacts in context of these coastal processes are assessed in Section 13.5.2.

13.5 Description of Potential Impacts

13.5.1 Construction Phase Impacts

13.5.1.1 Potential Impacts as a result of capital dredging works

As described in Chapter 5, the 3FM Project will include:

- Capital dredging to achieve a depth of -3 m CD at the Maritime Village.
- Localised dredging at Area K to facilitate the placement of scour protection.
- Capital dredging at Pigeon House road to create a -10.0m CD deep 325 m diameter turning circle.
- Capital dredging at Area N to -13.0 m CD to create a new 800 m berthing pocket for container vessels and to -3.0 m CD to accommodate construction activities.

All proposed dredging works are on the southern side of the navigation channel as shown in Figure 13.17. The dredging operations will result in the removal of 1,189,000 m^3 of marine sediments for disposal at sea. A breakdown of the dredging requirements is presented in Table 13.5.

Notwithstanding the application of extensive mitigation measures, the process of dredging unavoidably causes disturbance of sediment on the channel bed and dispersal of some material in the water column. Disposal of dredge spoil at the licenced dumping site in Dublin Bay also results in sediment release. These losses may have potential impacts on biodiversity (Chapter 7) and water quality (Chapter 9) in the form of a suspended sediment plume within the water column. The potential impacts arising from these factors has therefore been assessed in the following sections of the report.

A chemical sediment analysis of the sediments to be dredged from the Port’s navigation channel and basins found that the material is suitable for conventional dumping at sea. However, at Maritime village, the Marine Institute has recommended that the top 1.0 m of sediment is taken ashore, stabilised and reused within the Port Estate, where possible (see Chapter 8 Land, Solis, Geology and Hydrogeology).

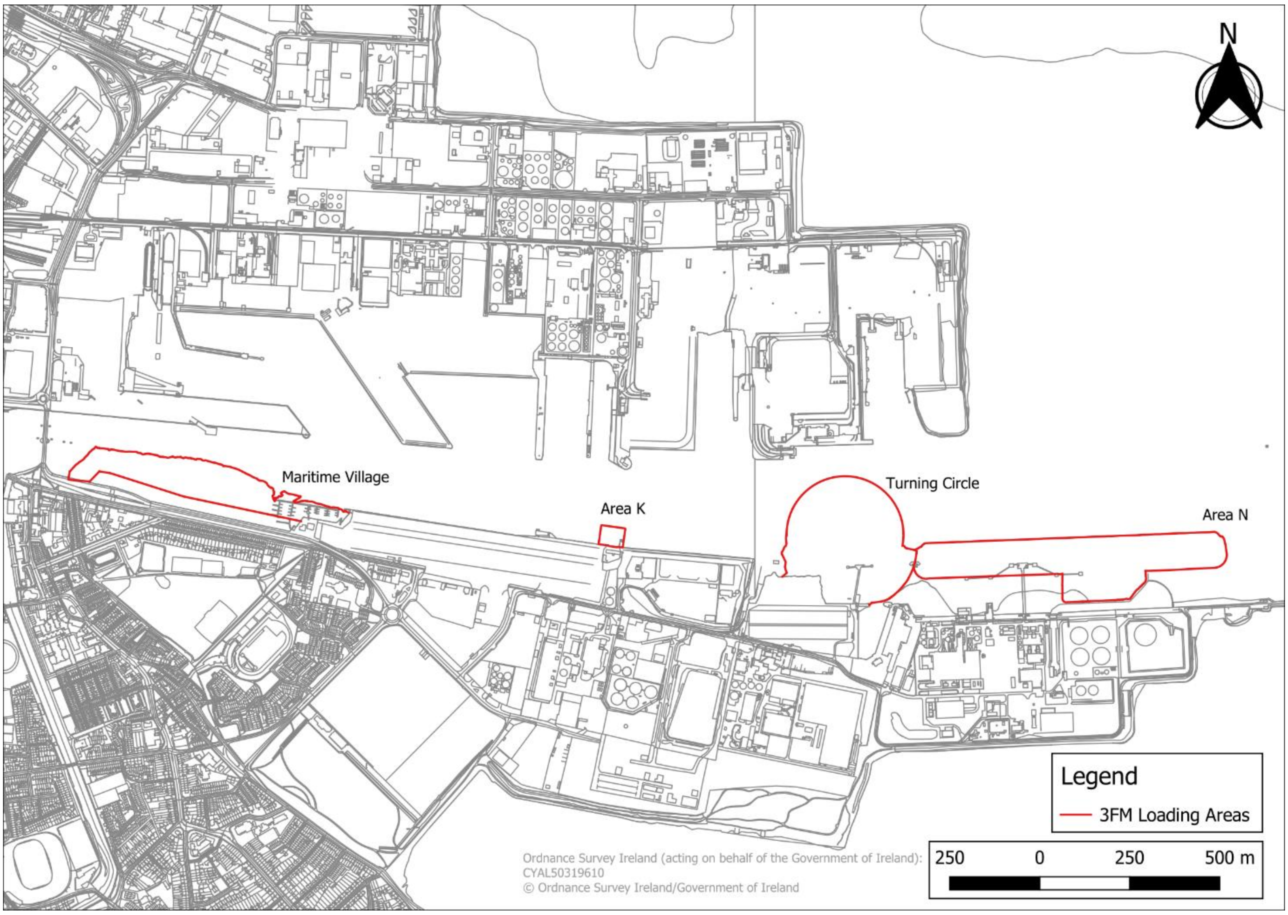


Figure 13.17: 3FM Project Dredging Areas

Table 13.5 Breakdown of dredging requirements for the 3FM Project

Location	Dredged Depth	Volume
Maritime Village – *capital dredging*	-3.0 m CD	197,000 m^3
Area K - Ro-Ro Terminal – *Localised Scour Protection to 220 kV cables*	-12.5 m CD	13,000 m^3
Turning Circle – *capital dredging*	-10.0m CD	444,000 m^3
Area N - Lo-Lo Terminal Berthing Pocket – *capital dredging*	-13.0 m CD	533,000 m^3
	-3.0 m CD	72,000 m^3
Total Dredge Volume		**1,259,000 m^3**
Volume not suitable for disposal at sea (top 1.0m at Maritime Village)		**70,000 m^3**
Total Dredge Volume suitable for disposal at sea		**1,189,000 m^3**

Particle Size Analysis described in Chapter 8 (Land, Solis, Geology and Hydrogeology) indicated that the material to be dredged as part of the 3FM Project is comprised of three discrete fractions with mean diameters of 200 µm, 20 µm and 3 µm, with each fraction constituting approximately 1/3 of the total volume of sediment to be dredged.

Extensive water quality monitoring using real time turbidity measurements recorded during previous dredging campaigns (Dumping at Sea Permits S0024-01 AER 2017 through to AER 2022) has shown that during disposal of dredged fine sands at the licensed disposal site, the fine sand falls rapidly to the bottom and any sediment plume is short lived and is not widely dispersed. However, sediments to be dredged in the 3FM Project are finer and contain a substantial silt fraction.

Therefore, plume modelling was undertaken for the silt fractions with silt losses of 1% at the dredger head being introduced as a sediment source in the bottom layer of the model. The other key parameters relating to the dredging simulations presented in the following Sections of this Chapter are set out in Table 13.6.

As the Liffey channel in Dublin Port is influenced by several fresh water river inflows and by water discharged into or abstracted from various outfall and intake assets, stratification of the water column can occur under certain tidal conditions in the Liffey channel particularly in the central section of the harbour. Therefore, the plume modelling simulations were undertaken using the MIKE 3 Hydrodynamic model described in Section 13.2.3. This model was coupled with the Sediment Transport module and included temperature and salinity effects. For the purposes of sediment dispersion modelling, i.e., the assessment of dredging operations, the Tolka, Liffey and Dodder river flows were taken as the winter average flows (Table 13.2).

The flow and temperature characteristics for the power station and other assets that discharge into Dublin Port and which were represented in the model are shown in Table 13.7. These variables are based on licensed maximum discharge characteristics as described in relevant Integrated Pollution Control (IPC) licenses issued by the Environmental Protection Agency (EPA) and verified through consultation with relevant stakeholders that operate these assets.

Four individual simulations were run to simulate the dredging operations at Area A, Area K, the Turning Circle and within the vicinity of the Maritime Village and the SPAR. Each simulation was run for a period of one month to represent sediment dispersion across all tidal conditions with results then being scaled according to represent the full dredging operation in each area. The output from these simulations is presented in the following Sections of this chapter.

Table 13.6 Dredging simulation input parameters

Parameter	Value
Trailer Suction Hopper Dredger capacity	4,100 m^3
Ratio of sediment/entrained water during loading	0.3
Average density of material inside hopper	1.65 t/m^3
Average Trip Frequency between Dublin Port and Disposal site	3.0 hours
Average Time to Fill Dredger Hopper	1.5 hours
Time to release load	90 seconds
Overspill Trailer Suction Hopper Dredger – **Hopper**	0%
Sediment loss at Trailer Suction Hopper Dredger – **Dredge head**	1% of silts

Table 13.7 Licensed maximum discharge characteristics for relevant assets in Dublin Port

Source	Discharge m^3/s	ΔT degree C	Outlet	Intake
Dublin Bay Power	8.40	9.50	Surface layer	Mid depth
Waste to Energy	6.60	9.50	Surface layer	Mid depth
Poolbeg Power Station	12.00	14.00	Surface layer	Surface layer
Wastewater Treatment	8.04	n/a	Surface layer	n/a

In line with the 3FM Draft Construction Environmental Management Plan (CEMP) no over-spill from the dredger's hopper was included in any of the four model simulations. As customary, DPC will continue to notify the power station operators in advance of each dredging campaign. This will allow operators to temporarily stop abstracting water from the Liffey for a short duration in the event that dredging is required within the immediate vicinity of their intake works.

Other key relevant mitigation measures that will apply to each dredging campaign in the 3FM Project are presented in Section 13.6.1.

Dredging at within the vicinity of Maritime Village and the SPAR

The dispersion of silts during ongoing dredging is illustrated by a series of plume diagrams that show the suspended sediment concentration of silt in the water column resulting from the dredging operations. Figure 13.18 to Figure 13.21 represent the dispersion of silt material at times of low water, mid flood, high water and mid ebb at a time during the simulated dredging campaign when the suspended sediment concentrations may be expected to be at their highest values (i.e., when the dredger is active at the site).

These figures show that the suspended sediment concentration plumes are confined to the southern half of the navigation channel at all times. The sediment concentrations of the plumes are generally less than 75 mg/l beyond the immediate dredge area. The lateral extent of the 10 mg/l plume envelope is generally less than 600 m under most tidal conditions but can reach *c.*900 m during certain spring mid-flood conditions. Suspended sediment plumes did not extend beyond the corner of Capital Dock during the 1 month simulation period.

Monitoring of the Liffey and Tolka Estuaries between East Link Bridge and the entrance to the Port at Poolbeg Lighthouse has been undertaken by the ABR and MP2 Projects (see Chapter 9 Water Quality and Flooding). Measurements of turbidity at the North Bank Light (adjacent to the Tolka Estuary) over the period 2017 – 2022 have ranged from 0 to 163 NTU with a 95%ile value of 15.0 NTU and a mean of 3.9 NTU (n=169,576)[2]. This equates to a suspended solids range of 0 to 400 mg/l with a 95%ile value of 37.5 mg/l and a mean of 9.75 mg/l. While there is a relatively small and very local predicted increase in suspended solids due to dredging at the Maritime Village, this falls within the background range measured close to this location during normal Port operations.

---

[2] Maximum and minimum values in the range reflect extreme outlier values they are not representative of general ambient water quality. The percentile values listed give a more robust indication of the true dispersal of the measurements, and clearly most of the measurements (90% of them) range between 0 NTU and the 95 percentile value of 15 NTUs.

The predicted deposition of the silt fractions lost to the water column during the dredging of the Maritime Village at the end of a simulated one-month dredging campaign is presented in Figure 13.22. This Figure shows that there is virtually no sediment material deposited outside of the dredge area and that the deposition of sediment is generally confined to within the immediate area of the dredging operation where deposition levels can reach up to 128 g/m^2. It should be noted that dredging proceeds until the specified design depth is reached and any material deposited within the dredge area will be removed by the dredger until the specification is met.

The estimated natural sediment load from the upstream Liffey catchment is estimated at about 200,000 tonnes per annum (DPC Maintenance Dredge AER 2022, Dumping at Sea Permit S0004-02). If dispersed over the Port area between East Link and Poolbeg Light and the Tolka Estuary this is roughly equivalent to a natural sediment load of 30 kg/m^2 in any year. The small level of deposition predicted as a result of dredging at the Maritime Village is therefore highly unlikely to pose any risk through siltation.

It can, therefore, be concluded that the dredging operations required for the Maritime Village 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.

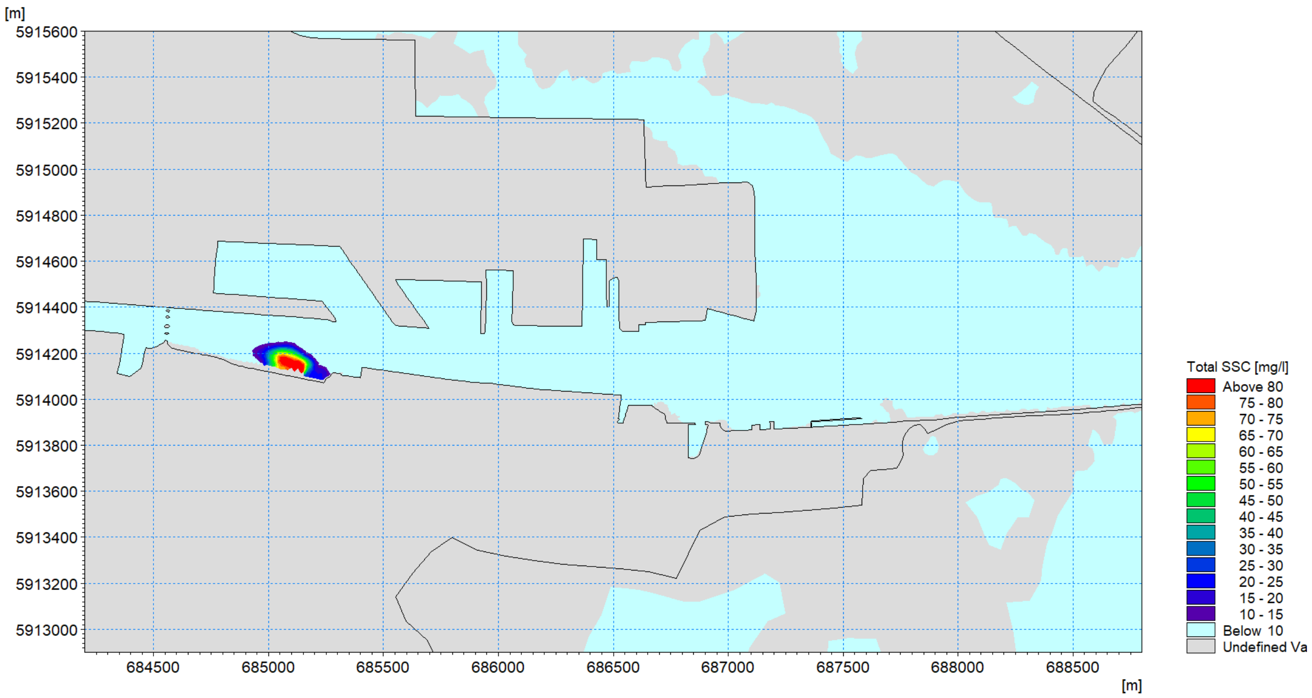


Figure 13.18: Suspended sediment concentration plume in the bottom layer during a typical low water phase of a spring tidal cycle whilst dredging the Maritime Village

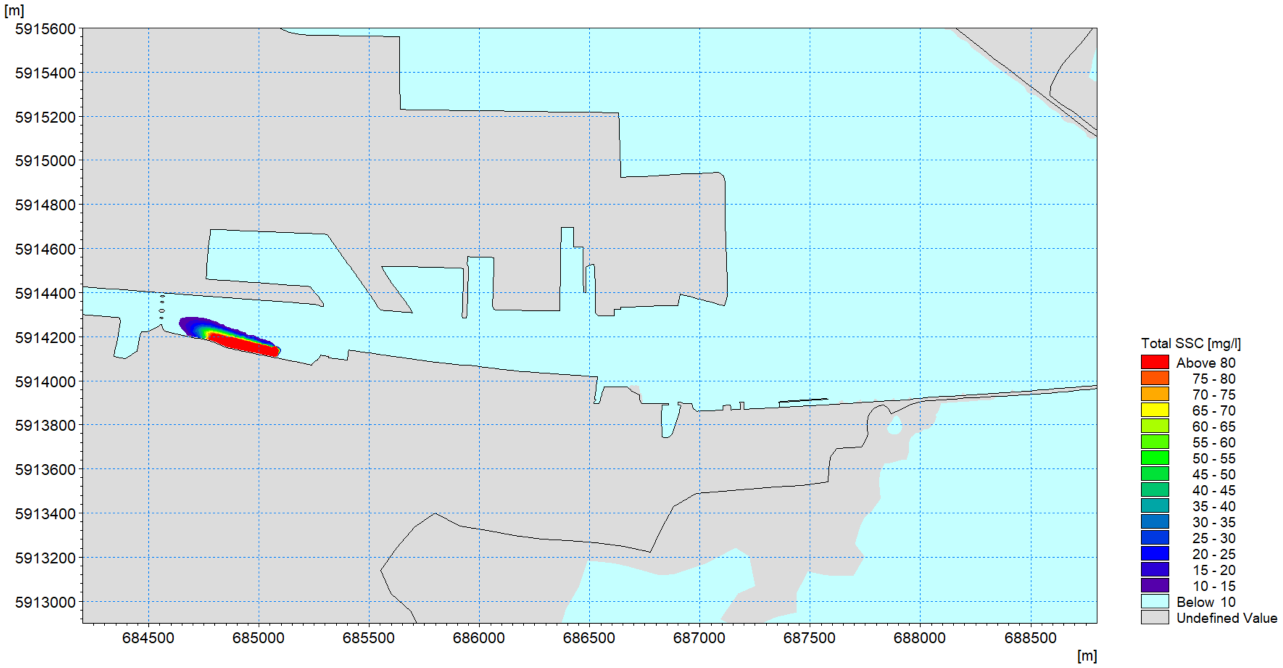


Figure 13.19: Suspended sediment concentration plume in the bottom layer during a typical mid flood phase of a spring tidal cycle whilst dredging the Maritime Village

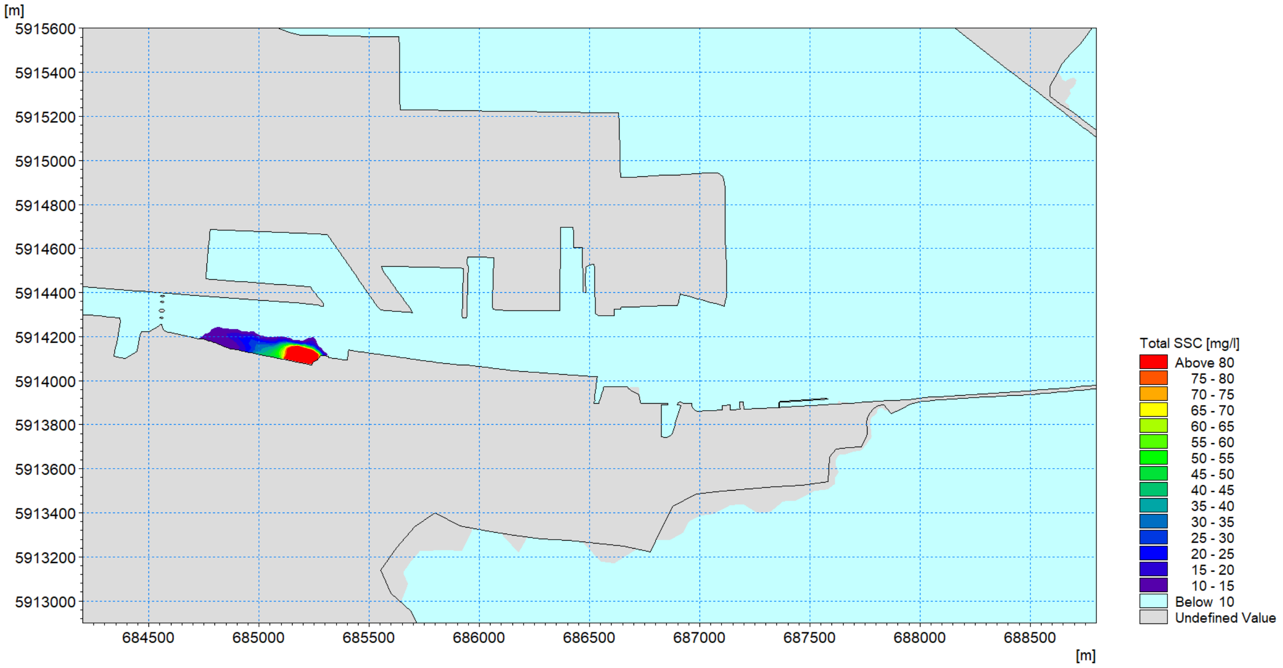


Figure 13.20: Suspended sediment concentration plume in the bottom layer during a typical high water phase of a spring tidal cycle whilst dredging the Maritime Village

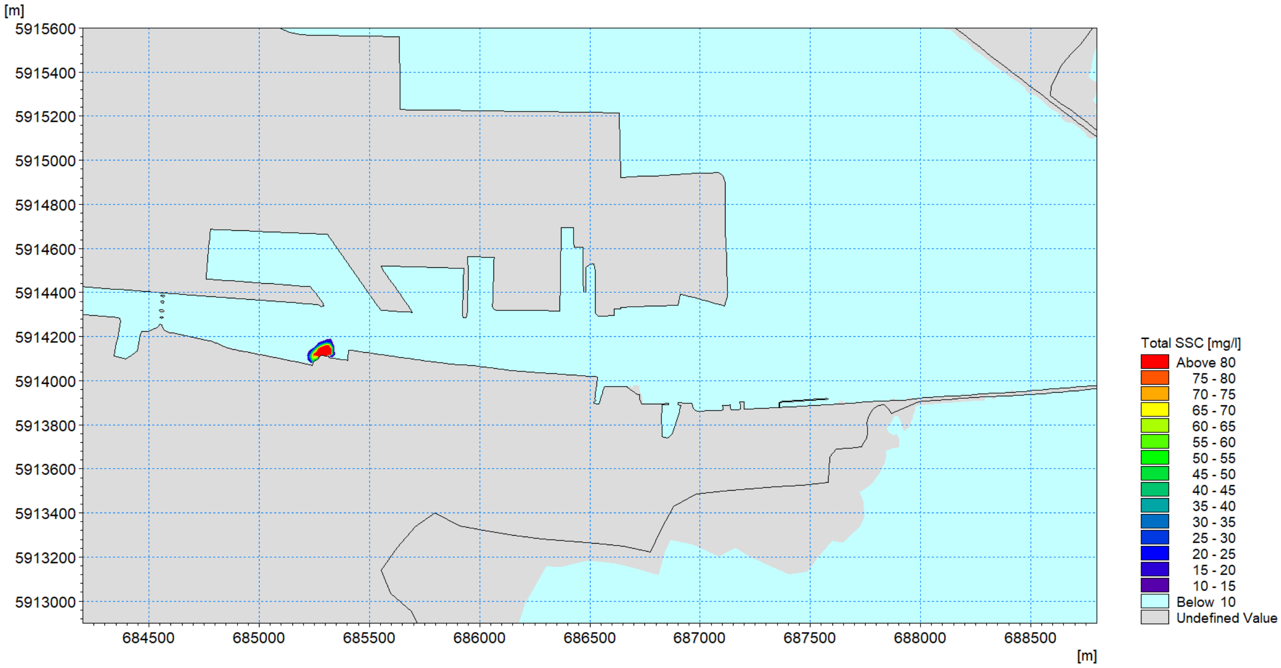


Figure 13.21: Suspended sediment concentration plume in the bottom layer during a typical mid ebb phase of a spring tidal cycle whilst dredging the Maritime Village

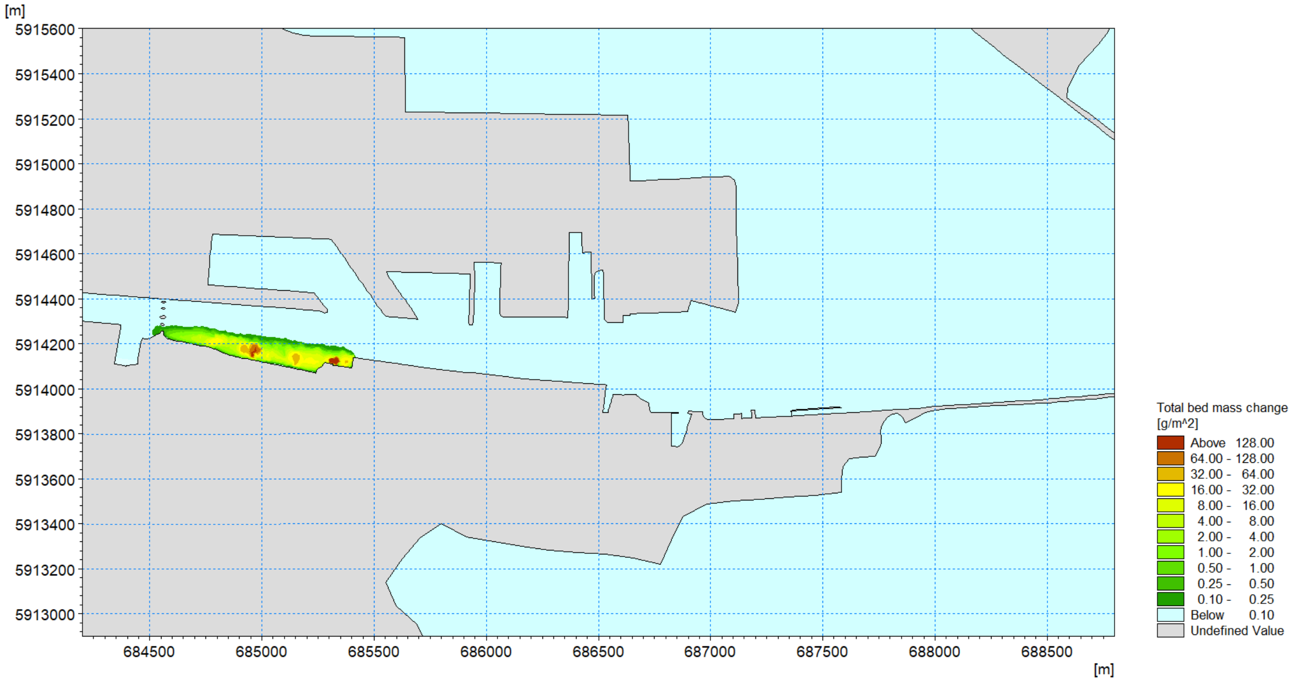


Figure 13.22: Deposition of sediment following the dredging operations at the Maritime Village

Dredging at Area K

The impact of dredging at Area K on suspended sediment concentrations is shown by a series of plume diagrams. Figure 13.23 to Figure 13.26 represent the dispersion of silt material at times of low water, mid flood, high water and mid ebb at a time during the dredging operation when the suspended sediment concentrations may be expected to be at their highest values (i.e., when the dredger is active at the site).

It will be seen from these figures the suspended sediment concentration plumes are confined to the southern half of the navigation channel. The sediment concentration of the plumes is generally less than 35 mg/l beyond the immediate dredge area. As set out in the previous section, this is a relatively small and very local predicted increase in suspended solids due to the dredging works and is well within the background range experienced at this location during normal Port operations. The lateral extent of the 10 mg/l plume envelope is generally less than 500 m under most tidal conditions.

The predicted deposition of the silt fractions lost to the water column following the dredging campaign at Area K is presented in Figure 13.27. This Figure shows that the volume of material deposited following the dredge operations is generally less than 10.0 g/m^2 and that the deposition of sediment is generally confined to within the immediate area of the dredging operation. By comparison with natural background sediment loads (previous section) such a small level of deposition is highly unlikely to pose any risk through siltation and no further mitigation is required. Again, any material deposited within the dredge area will be removed by the dredger until the specification is met.

It can, therefore, be concluded that, when considered in terms of background conditions, the dredging operations required for Area K 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. No further mitigation is required.

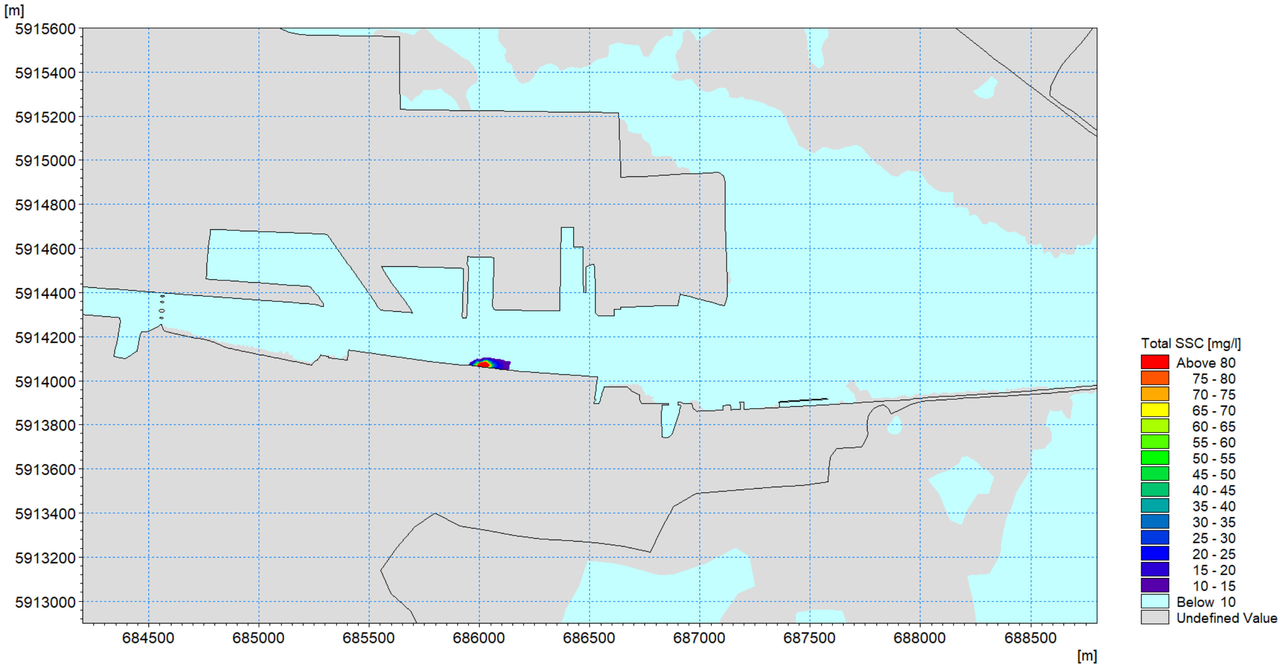


Figure 13.23: Suspended sediment concentration plume in the bottom layer during a typical low water phase of a spring tidal cycle whilst dredging Area K

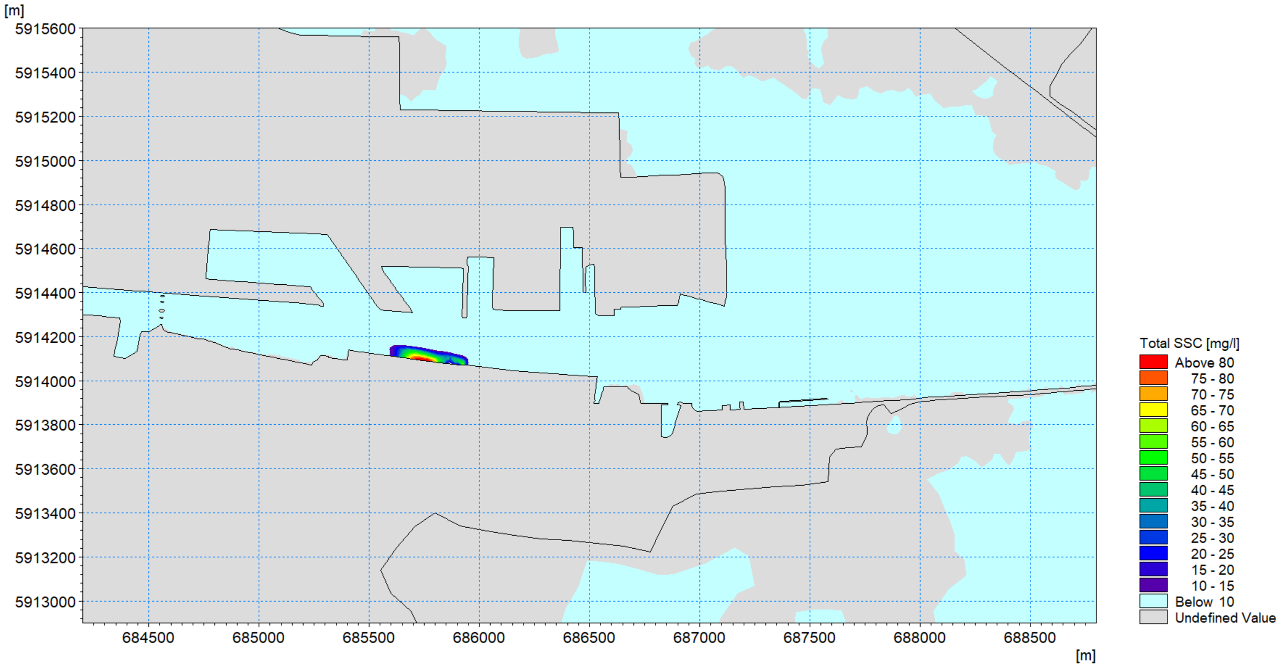


Figure 13.24: Suspended sediment concentration plume in the bottom layer during a typical mid flood phase of a spring tidal cycle whilst dredging Area K

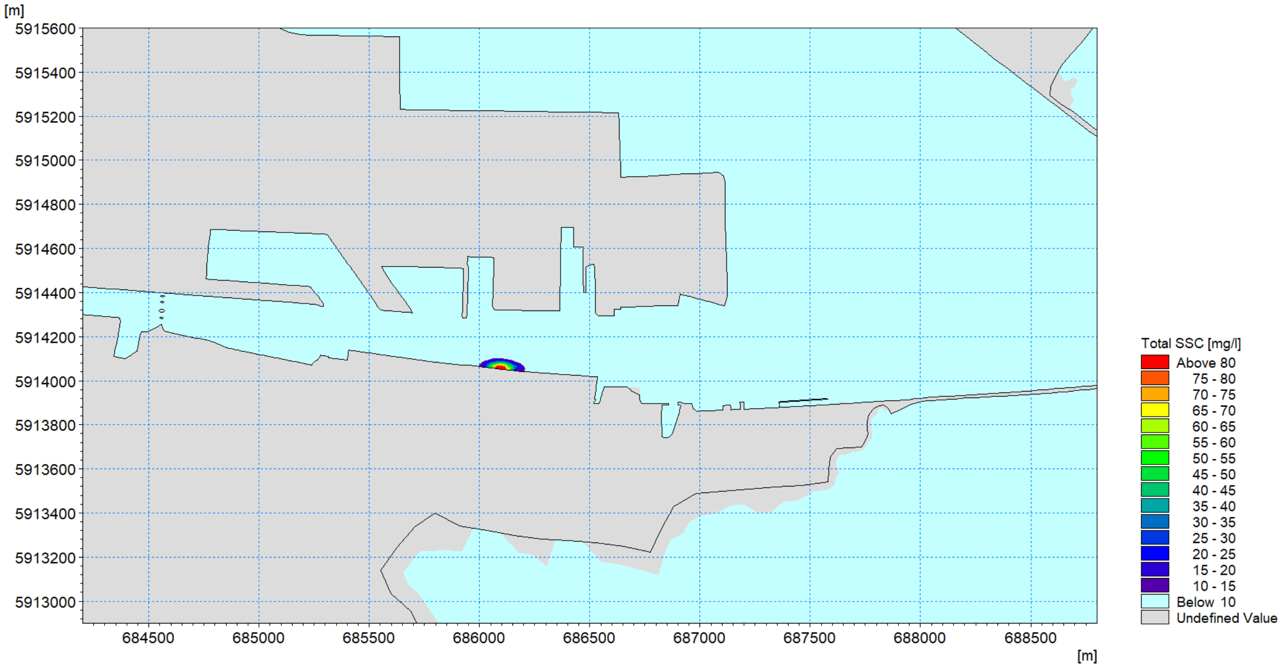


Figure 13.25: Suspended sediment concentration plume in the bottom layer during a typical high water phase of a spring tidal cycle whilst dredging Area K

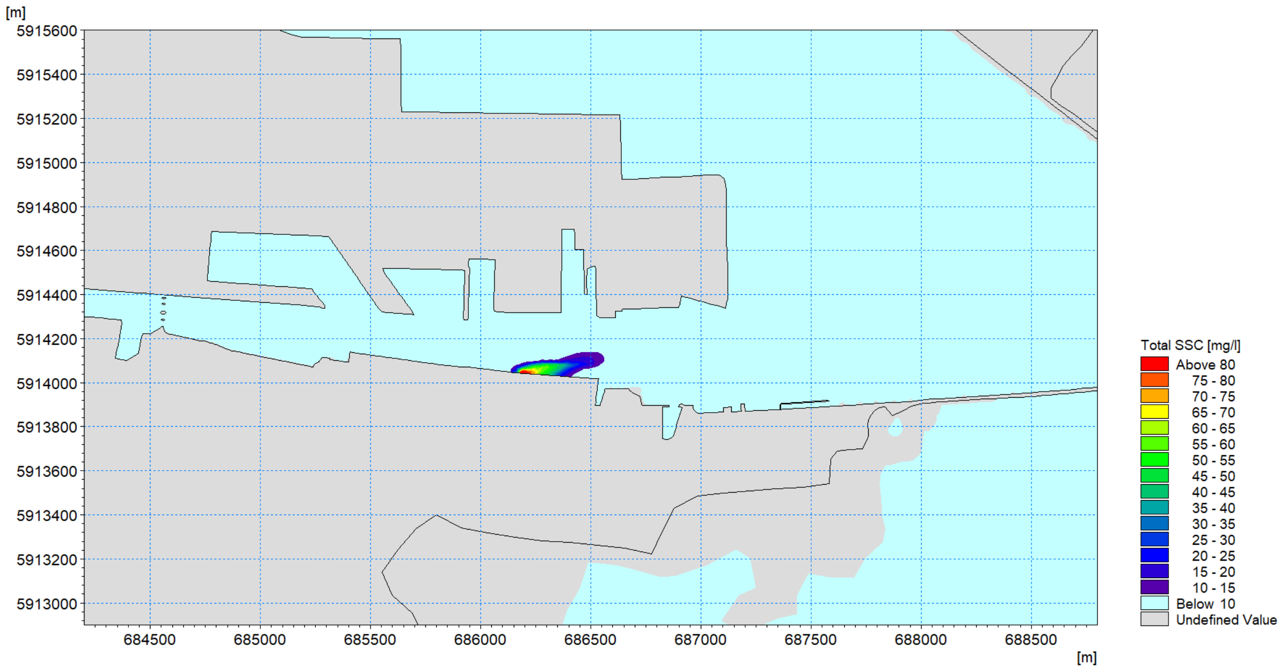


Figure 13.26: Suspended sediment concentration plume in the bottom layer during a typical mid ebb phase of a spring tidal cycle whilst dredging Area K

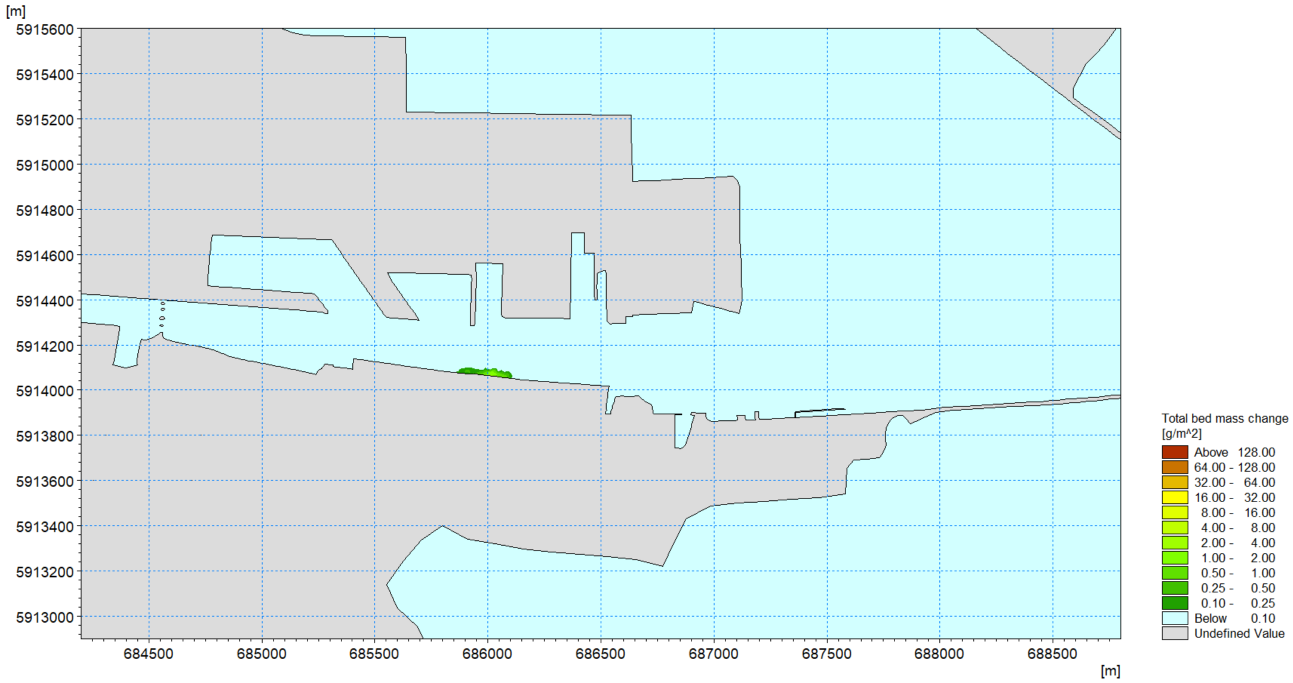


Figure 13.27: Deposition of sediment following the dredging operations at Area K

Dredging at the Turning Circle

The impact of dredging at the Turning Circle on suspended sediment concentrations is shown by a series of plume diagrams. Figure 13.28 to Figure 13.31 represent the dispersion of silt material at times of low water, mid flood, high water and mid ebb at a time during the dredging operation when the suspended sediment concentrations may be expected to be at their highest values (i.e., when the dredger is active at the site).

It will be seen from these figures that the concentration of suspended sediment plumes is greater in this area relative to suspended sediment concentrations associated with dredging works at the Maritime Village and Area K. This can be attributed to shallow water depths close inshore at Pigeon House. Even with shallow water depths, the suspended sediment concentration plumes are confined to the southern half of the navigation channel. The sediment concentration of the plumes is generally less than 25 mg/l beyond the immediate dredge area.

As set out previously, this is a relatively small and very local predicted increase in suspended solids due to the dredging works and is well within the background range experienced during normal Port operations. The lateral extent of the 10mg/l plume envelope is generally less than 500 m under most tidal conditions.

The predicted deposition of the silt fractions lost to the water column following the dredging campaign at the Turning Circle is presented in Figure 13.32. This Figure shows that the volume of material deposited following the dredge operations is generally less than 32.0 g/m^2 and that the deposition of sediment is generally confined to within the immediate area of the dredging operation. By comparison with natural background sediment loads (see previous section) such a small level of deposition is highly unlikely to pose any risk through siltation and no further mitigation is required.

It can, therefore, be concluded that, when considered in terms of background conditions, the dredging operations required for the Turning Circle will not result in any significant impact to either the water quality in terms of suspend sediments, or the nearby environmentally designated areas in terms of sediment deposition. No further mitigation is required.

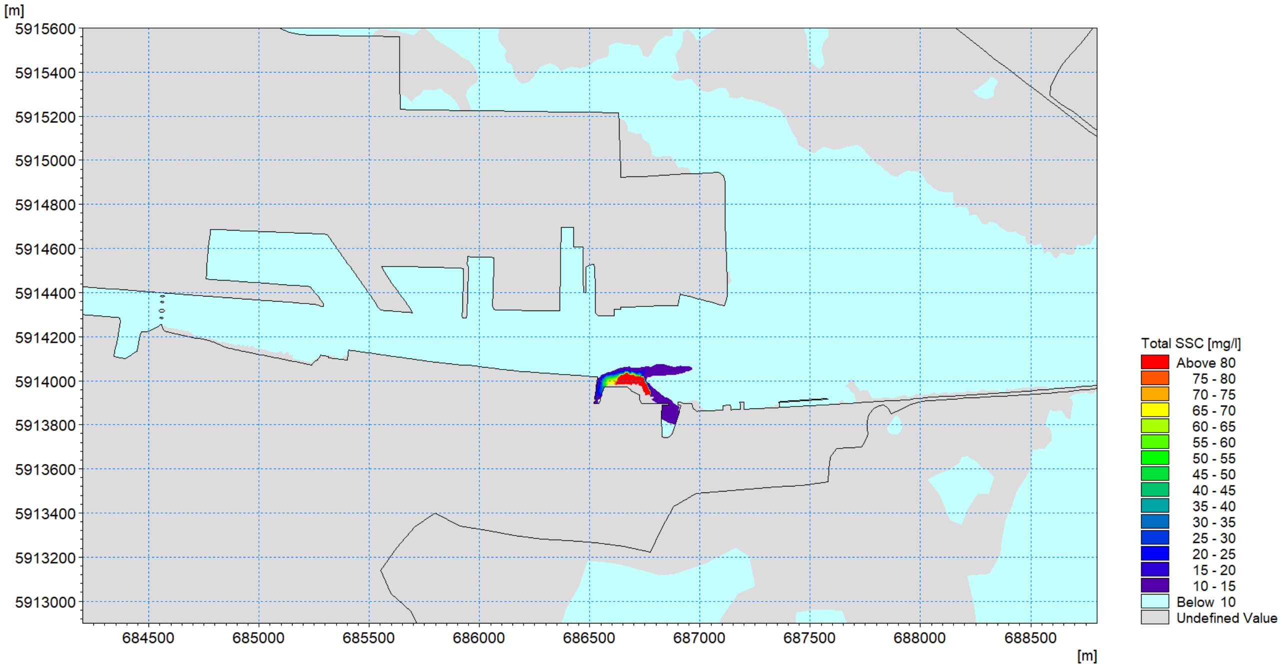


Figure 13.28: Suspended sediment concentration plume in the bottom layer during a typical low water phase of a spring tidal cycle whilst dredging the Turning Circle

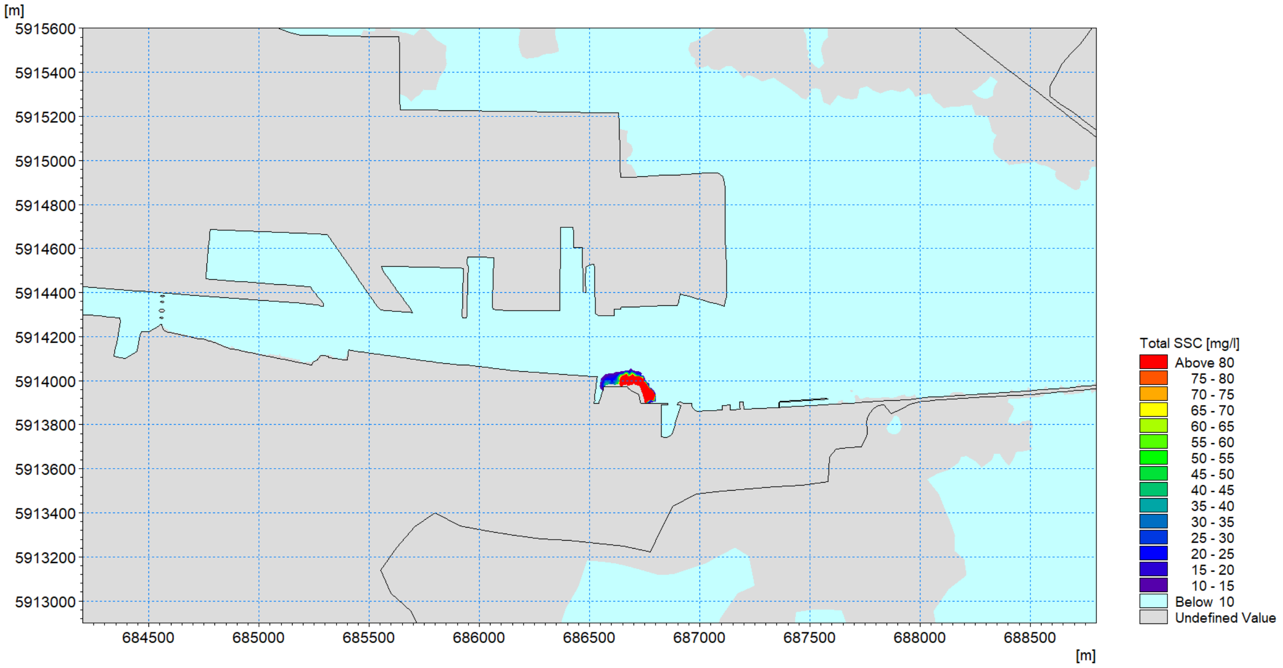


Figure 13.29: Suspended sediment concentration plume in the bottom layer during a typical mid flood phase of a spring tidal cycle whilst dredging the Turning Circle

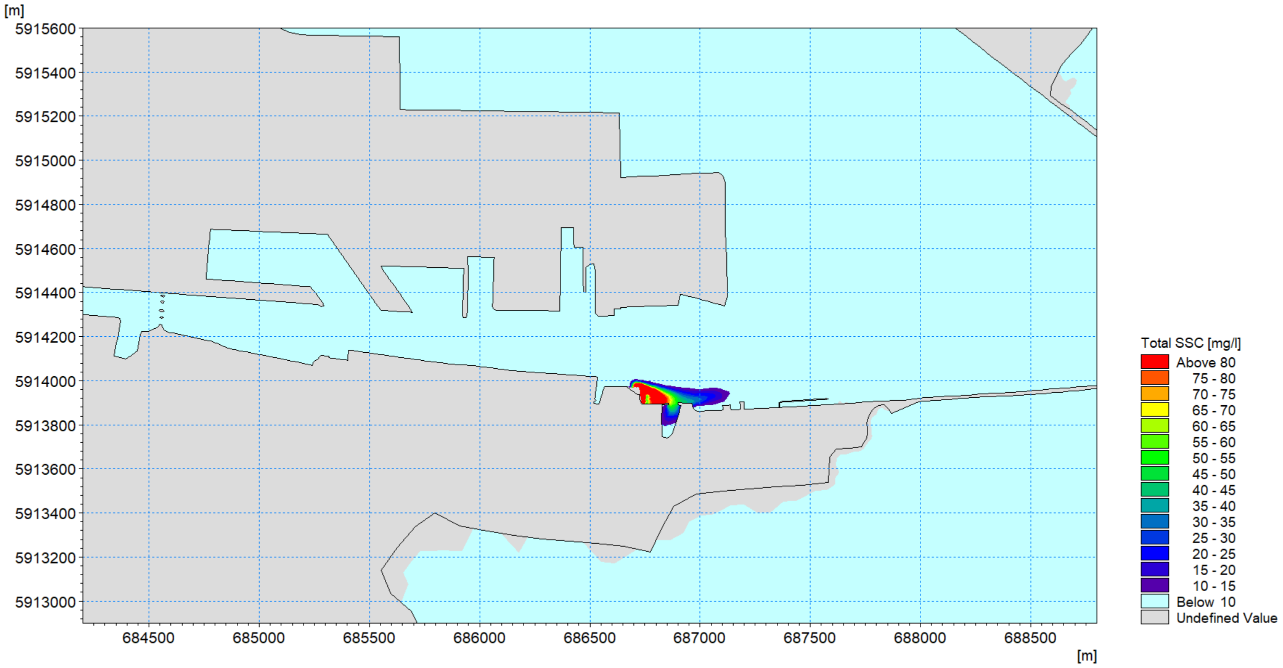


Figure 13.30: Suspended sediment concentration plume in the bottom layer during a typical high water phase of a spring tidal cycle whilst dredging Turning Circle

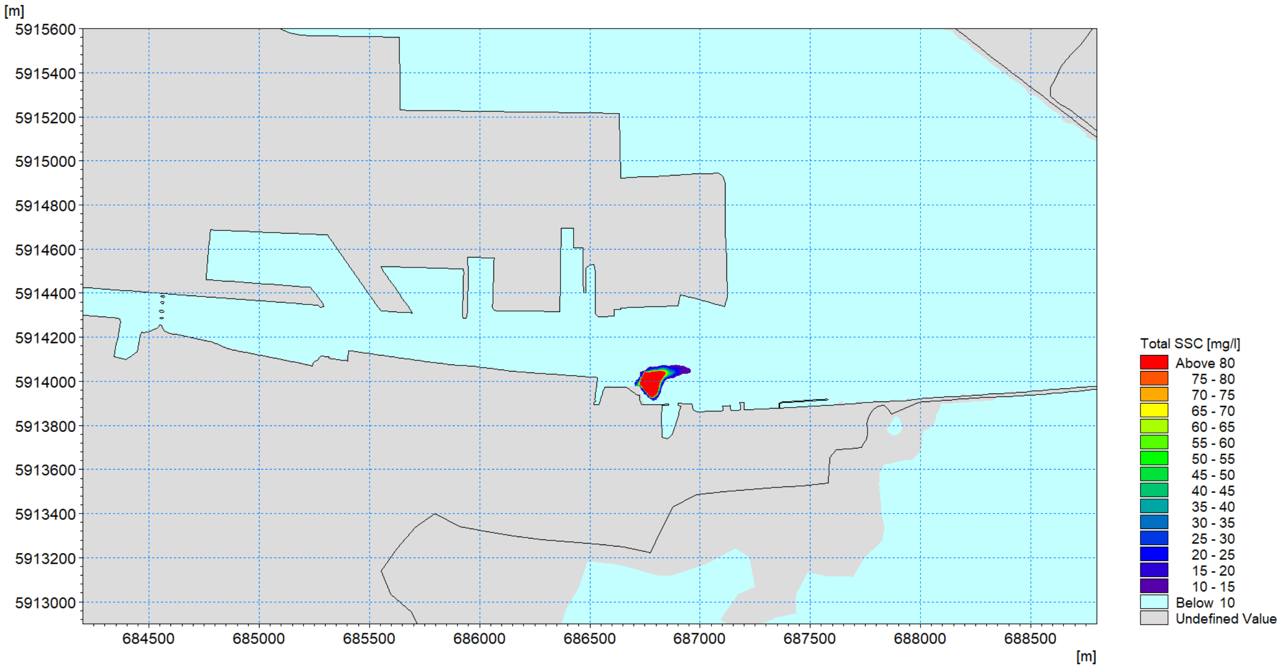


Figure 13.31 Suspended sediment concentration plume in the bottom layer during a typical mid ebb phase of a spring tidal cycle whilst dredging the Turning Circle

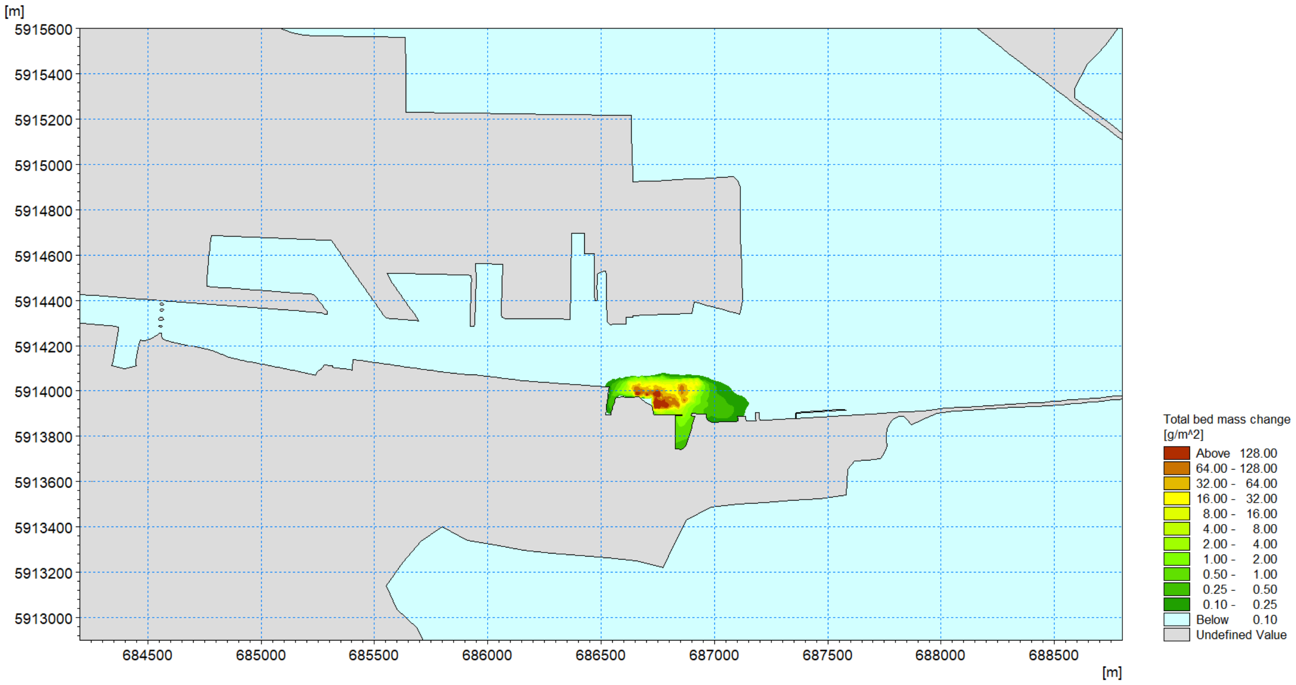


Figure 13.32: Deposition of sediment following the dredging operations at the Turning Circle

Dredging at Area N

The impact of dredging the berthing pocket at Area N on suspended sediment concentrations is shown by a series of plume diagrams. Figure 13.33 to Figure 13.36 represent the dispersion of silt material at times of low water, mid flood, high water and mid ebb at a time during the dredging operation when the suspended sediment concentrations may be expected to be at their highest values (i.e., when the dredger is active at the site).

It will be seen from these figures the suspended sediment concentration plumes are confined to the southern half of the navigation channel. The sediment concentration of the plumes is generally less than 30 mg/l beyond the immediate dredge area. As set out in the previous section, this is a relatively small and very local predicted increase in suspended solids due to the dredging works and is well within the background range experienced at this location during normal Port operations. The lateral extent of the 10 mg/l plume envelope is generally less than 750 m under most tidal conditions.

The predicted deposition of the silt fractions lost to the water column following the berthing pocket dredging campaign at Area N is presented in Figure 13.37. This Figure shows that the volume of material deposited following the dredge operations is generally less than 16.0 g/m^2 and that the deposition of sediment is generally confined to within the immediate area of the dredging operation.

Similarly, the impact of dredging construction access at Area N on suspended sediment concentrations is shown in Figure 13.38 to Figure 13.41 for the same four stages of the tide when the dredger is active at the site. It should be noted that the dredging volume for the construction access is significantly less than the berthing pocket, i.e. less than 15% and would therefore occur over a much shorter period, typically less than one week. The sediment concentration of the plumes is generally less than 60 mg/l beyond the immediate dredge area with the greatest increases for short periods during the flood tide when the sediment is advected into much shallower water. The volume of material deposited following the construction access dredging operation is in the same order as the berthing pocket i.e. generally less than 16.0 g/m^2. This is presented in Figure 13.42 and illustrates that deposition occurs in the immediate vicinity of the works and would not accumulate with the deposition associated with berthing pocket dredging at Area N.

By comparison with natural background sediment loads (previous section) such a small level of deposition is highly unlikely to pose any risk through siltation and no further mitigation is required. Again, any material deposited within the dredge area will be removed by the dredger until the specification is met.

It can, therefore, be concluded that, when considered in terms of background conditions, the dredging operations required for Area N will not result in any significant impact to either the water quality in terms of suspend sediments, or the nearby environmentally designated areas in terms of sediment deposition. No further mitigation is required.

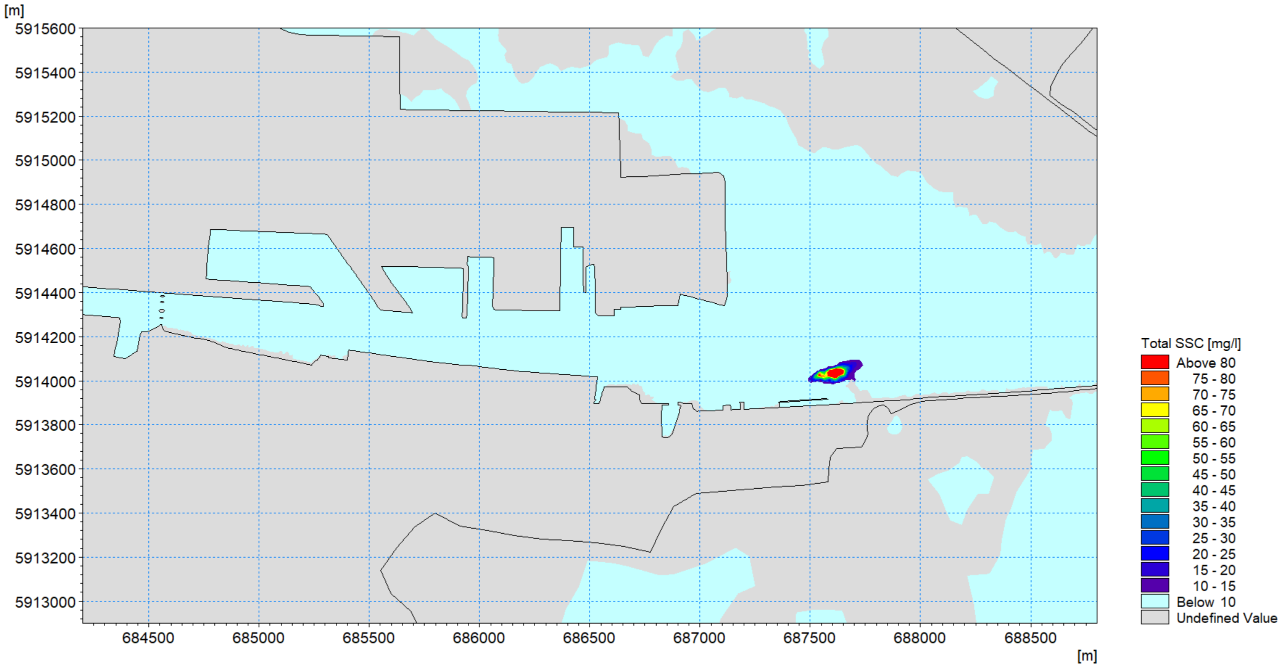


Figure 13.33: Suspended sediment concentration plume in the bottom layer during a typical low water phase of a spring tidal cycle whilst dredging the berthing pocket at Area N

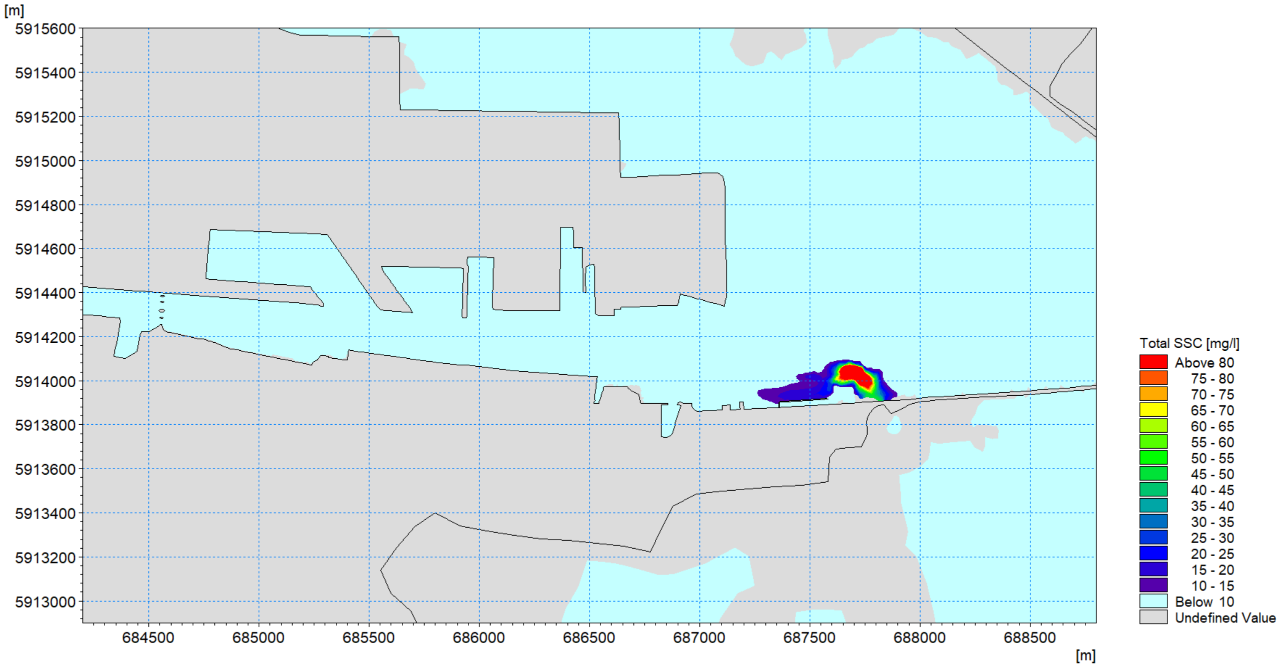


Figure 13.34: Suspended sediment concentration plume in the bottom layer during a typical mid flood phase of a spring tidal cycle whilst dredging the berthing pocket at Area N

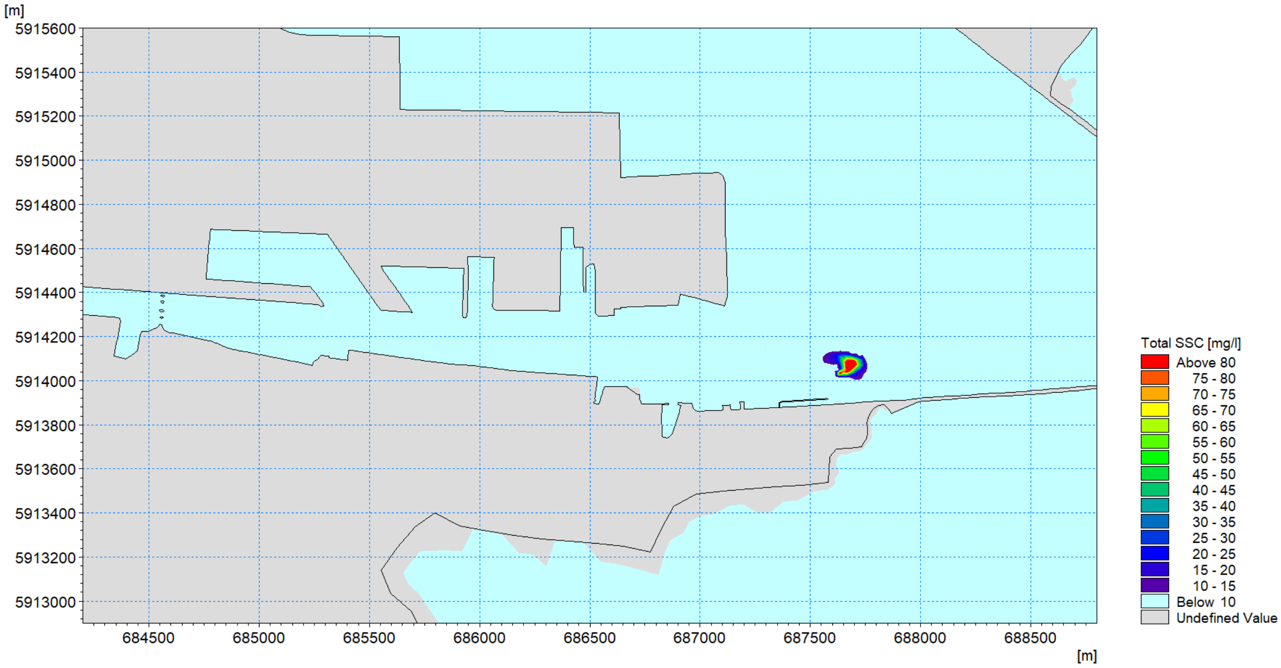


Figure 13.35: Suspended sediment concentration plume in the bottom layer during a typical high water phase of a spring tidal cycle whilst dredging the berthing pocket at Area N

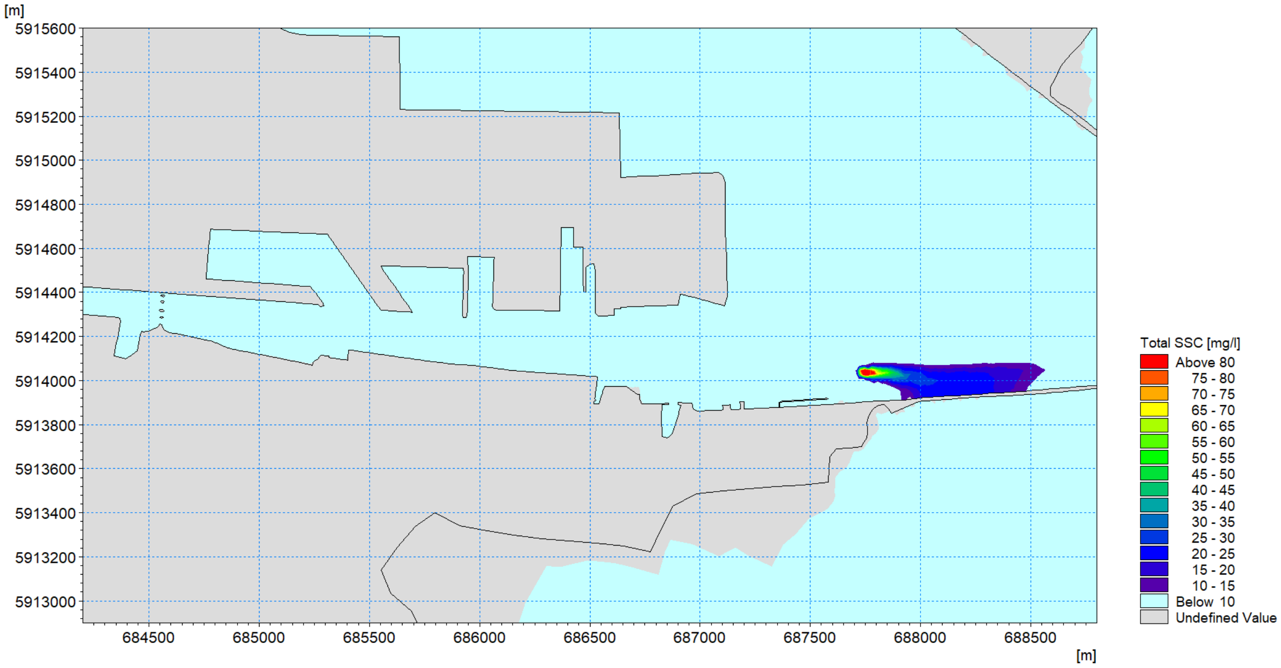


Figure 13.36: Suspended sediment concentration plume in the bottom layer during a typical mid ebb phase of a spring tidal cycle whilst dredging the berthing pocket at Area N

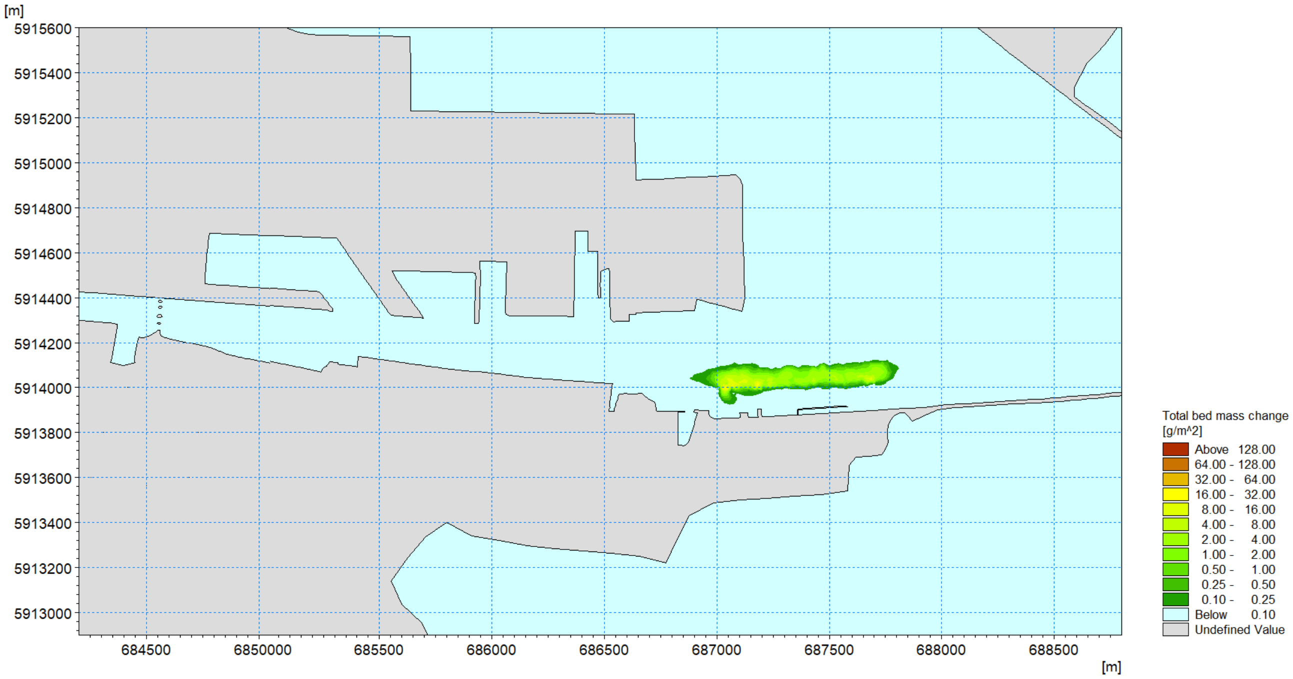


Figure 13.37: Deposition of sediment following the dredging operations for the berthing pocket at Area N

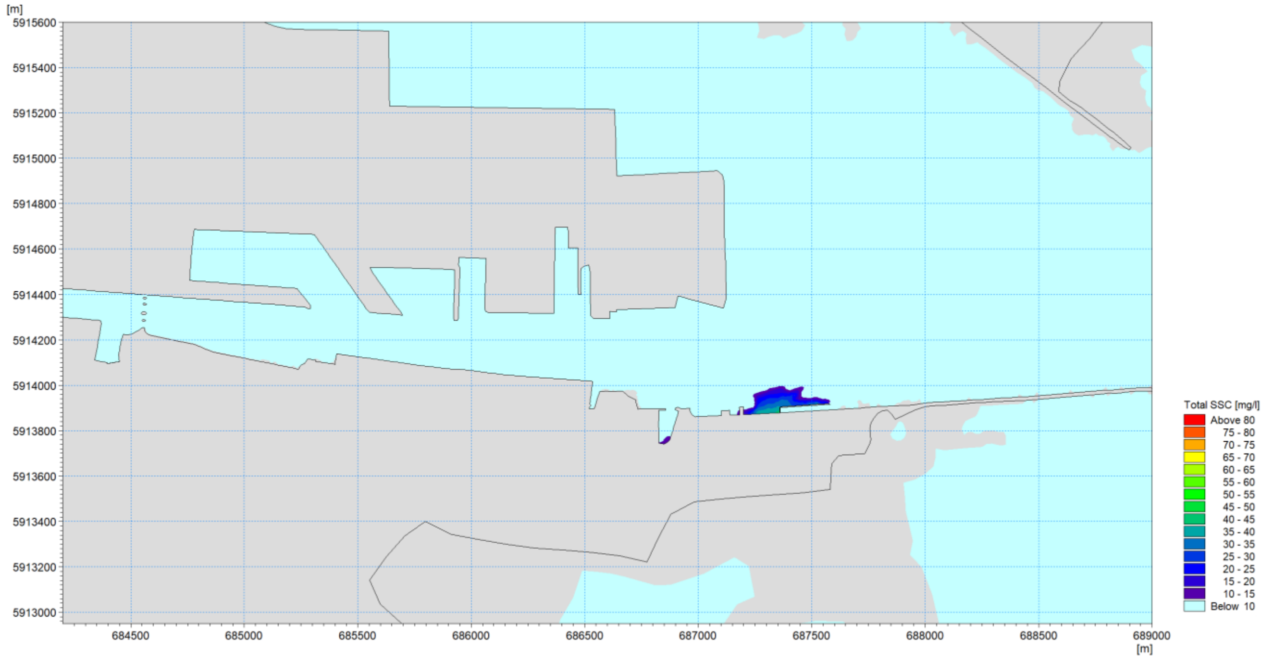


Figure 13.38: Suspended sediment concentration plume in the bottom layer during a typical low water phase of a spring tidal cycle whilst dredging construction access at Area N

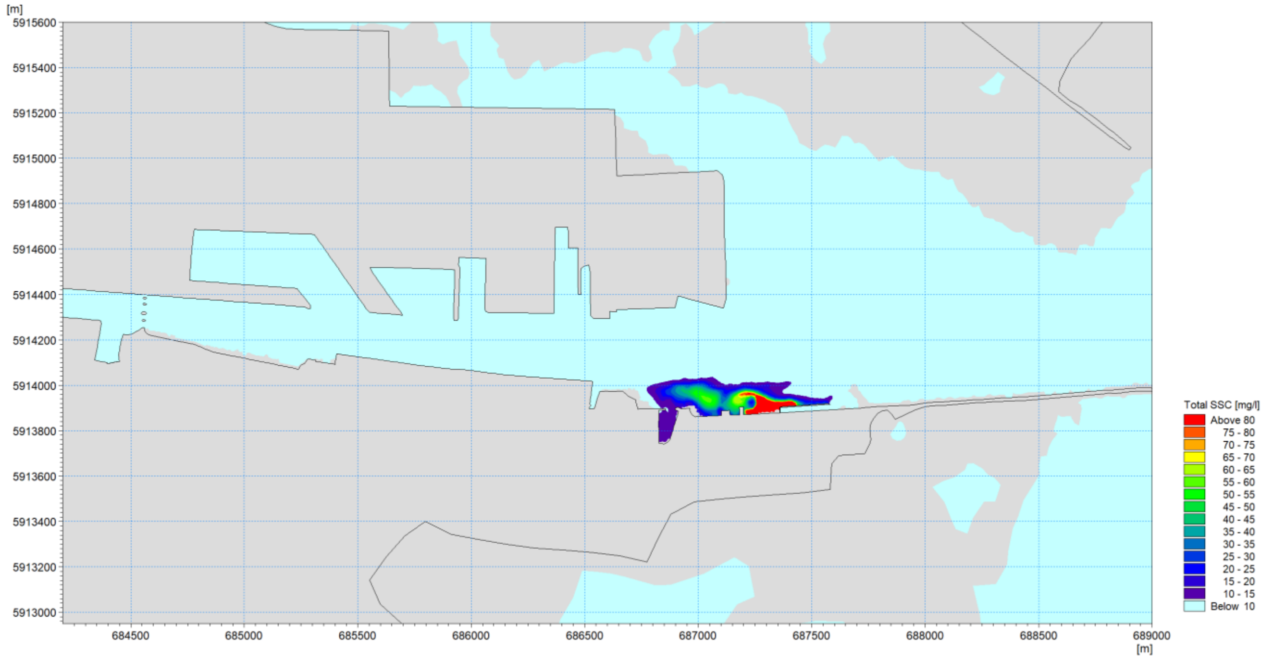


Figure 13.39: Suspended sediment concentration plume in the bottom layer during a typical mid flood phase of a spring tidal cycle whilst dredging construction access at Area N

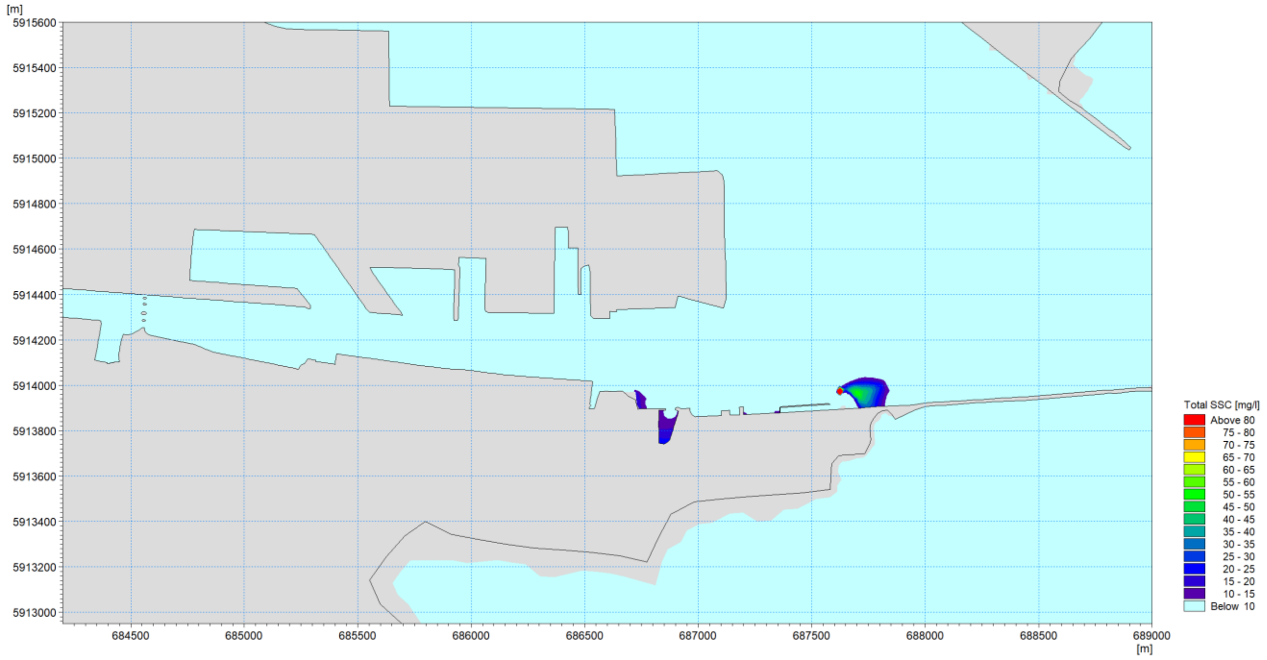


Figure 13.40: Suspended sediment concentration plume in the bottom layer during a typical high water phase of a spring tidal cycle whilst dredging construction access at Area N

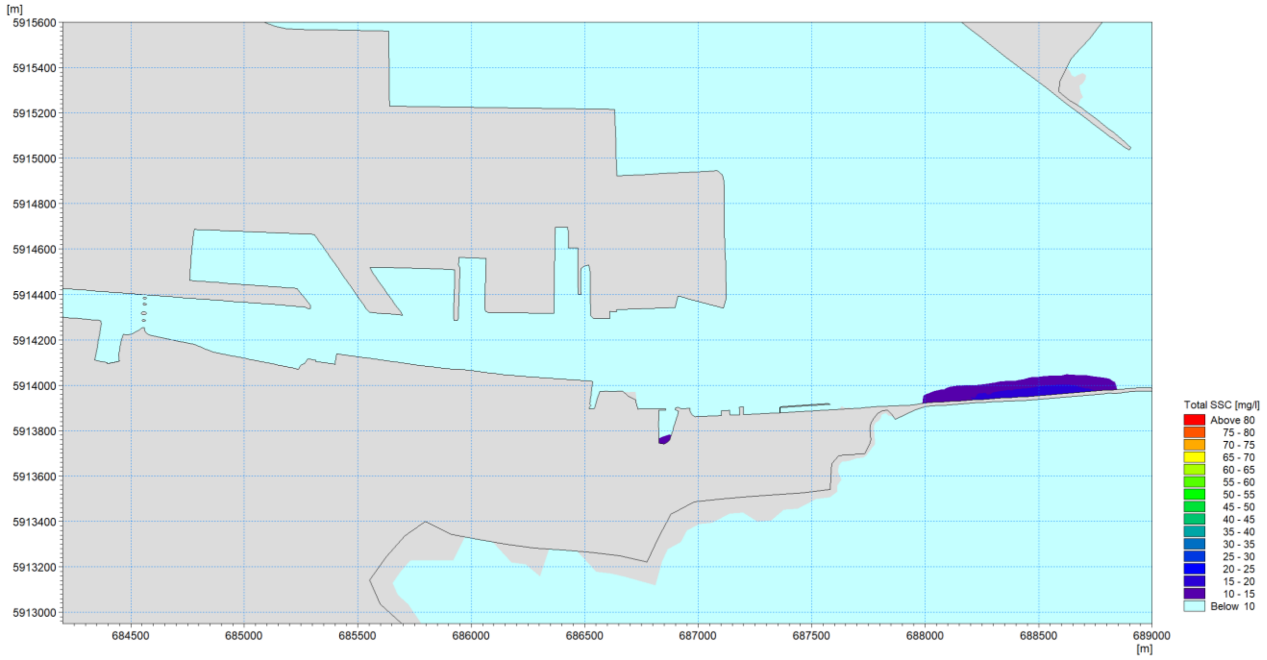


Figure 13.41: Suspended sediment concentration plume in the bottom layer during a typical mid ebb phase of a spring tidal cycle whilst dredging construction access at Area N

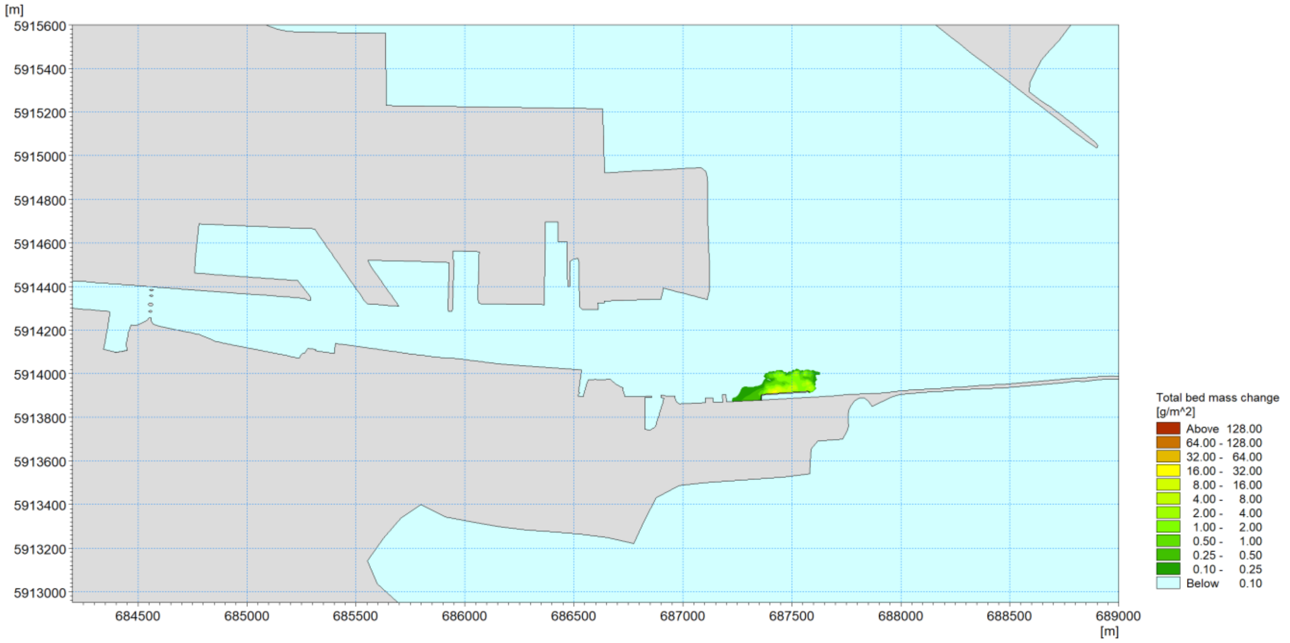


Figure 13.42: Deposition of sediment following the dredging operations for construction access at Area N

Impact of dredging on existing outfalls and power station cooling water systems

Water from the Liffey is abstracted by four power plants within the Dublin Port area: the North Wall Station; Synergen – Dublin Bay Power Plant; Covanta Waste to Energy Plant and Poolbeg Power Station. The water is abstracted as part of the electricity generation process and/or for cooling water components. High levels of suspended solids in cooling water have the potential to impact upon the plants cooling system and may result in an increase in operation and maintenance costs.

The Ringsend Waste Water Treatment Plant is also located on the southern bank of the River Liffey. This plant discharges treated effluent into the Liffey Estuary via a cooling water discharge channel to the north east of Poolbeg Generating Station whilst a storm water overflow is located to the north of the storm tanks about 800m upstream. High levels of suspended solids and the ingress of settling material during periods of low flow may have the potential to impact the operational performance of this outfall. The location of the various power station cooling water intake systems and the Ringsend Waste Water outfall is illustrated in Figure 13.12.

In order to determine whether any of the dredging operations associated with the 3FM Project would impact upon any of these cooling water intake systems or outfalls, RPS analysed the modelling results from the dredging simulations described in the previous four sections to calculate the peak and average suspended sediment concentrations due to dredging at each point of interest illustrated in Figure 13.12. These peak and average suspended sediment concentrations due to additional dredging loads are presented in Table 13.8. Also included in the table for comparison are the peak and average background suspended sediments levels which were derived from monitoring that was undertaken by Dublin City Council and as part of the ABR and MP2 projects between 2017 to 2022.

The results of the simulations show that the increased levels of suspended sediment concentrations at the power station intakes and Ringsend WwTW outfall are generally very small by comparison with background levels in the Liffey Estuary and are unlikely to have any effect on the quality of intake waters at power stations in terms of suspended solids content. The highest instantaneous values occur at the Poolbeg Power Station intake during the construction access dredging. However, the elevated levels occur only for short periods during the flood tides and therefore only comprise *c.*14 events typically peaking at less than 150 mg/l. These activities are also within the distance from the intake for which mitigation measures would be employed.

It is customary practice that DPC notifies the power station operators in advance of each dredging campaign. This allows the operations to temporarily stop abstracting water from the Liffey for a short duration in the event that dredging is required within the immediate vicinity of their intake works. The communication between DPC and the power station operators has enabled previous dredging campaigns, where dredging has taken place closer to the intakes, to be undertaken with minimal disruption.

Table 13.8 Peak and average Suspended Sediment Concentrations at various intakes and outfalls in Dublin Port during 3FM dredging operations

Intake	**Dredging Location/Scenario**	**Peak Concentration (mg/litre)**	**Average Concentration over 1 month (mg/litre)** **(*1 week duration)**
Poolbeg Power Station	Maritime Village	10.8	4.2
	Area K	3.8	1.3
	Turning Circle	89.3	10.0
	Area N - berthing pocket	34.2	6.4
	Area N – construction access*	385.7	22.3
Synergen – Dublin Bay Power Plant	Maritime Village	29.8	11.4
	Area K	76.9	4.5
	Turning Circle	38.0	8.9
	Area N - berthing pocket	18.7	3.8
	Area N – construction access*	6.3	2.2
North Wall station	Maritime Village	17.9	11.2
	Area K	1.8	1.2
	Turning Circle	11.0	5.8
	Area N - berthing pocket	4.0	2.4
	Area N – construction access*	1.5	1.0
Covanta – Waste to Energy Plant	Maritime Village	36.5	12.8
	Area K	114.6	4.7
	Turning Circle	33.9	9.2
	Area N - berthing pocket	17.8	3.7
	Area N – construction access*	6.4	2.2
SS Monitoring Results (2017 - 2022) *Representing Background Levels*	Liffey Estuary (East Link Bridge)	1,595 (95%'ile = 22.5)	24.5
	Liffey Estuary (Poolbeg jetty)	850	5.8

13.5.1.2 Potential Impacts as a result of disposing dredge material at sea

A programme of sediment quality sampling and analysis within the Tolka Estuary and Dublin Port area (Chapter 8 Land, Solis, Geology and Hydrogeology) has shown that that the sediments to be dredged as part of the 3FM Project are suitable for conventional dumping at sea (subject to the granting of a Dumping at Sea Permit by the EPA). The closest and preferred site is located at the approaches to Dublin Bay to the west of the Burford Bank as presented in Figure 13.43. This disposal option is preferred because it keeps the sand element of the dredge material within the natural Dublin Bay sediment cell.

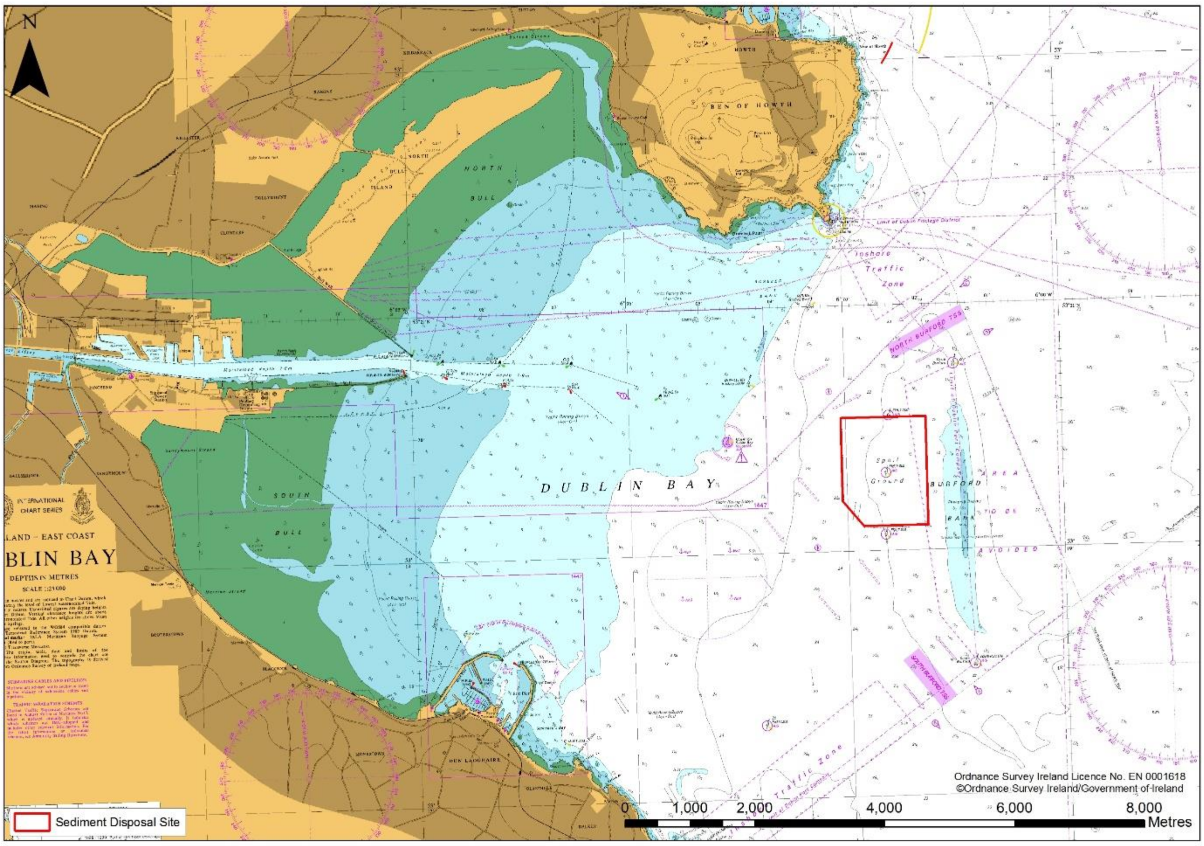


Figure 13.43: Location of the licensed dredged spoil disposal site

The disposal of sediments at sea has the potential to cause a temporary increase in suspended sediments and turbidity levels during the disposal operations and, under certain conditions, could have adverse effects on marine biota (for example, through siltation of benthic communities), changes to sediment structure, or interference with feeding in reduced visibility.

To assess the impact of the 3FM Project disposal operations at the licensed offshore disposal site, a coupled MIKE 21 Hydrodynamic and Sediment Transport model was used to determine the dispersion of the sediment material during the disposal operations.

It was assumed that the Trailer Suction Hopper Dredge would discharge material over the disposal site every *c.* 3 hours and that the equivalent of approximately of 2,030 tonnes (wet weight) would be released per dump. Key parameters relating to the sediment dumping simulations are outlined Table 13.9.

Table 13.9: Disposal simulation input parameters

Parameter	Value
Trailer Suction Hopper Dredger capacity	4,100 m^3
Ratio of sediment/entrained water during loading	0.3
Average density of material inside hopper	1.65 t/m^3
Average Trip Frequency between Dublin Port and Disposal site	3.0 hours
Average Time to Fill Dredger Hopper	1.5 hours
Time to release load	90 seconds

The model simulations were run for the disposal of the dredged material over the course of a complete lunar month, which includes the full range of spring and neap tidal flow conditions. The characteristics of the sediment modelled in this simulation are equivalent to those used in the dredging simulations described in the previous section of this chapter. As such, the sediment material was characterised by three discrete fractions with mean diameters of 200 µm, 20 µm and 3 µm, with each fraction constituting 1/3 of the total volume of silt to be dredged.

The sediment material was introduced into the surface of the model as a point source that moved across the dump site area during the disposal operation. The model then simulated the dispersion, settlement and re-erosion of each fraction of the silt in response to the tidal currents throughout the model area.

The coarser fraction of the sediment, i.e., the sand fraction that had a mean grain size of 200 µm, was found to behave differently relative to the two finer silt fractions that had mean grain diameters of 20 µm and 3 µm. The sand fraction remained on the dump site, whereas the two finer silt fractions were carried away by the tidal currents.

The results of the simulations are given in terms of maximum total suspended sediment concentrations envelope in Figure 13.44, which depicts the maximum level of the suspended sediment concentration which occurs in each cell at any time during the simulation and is thus an envelope covering all the sediment plume excursions. It will be seen from Figure 13.45 that the sediment plume outside the area of the dump site is less than 200 mg/l and does not extend further than 750 m to the north or south of the dump site.

Based on these results, it can be concluded that the disposal operations associated with the 3FM Project will not result in any significant increases to the background level of suspended sediments and will not, therefore, impact the existing water quality in the greater Dublin Bay area.

NOTE - Mean turbidity measured in Dublin Bay (4 monitoring buoys - 3 at dumpsite and 1 background) is 10.25 NTU. Based on the relationship established for fine sands in Dublin Bay this is equivalent to a Total Suspended Solids (TSS) concentration of 16.5 mg/l or based on finer silts/sands of Liffey Estuary to a TSS concentration of 25.6 mg/l (See Chapter 9 Water Quality and Flooding). Note that these measurements cover periods of maintenance and capital dredging.

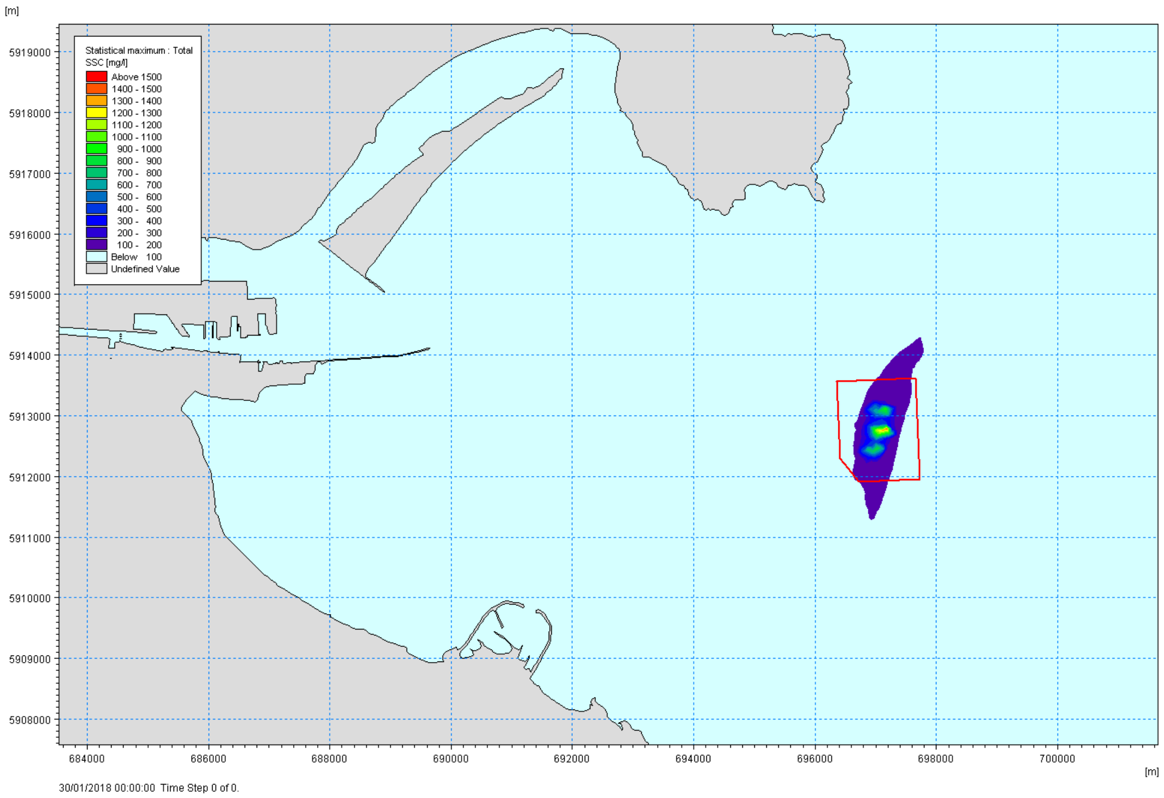


Figure 13.44: Maximum Total Suspended Solids Concentration envelope using a Trailing Suction Hopper Dredger dumping circa 2,030 tonnes wet weight at 3 hourly intervals on average within each winter capital dredging season

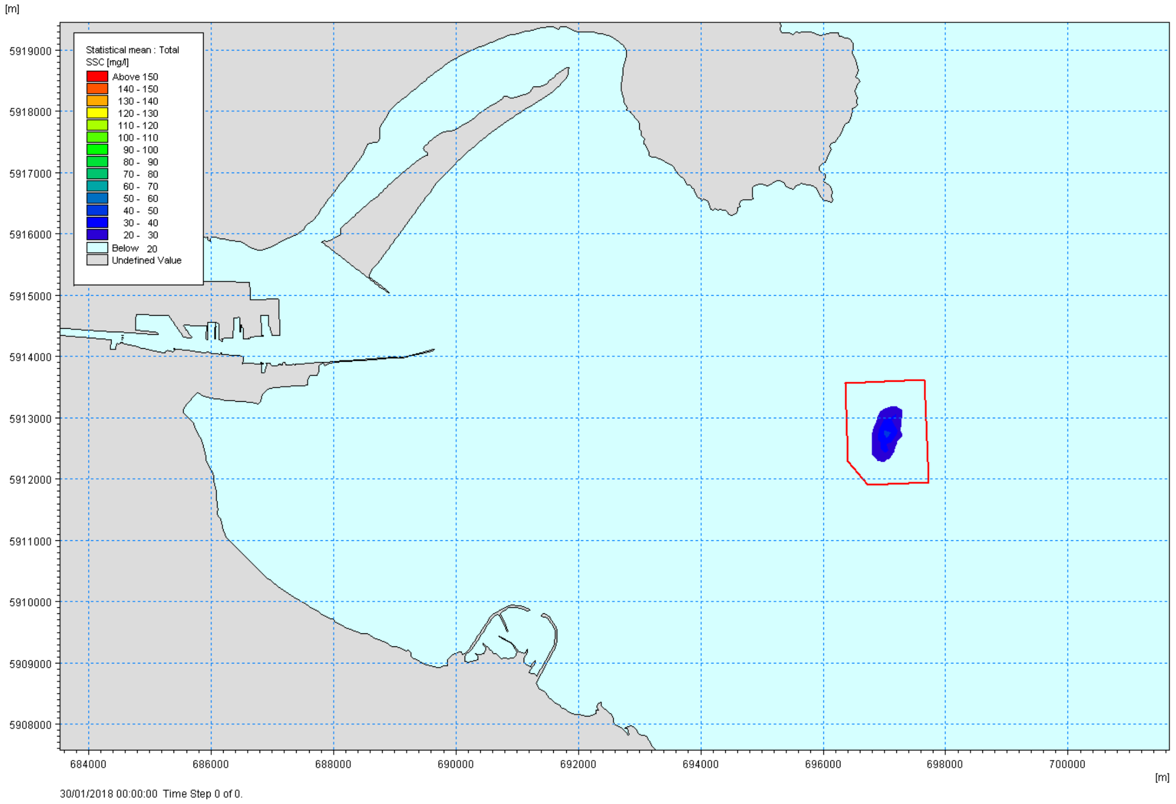


Figure 13.45: Mean Total Suspended Solids Concentration envelope using a Trailing Suction Hopper Dredger dumping circa 2,030 tonnes wet weight at 3 hourly intervals on average within each winter capital dredging season

13.5.1.2.1 Long-term fate of sand material at the dumpsite

As noted in the previous section, the sand fraction of dredge material was found to remain on the dumpsite during the course of the simulation period. To further validate this finding, RPS reviewed site-specific high-resolution bathymetric surveys of the dumpsite to measure changes in seabed elevations and thus derive rates of change. Given that much of the dump site is characterised by well-defined sand waves, the output from this assessment was used as a proxy to determine the long-term potential for sediment erosion and movement. This assessment is described below.

As part of DPC's extensive environmental monitoring programme, Hydromaster Ltd. is contracted to undertake high-resolution bathymetric surveys of the dump site before and after dredging campaigns. Most recently, the dump site was surveyed prior to the first capital dredging campaign under S0024-02 on 13th October 2022 and again on 7th December 2022 upon completion of the campaign. The output from both surveys is illustrated in Figure 13.48.

As illustrated in Figure 13.48, the elevation of the dumpsite ranges between *c.* -24 m along the western boundary and *c.* -11 m along the eastern boundary. Other notable features from this survey include two areas near the centre of the dump site whereby depths are *c.*5 m shallower than the immediately surrounding area. In addition to these shallower areas, distinct sand waves can also be observed in the shallower areas, particularly along the northeast and southern boundaries of the site.

Using a series of Geographical Information System (GIS) tools that were specifically developed for terrain analyses and the assessment of ridge forms, these surveys were analysed to identify key morphological features. The output from this process is presented in Figure 13.49 which illustrates the presence of prominent sand waves common to both surveys and also the deposition of dredge material in the post dredge campaign survey.

Using sand wave features common to both surveys, the spatial movement of morphological features was calculated using more than 40,000 unique vertices as illustrated in Figure 13.50. These differences were then divided by the duration between the two surveys to estimate rates of movement.

The output of this assessment demonstrated that the transport of the coarse material was greatest in shallower water, but that even in these areas the average rate of movement equated to *c.* 0.10 m/day. In deeper waters whereby the seabed is not exposed to the same wave radiation or tidal stresses, the average rate of movement equated to just *c.* 0.05 m/day. The dominant direction of sediment transport was generally from south to north, however, there was variation across the dump site.

Given that the dumpsite is approximately 1.6 km in length, it is estimated that coarse fraction of spoil material disposed of at the centre of the dump site would take between c. 10 – 40 years to move beyond the boundary of the dump site.

It is worth noting that these surveys were undertaken in October and December 2022, during which period the Marine Institute's M2 wave buoy recorded relatively heavy sea conditions as illustrated in Figure 13.47.

Furthermore, since 2012, the Marine Institute, has carried out monitoring to determine macroinvertebrate ecological quality status (EQS) in coastal and transitional waters around the Irish Coast in order to fulfil requirements of the Water Framework Directive (WFD). As part of this programme, sampling must be carried out within each waterbody, including Dublin Bay, at least twice within the 6-year cycle (once every three years).

Based on the sampling and monitoring of 15 individual locations illustrated in Figure 13.46, the seabed material was found to comprise of muddy and fine sand or very fine sands at all stations. Coarse material was found to contribute an insignificant part of the sediment. Furthermore, the benthic communities surveyed in Dublin Bay were characteristic of the shallow muddy fine sand sediments sampled. Taxa common throughout the stations included, amongst others, the polychaetes *Glycera tridactyla, Nephtys hombergii, Spiophanes bombyx* and *Chaetozone christiei.*

The results of the Marine Institute's long-term (since 2012) environmental benthic surveys therefore support conclusion that the movement of coarse material into Dublin Bay as a result of disposing of dredge material at the dump site is extremely limited and highly unlikely to result in a large-scale deposition event in Dublin Bay.

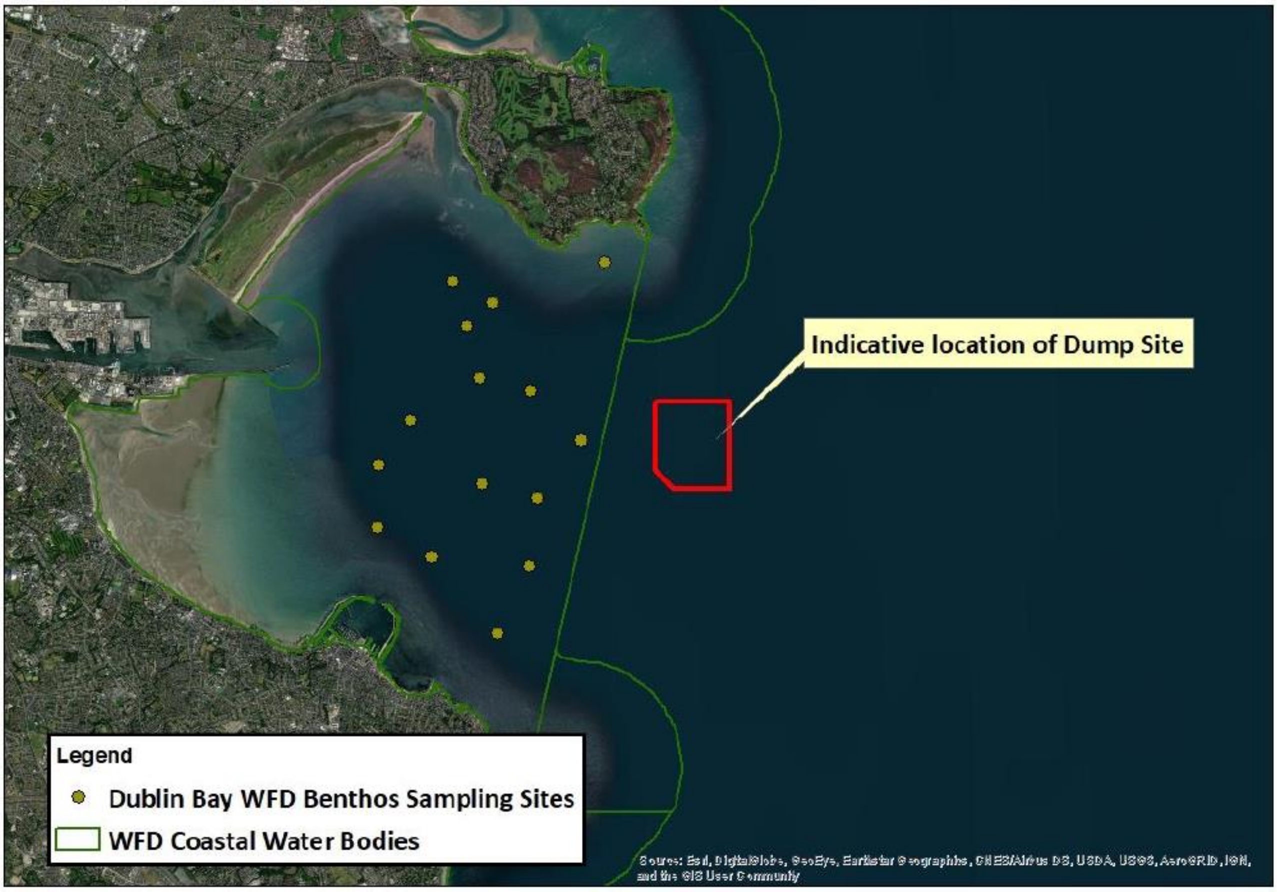


Figure 13.46: Dublin Bay Water Framework Directive benthos macro-invertebrate sampling points (n=15) in relation to the dump site

Table 13.10: Average rate of sediment transport based on a difference assessment of high resolution surveys of the dump site on 13.10.2022 and 07.12.2022

Contour [m]	Average Rate of movement [metres / day]
-24	0.055
-23	0.068
-22	0.053
-21	0.048
-20	0.076
-19	0.084
-18	0.160
-17	0.169
-16	0.123
-15	0.130
-14	0.174
Average	**0.104**

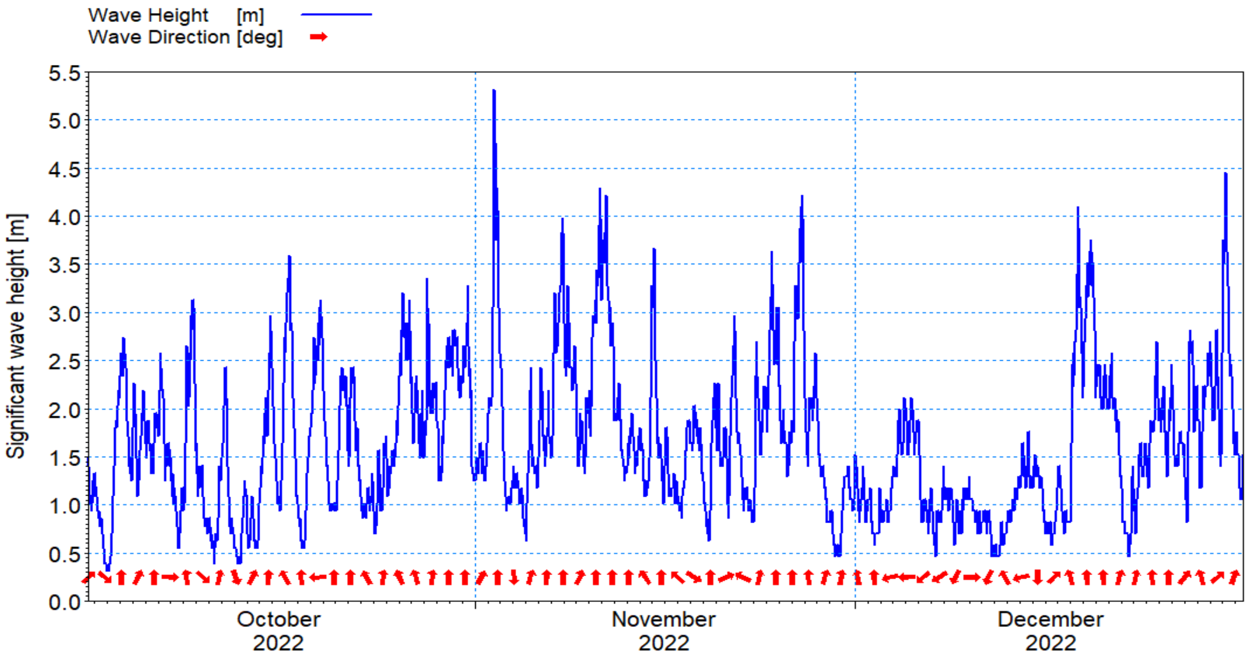


Figure 13.47: Wave climate as recorded by the Marine Institute’s M2 wave buoy between October and December 2022.

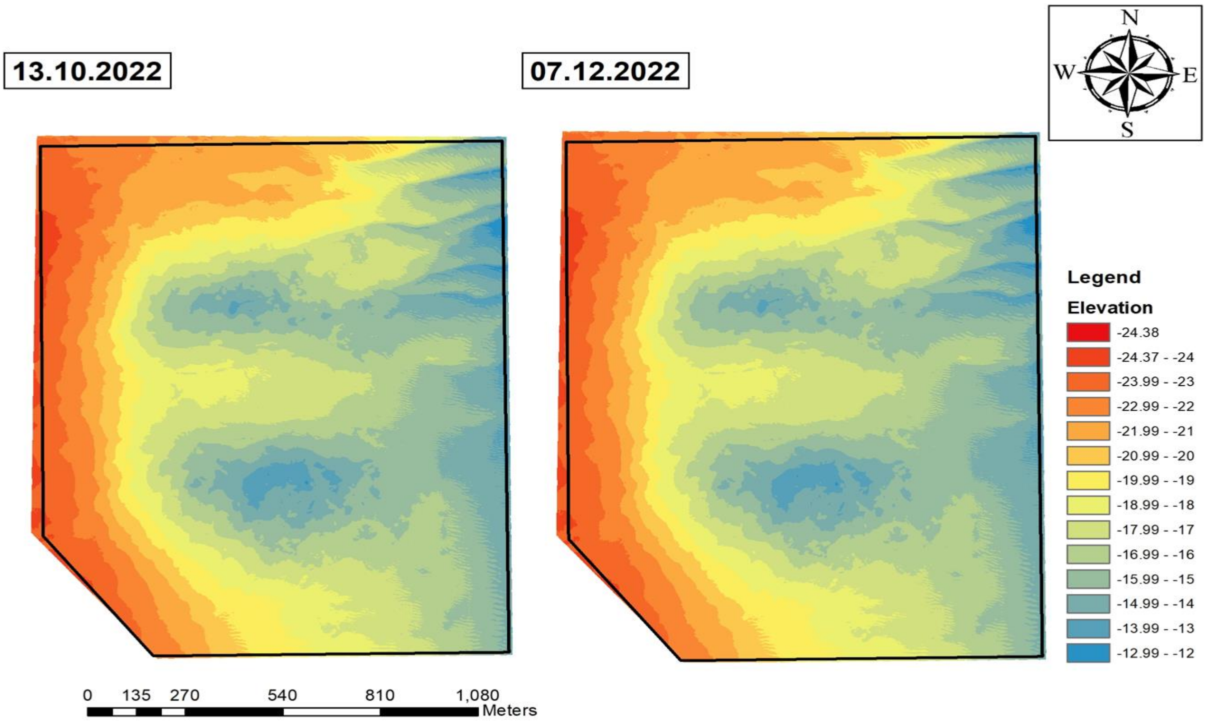


Figure 13.48: Pre and post dredging campaign bathymetric surveys at the licenced offshore dump site at the approaches to Dublin Bay

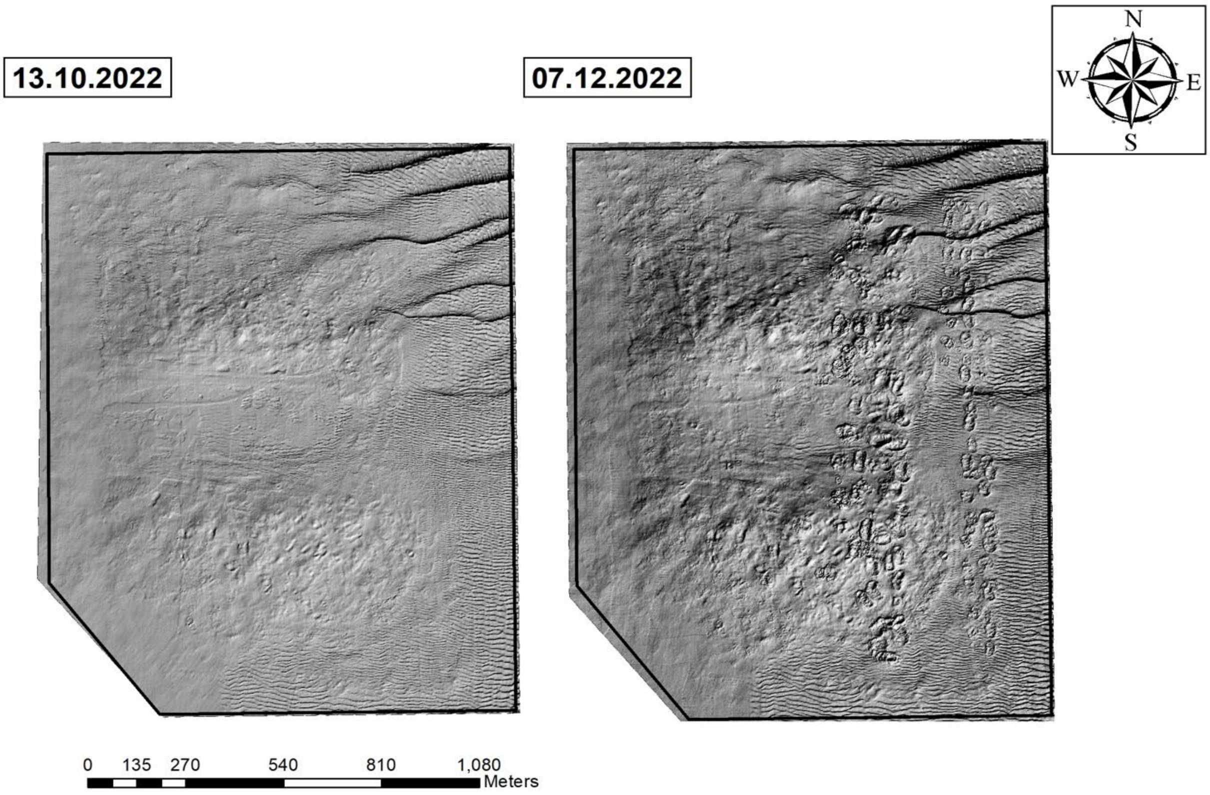


Figure 13.49: Sand wave and other morphological features identified from a terrain analyses of both survey datasets

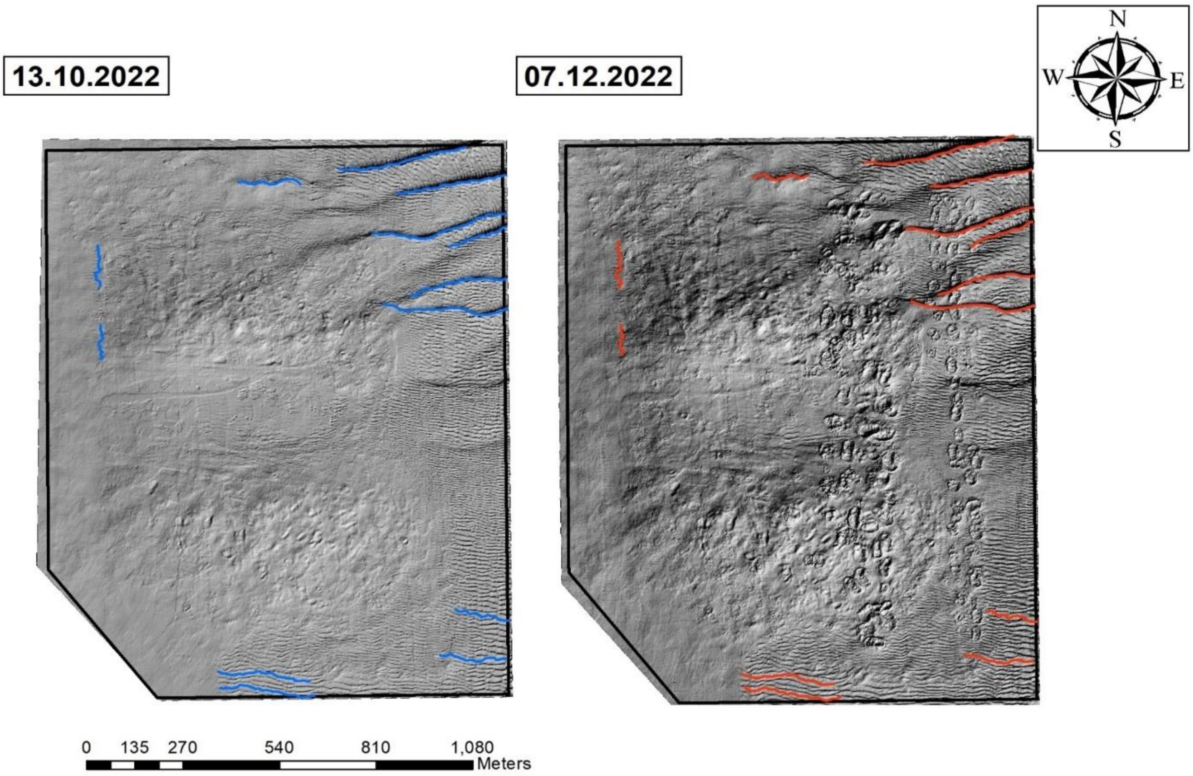


Figure 13.50: Sand wave features common to both surveys identified by blue and red vectors that were used to assess movement of bed material

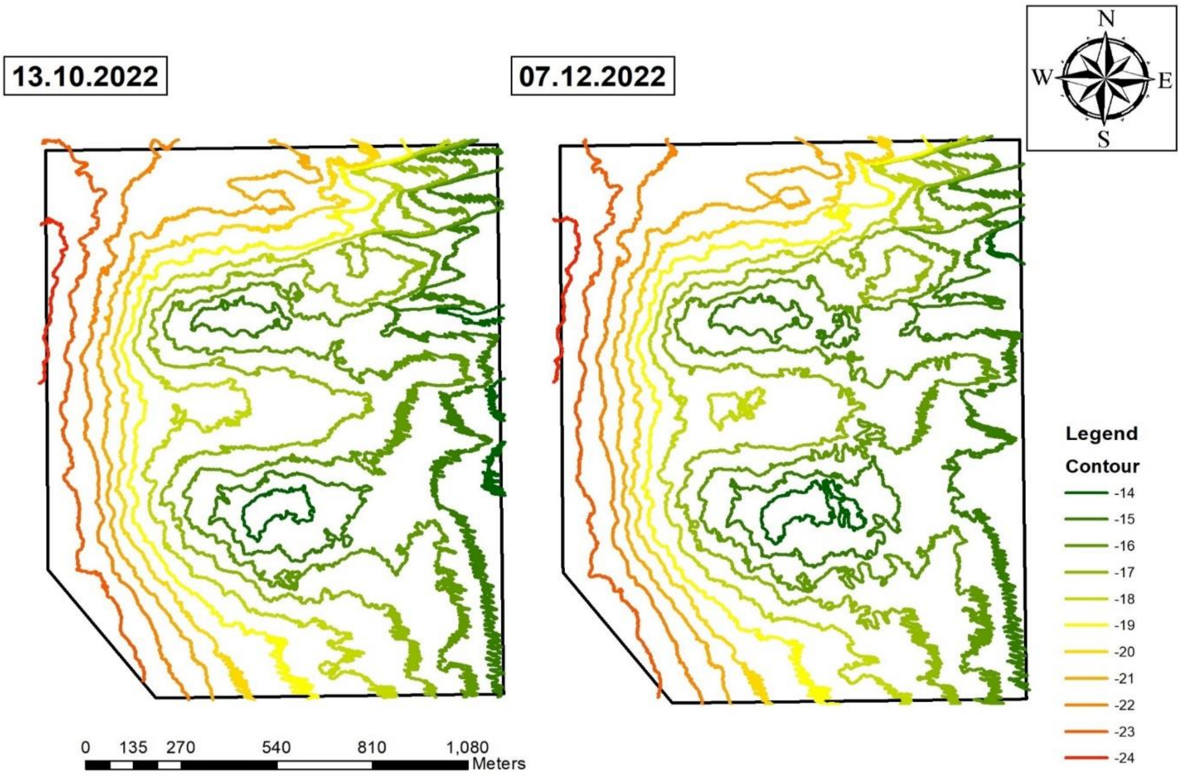


Figure 13.51: Elevation contours of both surveys used to assess the movement of bed material at the dump site

13.5.2 Operational Phase Impacts

13.5.2.1 Potential changes to the existing tidal regime

The potential for changes with the elements of the scheme in place was assessed to consider the potential for operational phase impact. The MIKE 21 Hydrodynamic module described in Section 13.2.3 was used in conjunction with the post-3FM Project scenario (i.e., Dublin Port, including the ABR, MP2 and 3FM Projects) 2D model to simulate the tidal regime in the Dublin Port following the implementation of the 3FM Project. Typical tidal flow patterns for a spring ebb and spring flood tide from the post-3FM Project simulation are presented in Figure 13.52 and Figure 13.53.

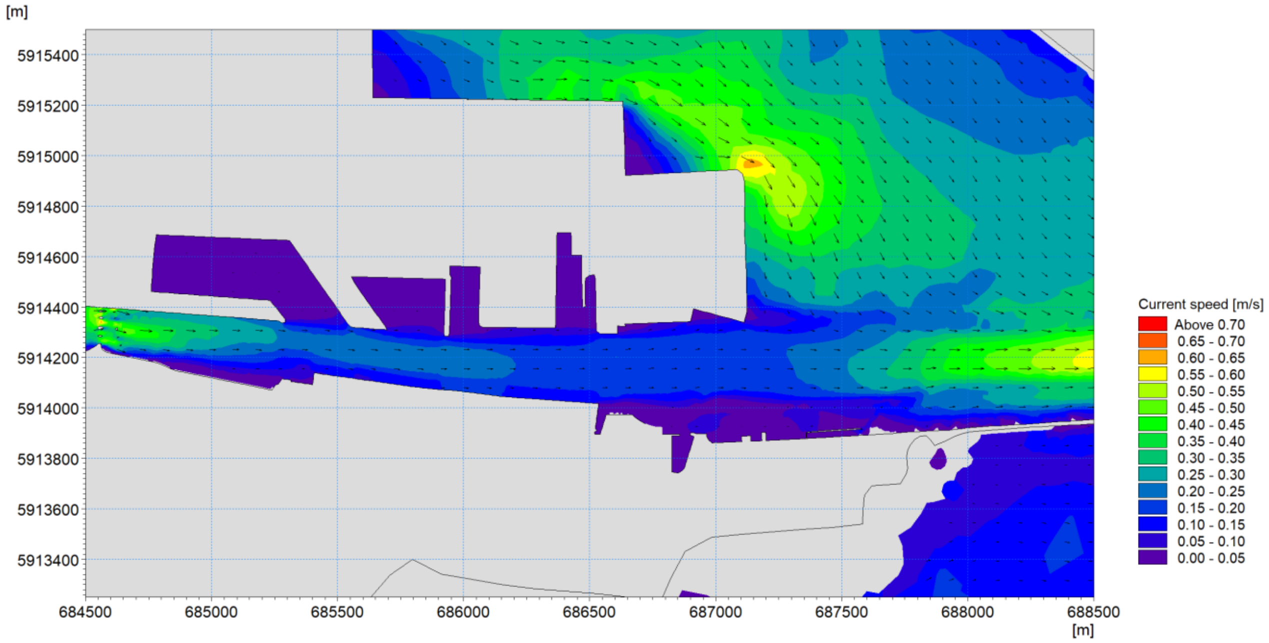


Figure 13.52: Typical spring mid ebb tidal flow patterns – Post 3FM Project

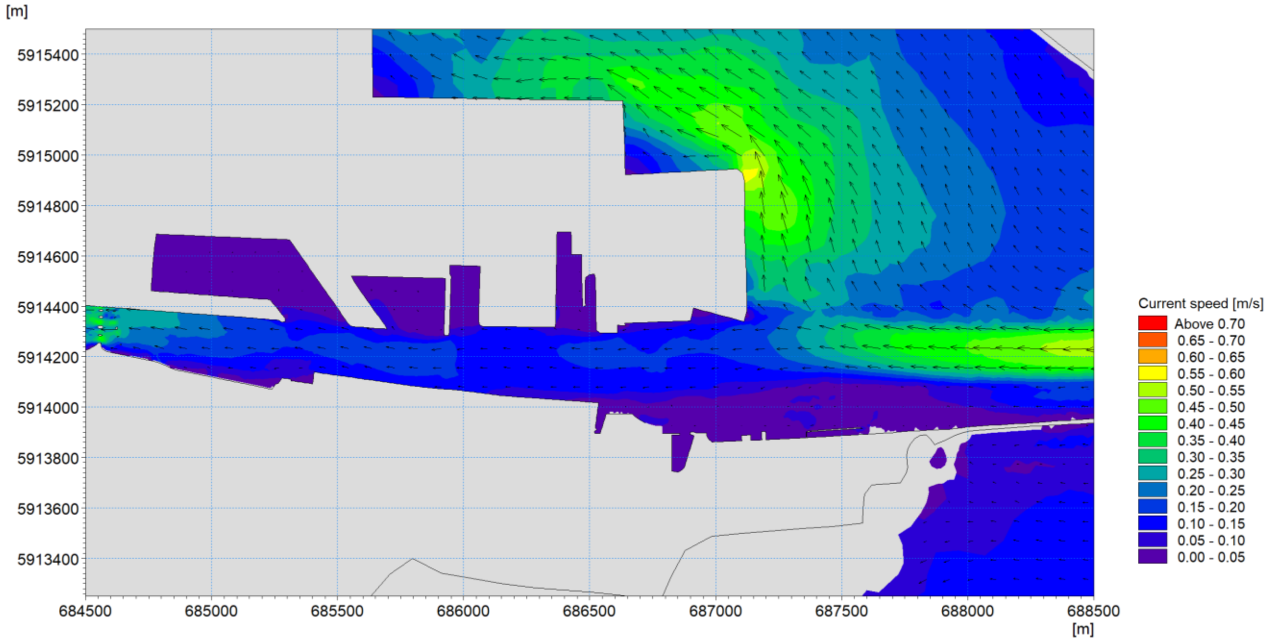


Figure 13.53: Typical spring mid flood tidal flow patterns – Post 3FM Project

The difference in modelled current velocities for the pre and post 3FM Project simulations have been computed for the mid spring ebb and the mid spring flood tides and are presented in Figure 13.54 and Figure 13.55. Spring tides are periods of greatest current velocities.

These figures show that the maximum predicted change to the mid-ebb or flood current speeds is less than ±0.25 m/s throughout the Port area. The greatest changes are generally observed within the vicinity of the SPAR and the Maritime Village where current speeds may change by ±0.20 m/s. This increase in current speeds could result in scouring of the seabed around the proposed SPAR foundations during periods of extreme river flow discharge conditions.

It is important to note that the changes presented in Figure 13.54 and Figure 13.55 relate to mean winter river flow rates (see Table 13.2) and would be considerably less during average or low conditions.

Current speeds along Area K generally increased by up to 0.15 m/s during most phases of the tidal cycle owing to the removal of a nib structure which previously obstructed flows and resulted in sediment accretion within the vicinity of cooling water intakes.

At the Turning Circle, changes to the tidal regime are generally confined to within the footprint of the works. In this area, current speeds are predicted to change by up to ±0.10 m/s because of changes to bathymetry caused by the 3FM Project.

At Area N, the greatest change to the tidal regime is observed within the eastern extent proposed dredge pocket where current speeds are predicted to change by up to ±0.10 m/s. The proposed pile structure required to support Area N did not result in a significant change to tidal currents in this area, changes were limited to reductions in current speeds of less than 0.1 m/s during most phases of the tidal cycle largely attributed to increases in water depth at this location due to dredging activities.

In general, 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 to 150 m of the works. No notable changes to the tidal regime were detected outside of Dublin Port.

Based on this information, 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. Given the localised nature and small absolute magnitude of any predicted changes in tidal current velocity it is unlikely that there will be any significant change in net scouring or deposition of sediments within the Liffey Estuary, Dublin Bay or at any of the intakes illustrated in Figure 13.12 resulting from the 3FM Project.

The risk of impact to the tidal regime is generally determined to be negligible, however increased current speeds as a result of the SPAR development could result in scouring of the seabed around the proposed SPAR foundations during periods of extreme river flow discharge conditions.

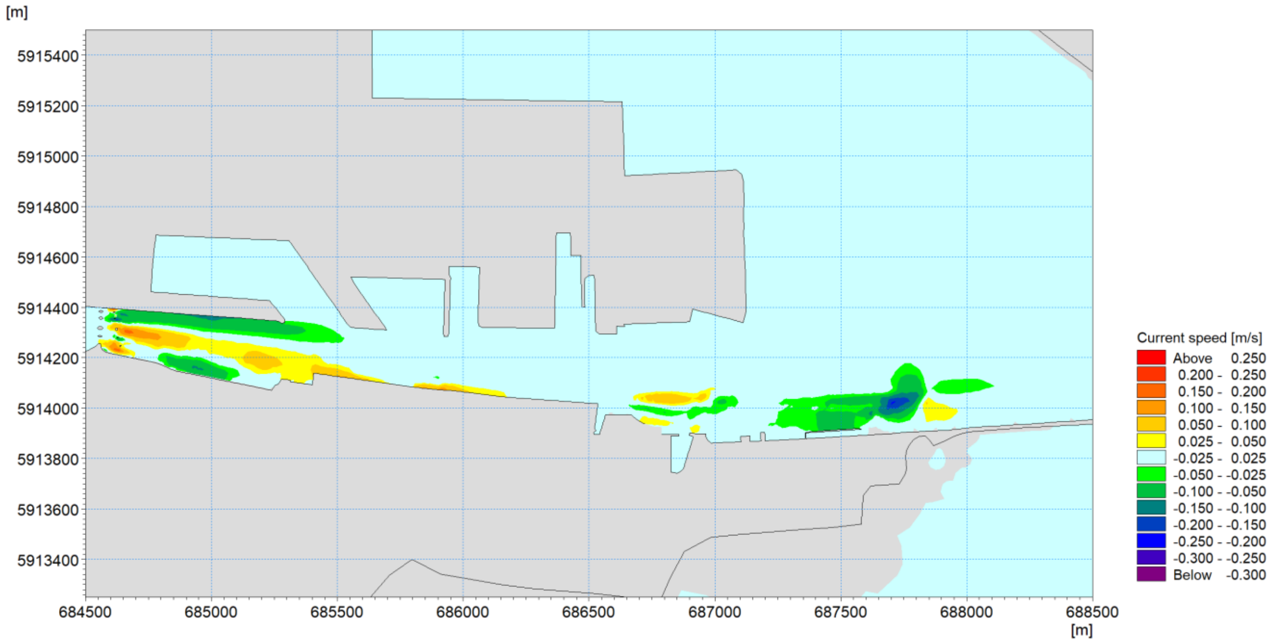


Figure 13.54: Difference in typical spring mid ebb tidal flow patterns as a result of the 3FM Project

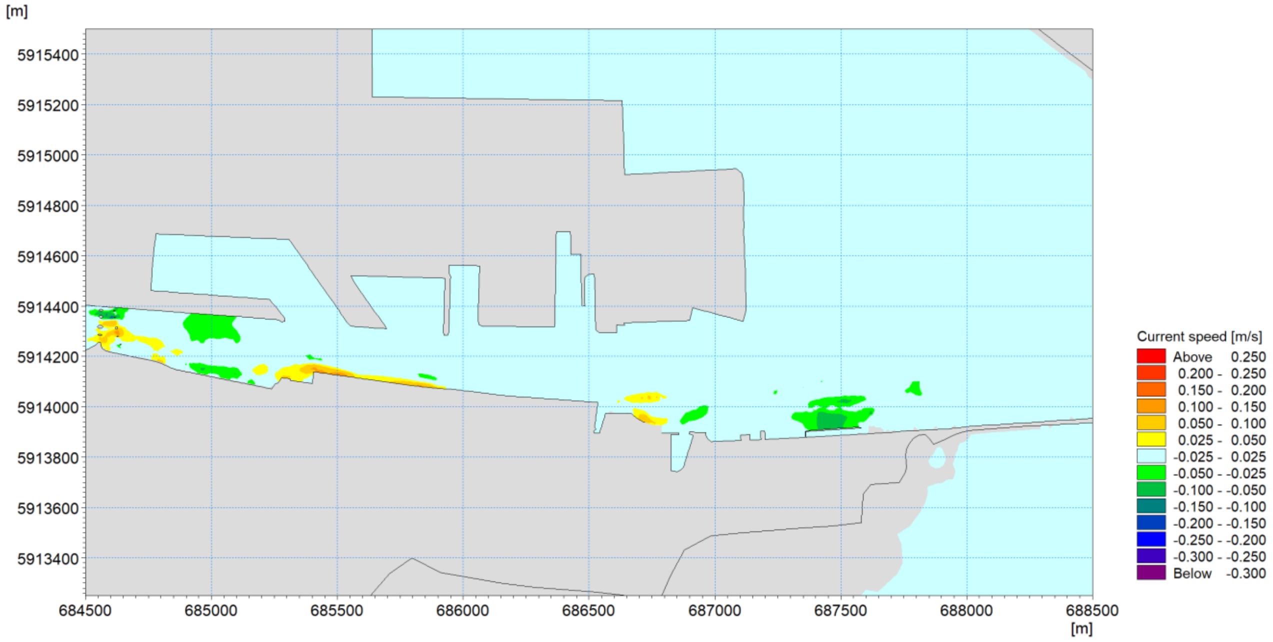


Figure 13.55: Difference in typical spring mid flood tidal flow patterns as a result of the 3FM Project

13.5.2.2 Potential changes to the existing inshore wave climate

Operational phase impacts also considered included potential alteration to wave climate (and its associated possible impact on flood risk). The MIKE 21 Spectral Wave module described in Section 13.2.3 was used in conjunction with the post-3FM Project scenario 2D model to re-run the offshore wave climate simulations in Dublin Bay based on various wave directions as described in Section 13.3.2.

The simulated inshore wave climate in Dublin Port and the adjacent Dublin coastline post 3FM Project is illustrated in Figure 13.56 to Figure 13.58 for north easterly, easterly and south easterly storm events at spring high tide respectively.

Wave height difference plots are presented for the three storm events in Figure 13.59 to Figure 13.61 to highlight the changes to the inshore wave climate because of the 3FM Project. The results show that, during all storm events modelled, only small changes in the wave climate in Dublin Port are predicted and no discernible change in the adjacent coastline areas i.e., Clontarf, Tolka Estuary, Sandymount, i.e., < ±0.01 m.

During easterly storm events, wave heights at the Maritime Village may increase by up to 0.10 m owing to changes in bathymetry in this area. During north easterly and easterly storm events, wave heights are expected to decrease by up to 0.20 m within the vicinity of Area N as a result of the proposed pile structures which will attenuate wave energy.

There are virtually no changes to the wave climate within 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 ±0.20m during typical storm conditions. These changes are not considered significant and will not impact operations within the Port. Therefore, the risk of potential coastal flooding due to the 3FM Project in these areas is determined to be negligible and no mitigation is required. An assessment of the impact of the 3FM Project on the existing flood risk can be found in in Chapter 9 (Water Quality and Flooding).

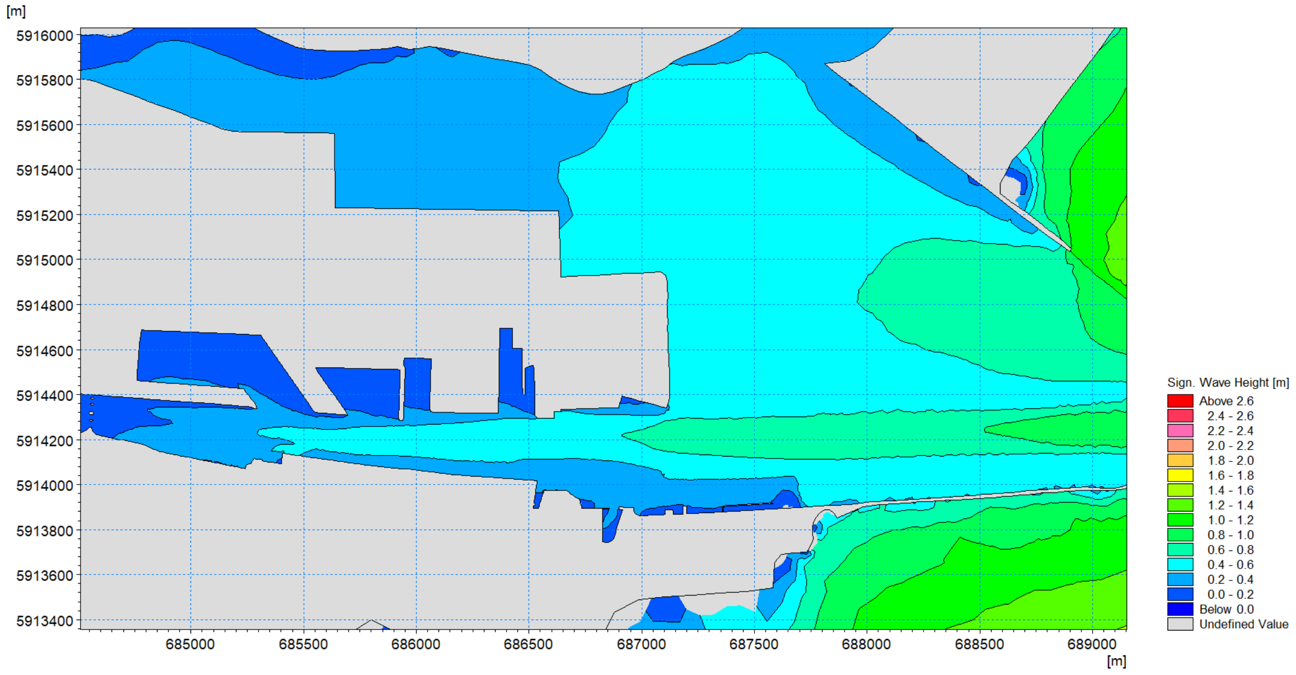


Figure 13.56: North easterly storm wave heights at spring high water – Post 3FM Project

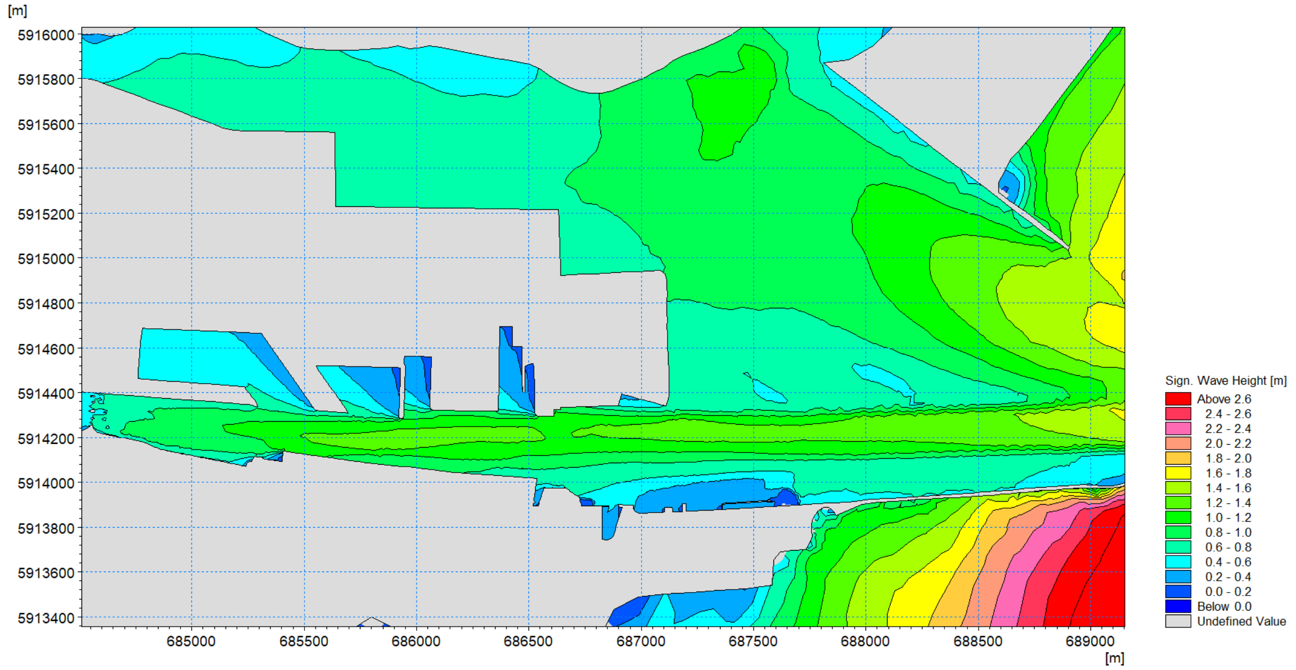


Figure 13.57: Easterly storm wave heights at spring high water – Post 3FM Project

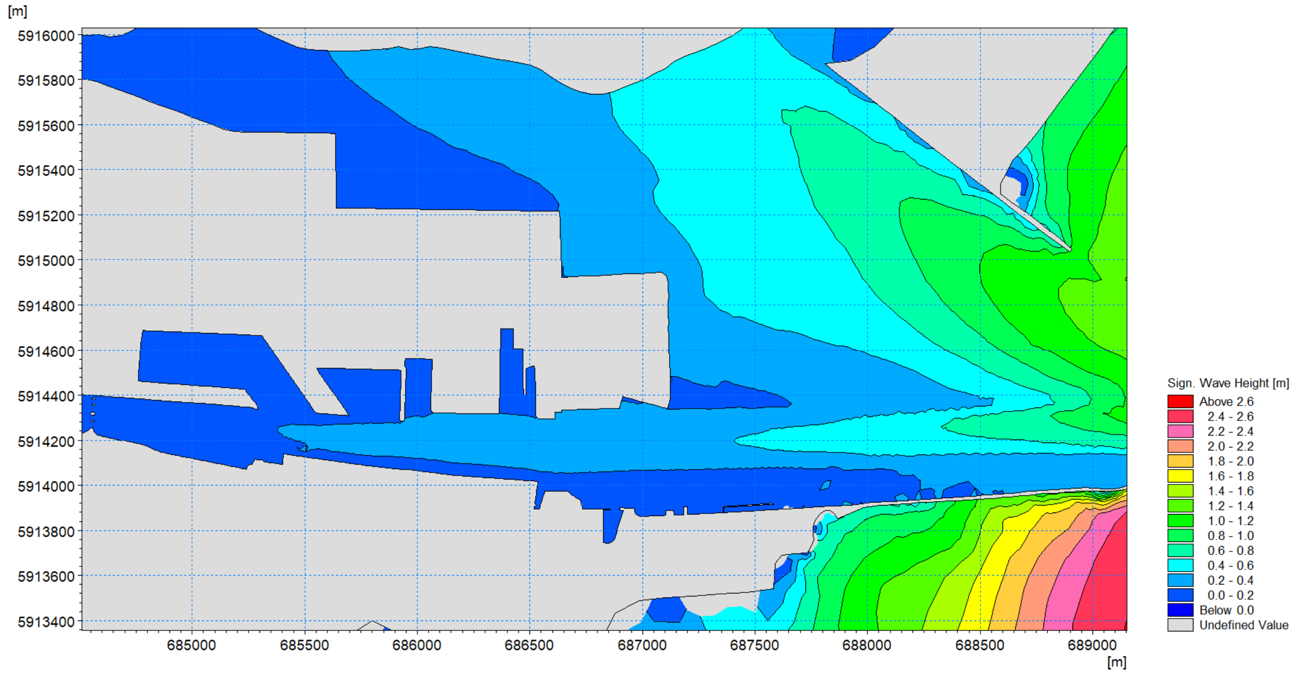


Figure 13.58: South easterly storm wave heights at spring high water – Post 3FM Project

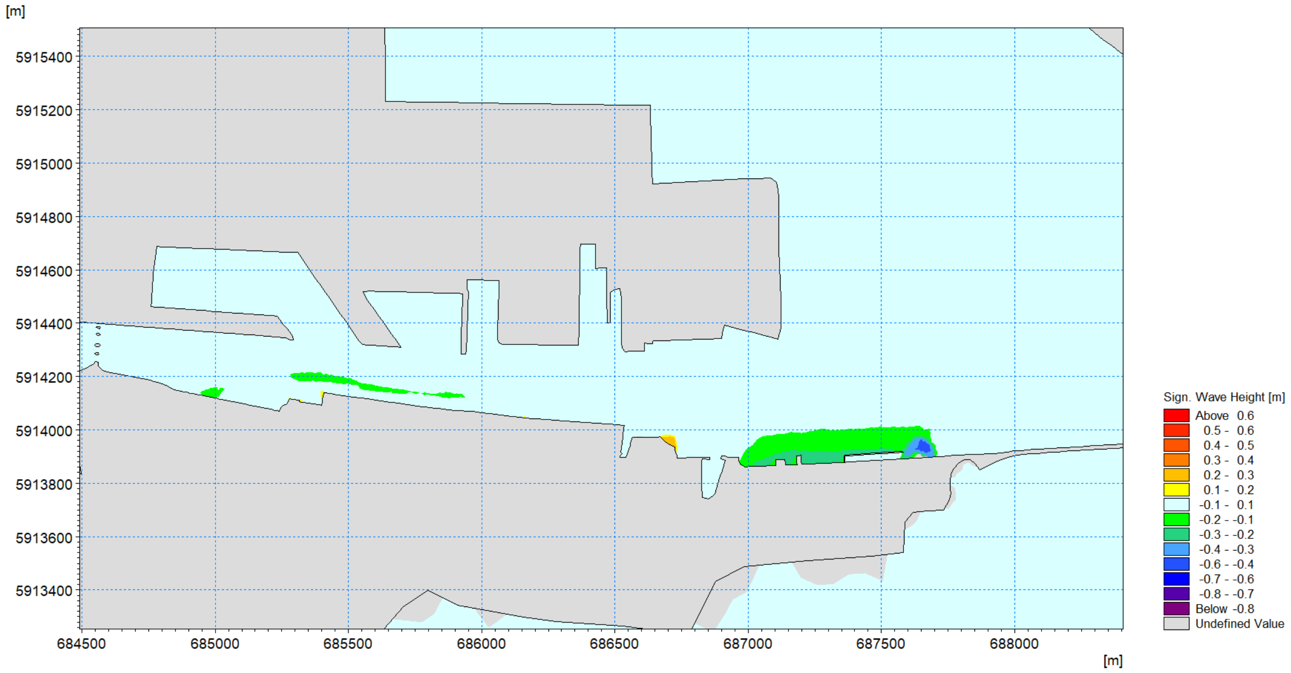


Figure 13.59: Difference in wave heights during a north easterly storm event as a result of the 3FM Project

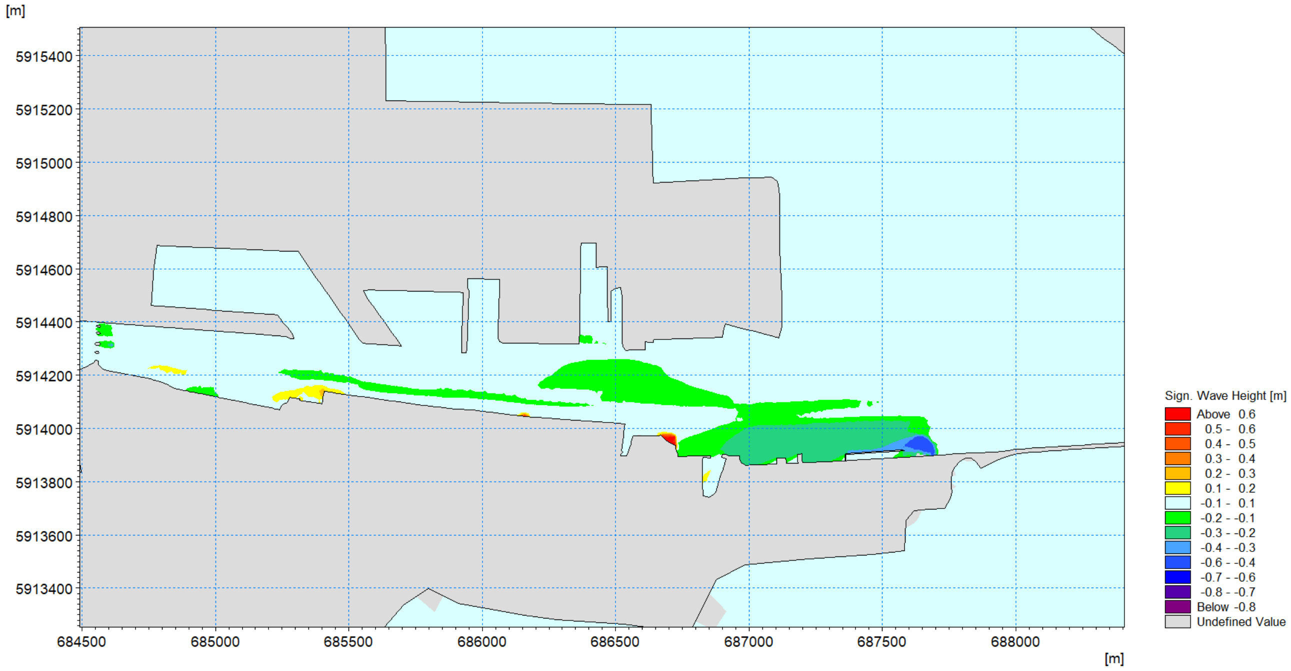


Figure 13.60: Difference in wave heights during a easterly storm event as a result of the 3FM Project

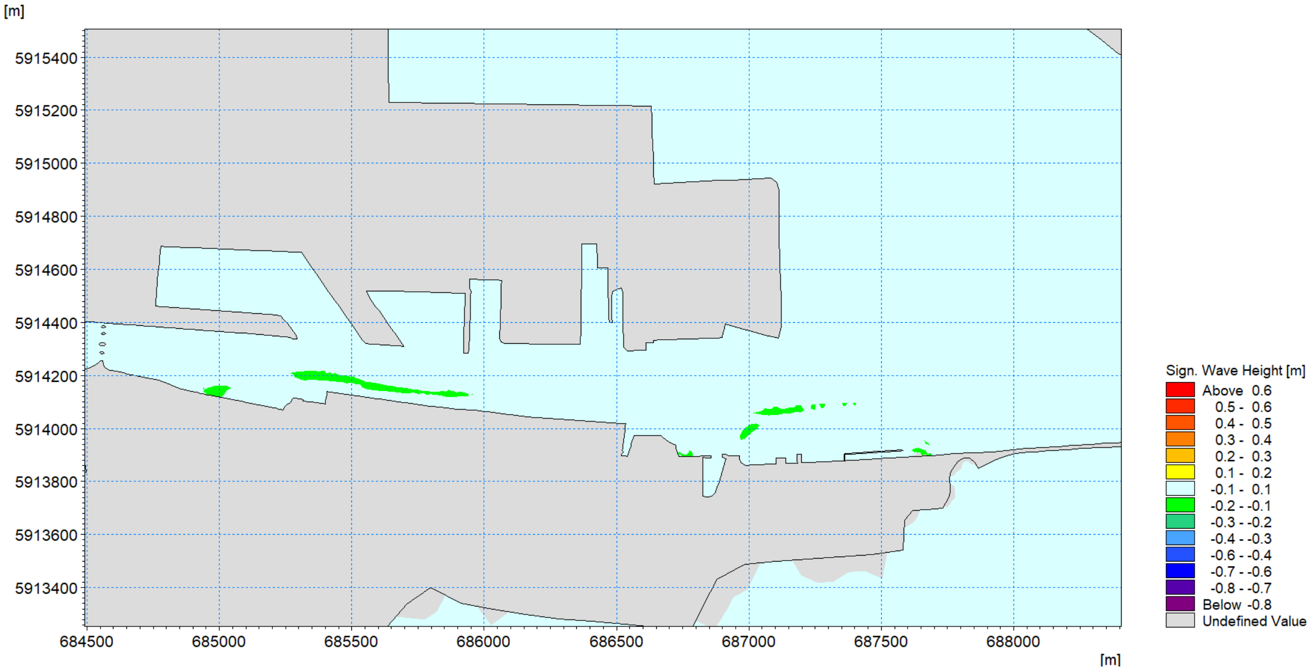


Figure 13.61: Difference in wave heights during a south easterly storm event as a result of the 3FM Project

13.5.2.3 Potential changes to the existing dispersion within Dublin Port

Any change to the thermal properties of the water abstracted from the Liffey has the potential to impact upon the plant's cooling system which may result in environmental or operational impacts. This assessment therefore also considered the operational phase impacts to the dispersion of thermal plumes within Dublin Port. The MIKE 3 Hydrodynamic module described in Section 13.2.3 was used in conjunction with the post-3FM Project scenario 3D model to re-run the thermal dispersion simulations described in Section 13.3.3.

The simulated typical thermal plume patterns for the mid–flood, high water, mid-ebb and low water phases of a typical spring tide with the 3FM Project *in-situ* are presented in Figure 13.62 through to Figure 13.65 respectively.

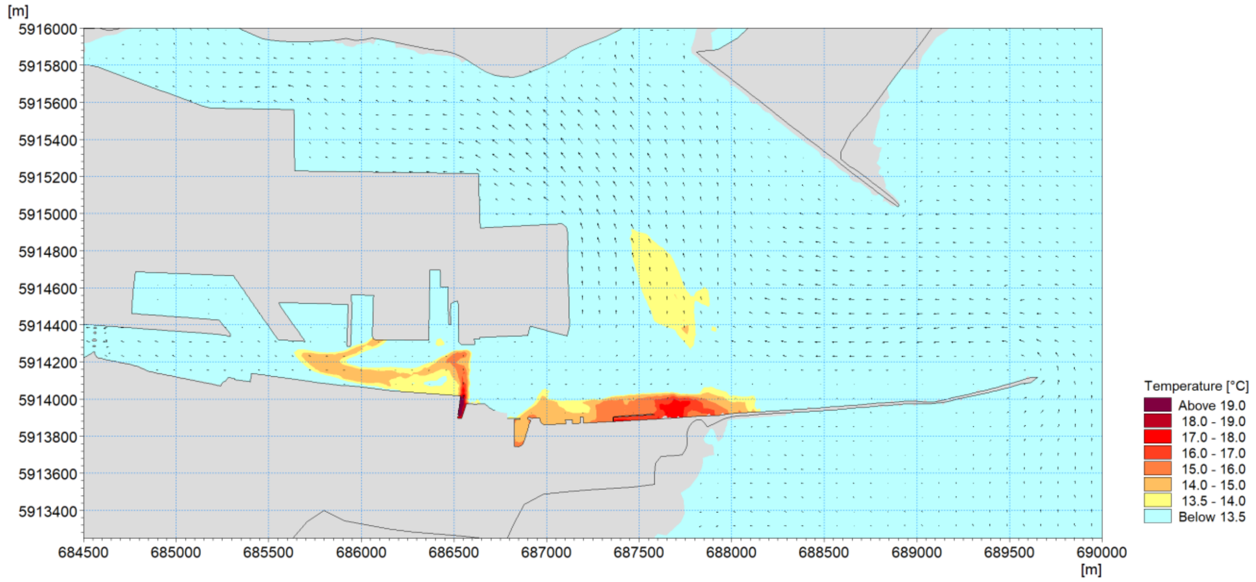


Figure 13.62: Near surface thermal plume envelopes during a typical spring mid flood tide – Post-3FM Project

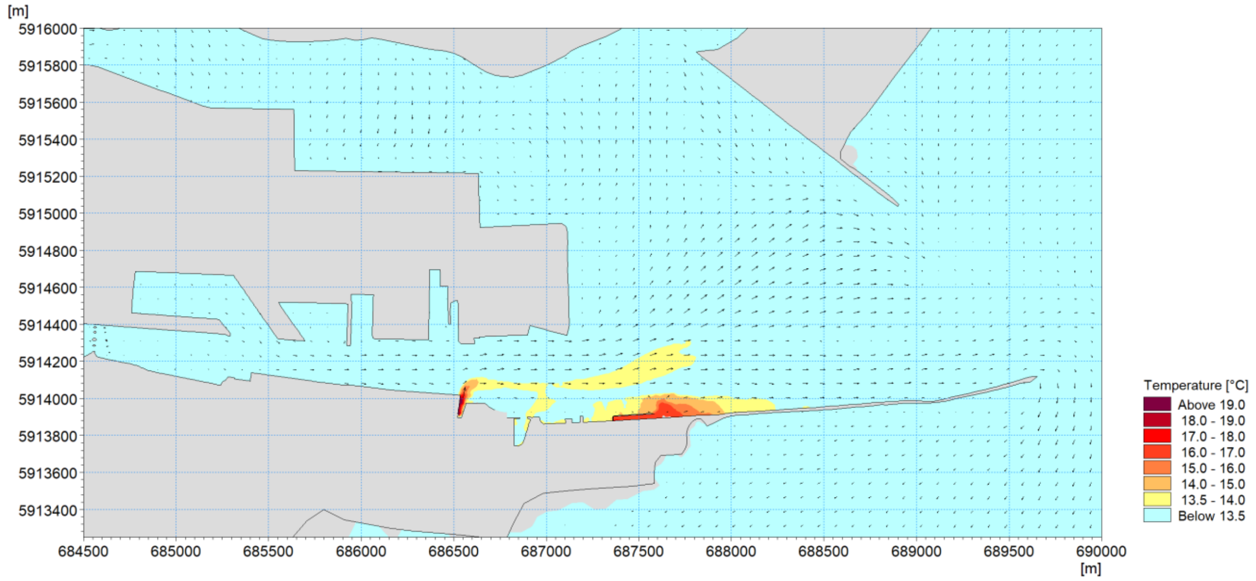


Figure 13.63: Near surface thermal plume envelopes during a typical spring high tide – Post-3FM Project

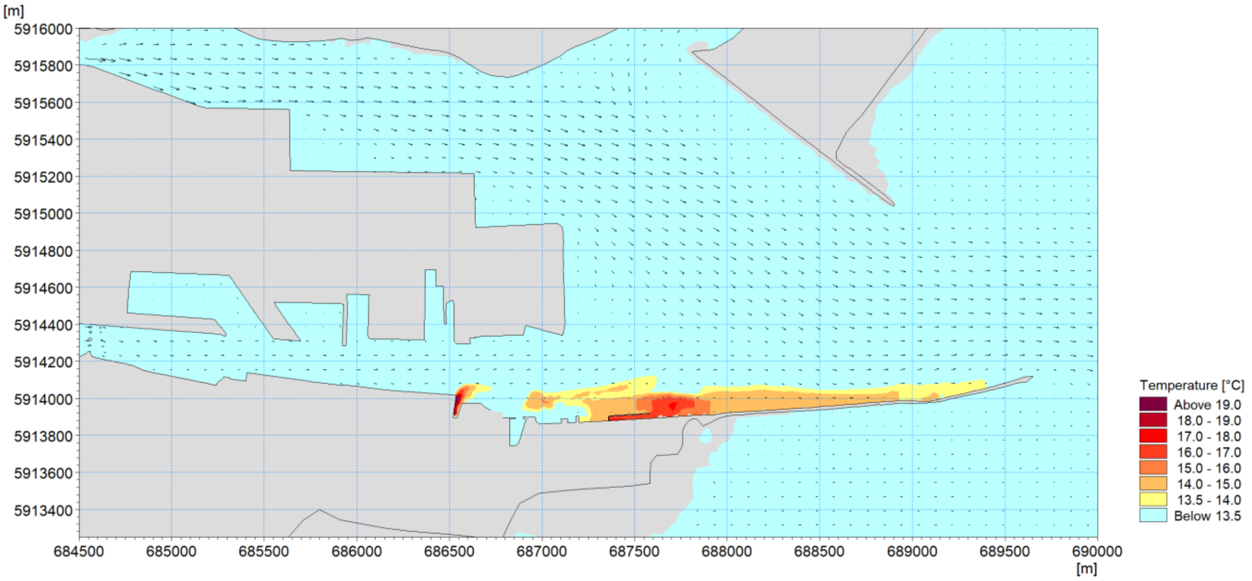


Figure 13.64: Near surface thermal plume envelopes during a typical spring mid ebb tide – Post-3FM Project

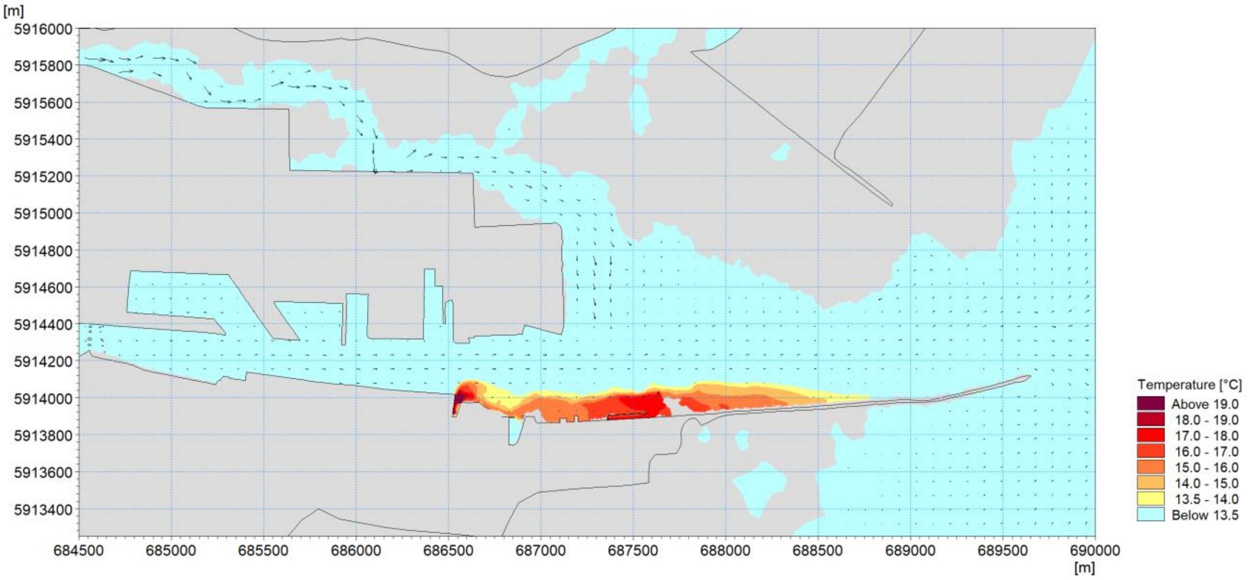


Figure 13.65: Near surface thermal plume envelopes during a typical spring low tide– Post-3FM Project

As outlined in section 13.2.2, the thermal plume modelling was undertaken in three dimensions, with the use of a sigma coordinate transformation approach whereby the vertical layer is divided into a discrete number of layers fixed proportionally to water depth. The relative depth and thickness of the layers varies spatially (i.e. are shallower in shallow water) and also temporally (i.e. with the changing water level associated with tidal flows). This is because the sigma layers used represent a fix percentage of the water column, the depth of which changes with tides and location. Therefore, within the context of undertaking a comparison between baseline and post construction of the 3FM Project, the sigma layer arrangements with respect to thickness will be different between the two scenarios where the bed level has changed, i.e. where either dredging or reclamation has been undertaken.

Due to the buoyant nature of the thermal plumes, the dispersion occurs within top 1 to 2 m of the water surface and therefore differences between sigma layers, which are concentrated towards the surface, will be sensitive to differences in temperature. As a result of this sensitivity calculating arithmetic differences between layers may introduce numerical artifacts which would not be reflected in reality. For this reason, the potential changes in temperature were calculated for a horizontal ‘slice’ through the model at 0.75m below the water surface, i.e. representative of the location of the thermal plume. In the following figures, grey areas shown within the Port and outer Bay indicate locations which are either dry or contain water depths less than 0.75m.

Thermal plume envelope plots relating to a slice 0.75 m below the water surface are presented for the same phases of a typical spring tide as previously in Figure 13.66 to Figure 13.69. Each figure is comprised of three plots; the upper figure relates to the baseline (ABR and MP2), the central figure is post-construction of the 3FM Project, and the lower figure is the difference in temperature between these scenarios.

In general, the greatest changes in water temperatures are observed at the Turning Circle. However, this is an *apparent* change, given that the corner of Pigeon House will be dredged and thus submerged in the Post-3FM scenario. Any change in this area would therefore be considered an increase, even if water temperatures are at a background temperature of 12ºC.

Aside from the Turning Circle, the only other change to the dispersion of thermal plume envelopes is observed within the immediate vicinity of Area N where water temperatures also increase. This can be attributed to two factors. There is a general increase of up to 4ºC which is due to the influence of the proposed piling in this area which results in a very marginal decrease in thermal dispersion in the vicinity. There is a more localised increase adjacent to the south wall at low water which, much like the turning circle, occurs where areas which were previously very shallow or dry become submerged in the Post-3FM scenario.

Importantly, this does not result in a significant change to water temperatures at the Poolbeg Power intake. This is demonstrated in Figure 13.70 which presents the change in water temperatures at the intake and an average value over the water depth as a result of the 3FM Project. Based on this data, the 3FM Project was found to reduce the average temperature at the Poolbeg intake by 0.16ºC whilst overall the depth average values remain unchanged. This is consistent with the marginal decrease in thermal dispersion due to a minor reduction in current speed as a result of the proposed piling.

It can therefore be concluded that there are no significant changes to the dispersion of thermal plumes envelopes within Dublin Port as a result of the 3FM Project and no mitigation is required.

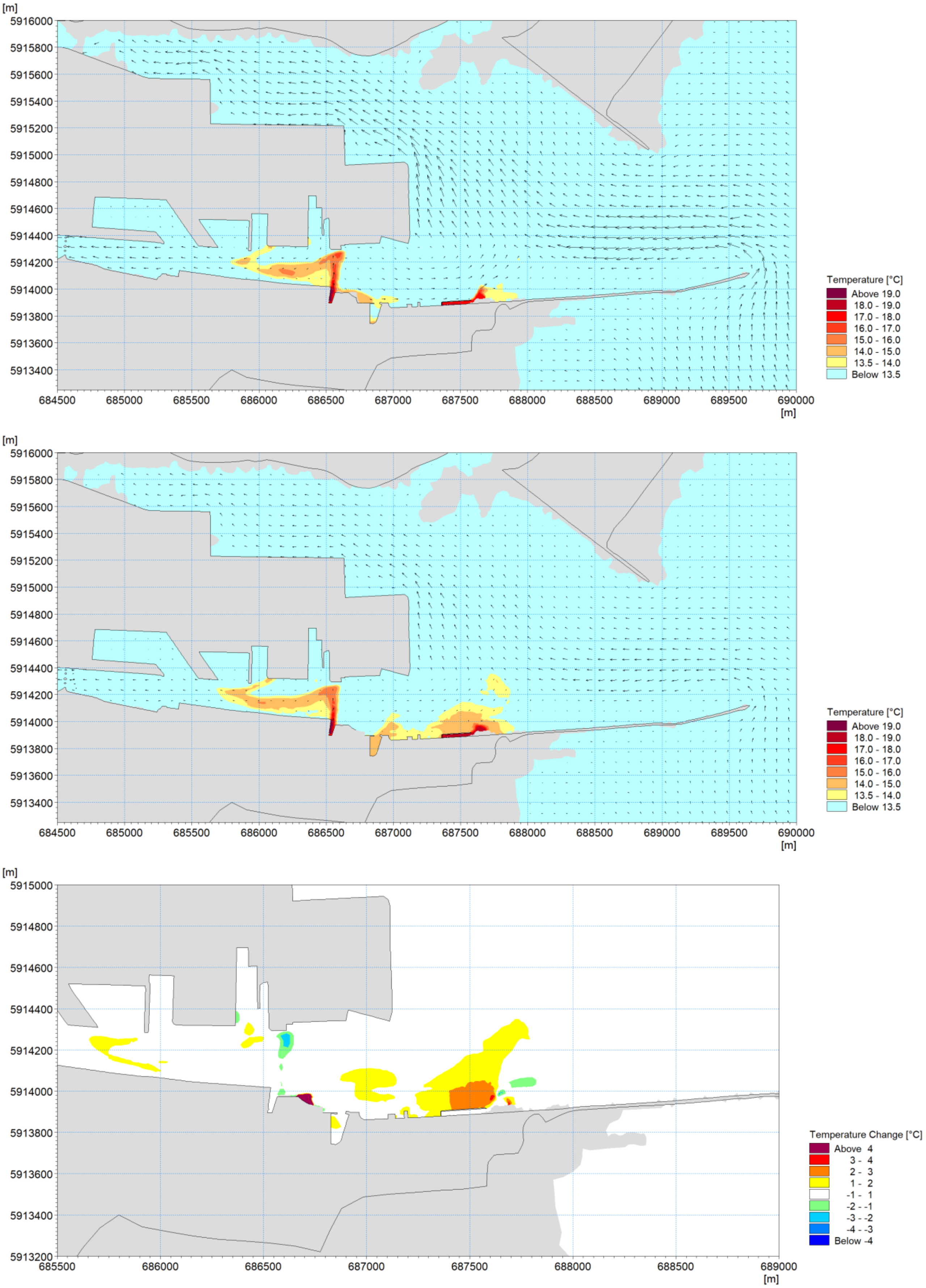


Figure 13.66: Baseline (upper), post 3FM Project (centre) and difference (lower) thermal plume envelopes 0.75 m below the surface during a typical spring mid-flood tide

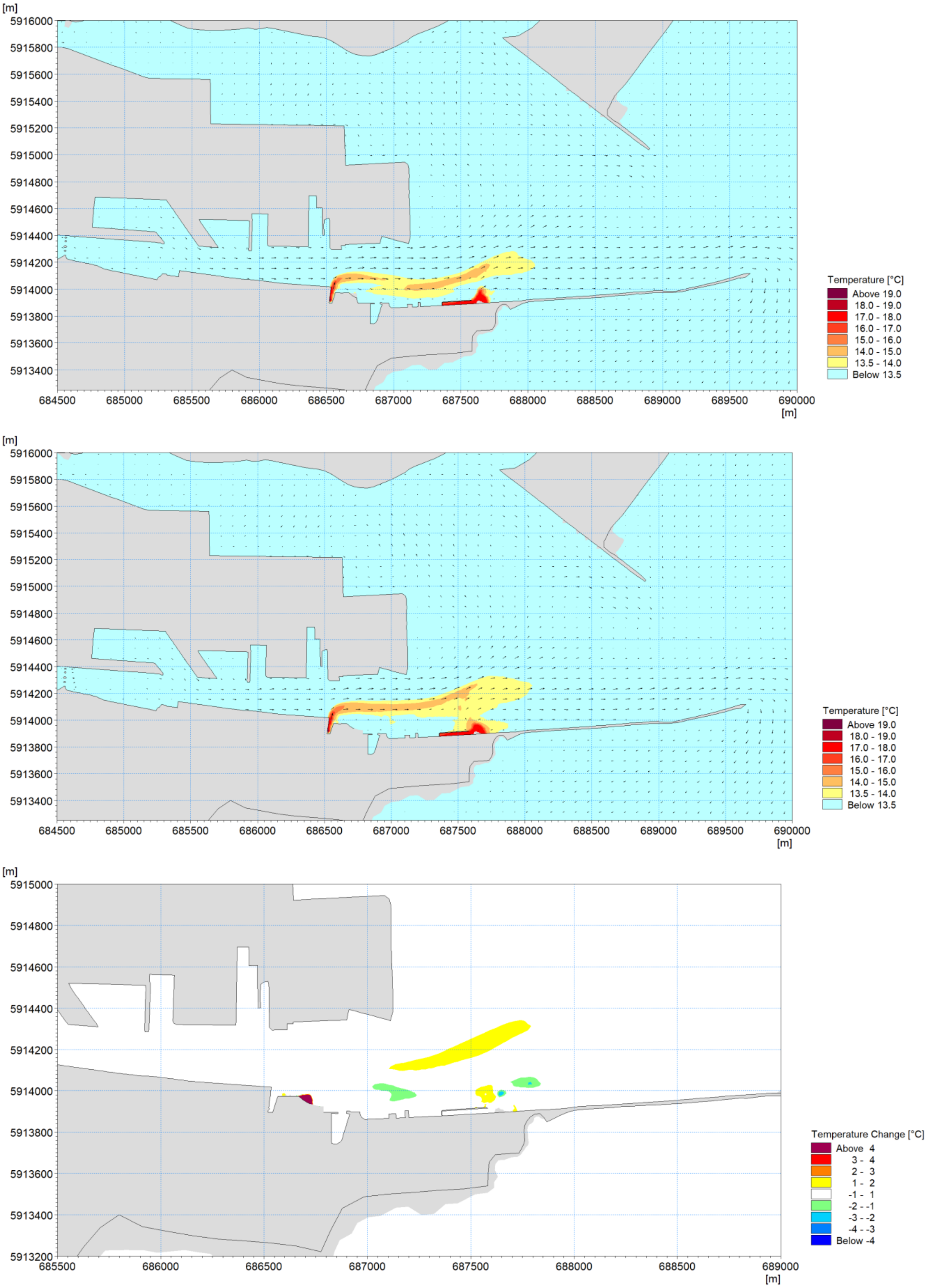


Figure 13.67: Baseline (upper), post 3FM Project (centre) and difference (lower) thermal plume envelopes 0.75 m below the surface during a typical spring high tide

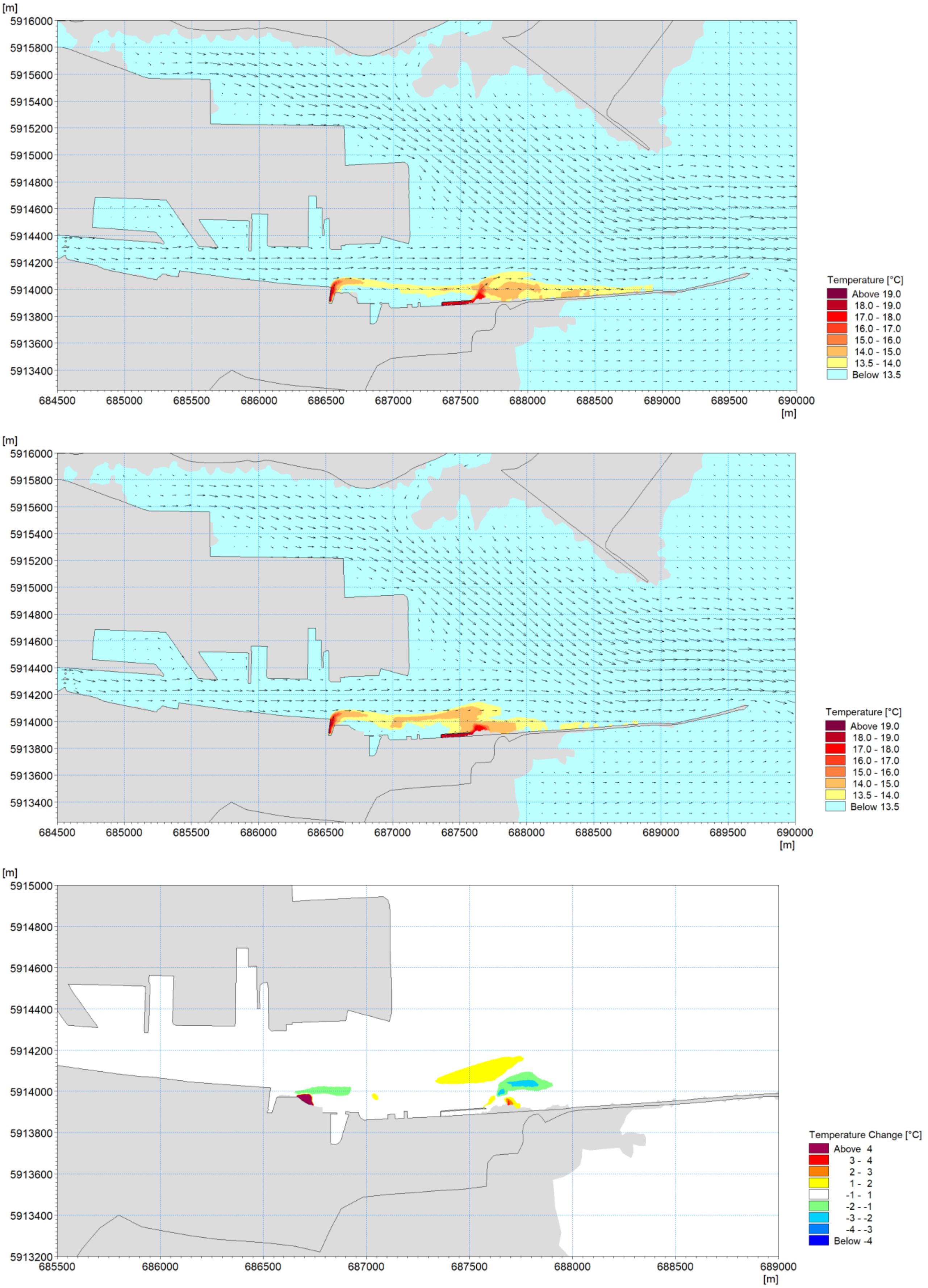
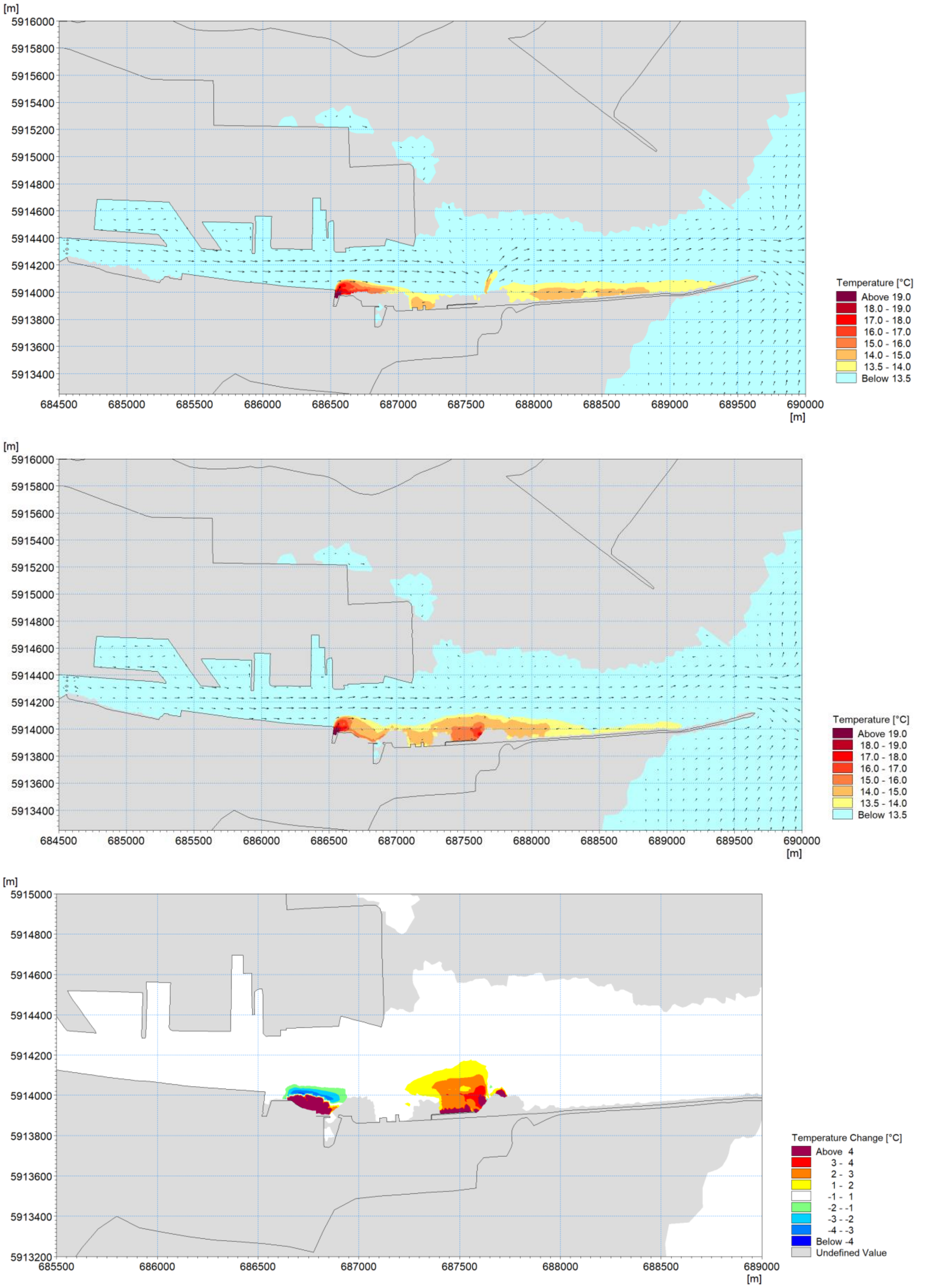
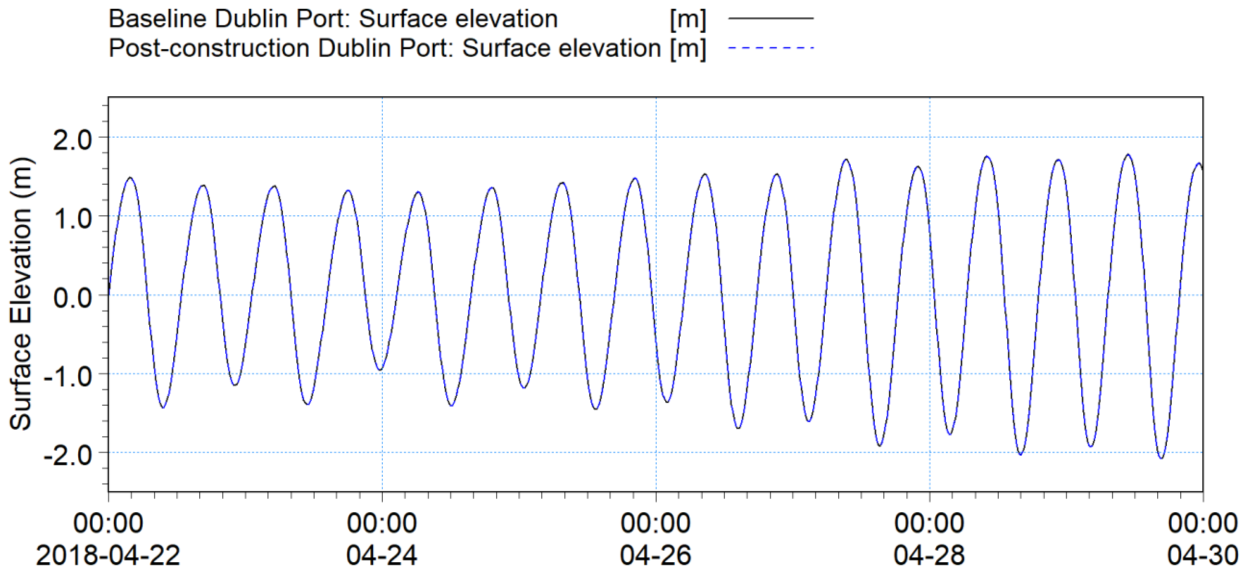


Figure 13.68: Baseline (upper), post 3FM Project (centre) and difference (lower) thermal plume envelopes 0.75 m below the surface during a typical spring mid-ebb tide



18/04/2018 18:30:00 Time Step 0 of 0. Z Level -2.707.

Figure 13.69 Baseline (upper), post 3FM Project (centre) and difference (lower) thermal plume envelopes 0.75 m below the surface during a typical spring low tide



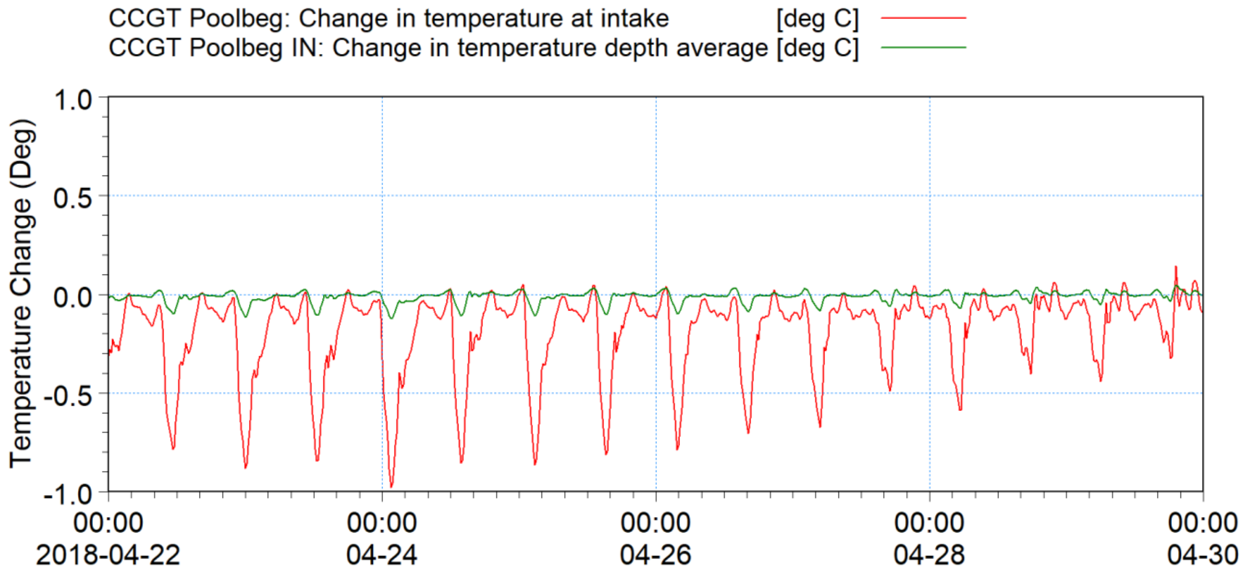


Figure 13.70: Surface elevations (upper) and temperature changes at the Poolbeg intake model layer and average temperature differences across all layers (lower) as a result of the 3FM Project (minus values indicating a temperature decrease relative to baseline conditions and vice versa).

13.5.2.4 Potential changes to the sediment transport regime

As indicated in Chapter 7 (Biodiversity) and shown in Figure 13.71, the 3FM Project site is bounded to the North and East by the South Dublin Bay and Tolka Estuary Special Protection Area (SPA). It was, therefore, important to consider potential changes to the sediment transport regime as a result of the 3FM Project.

Sediment on the seabed is transported when it is exposed to large enough forces, or shear stresses, by the water movements. These movements can be caused by the current or by the wave orbital velocities or a combination of both. The relevant parameters for the description of the sediment transport within a coastal environment are therefore based on the following coastal processes:

1. Wave conditions at the site and the possible variations over a site
2. Current conditions as well as the variations of current over an area
3. Water-level conditions, i.e., tide, storm surge and wave set-up
4. The sediment characteristics over an area
5. The sources and sinks of sediment, such as rivers or tidal inlets.

Given that the previous Sections of this report have demonstrated that the 3FM Project will have no significant impact on these processes, it can be concluded that the 3FM will not result in a significant impact to the sediment transport regime within Dublin Port, at any of the outfall or intake assets, or the wider Dublin Bay area.

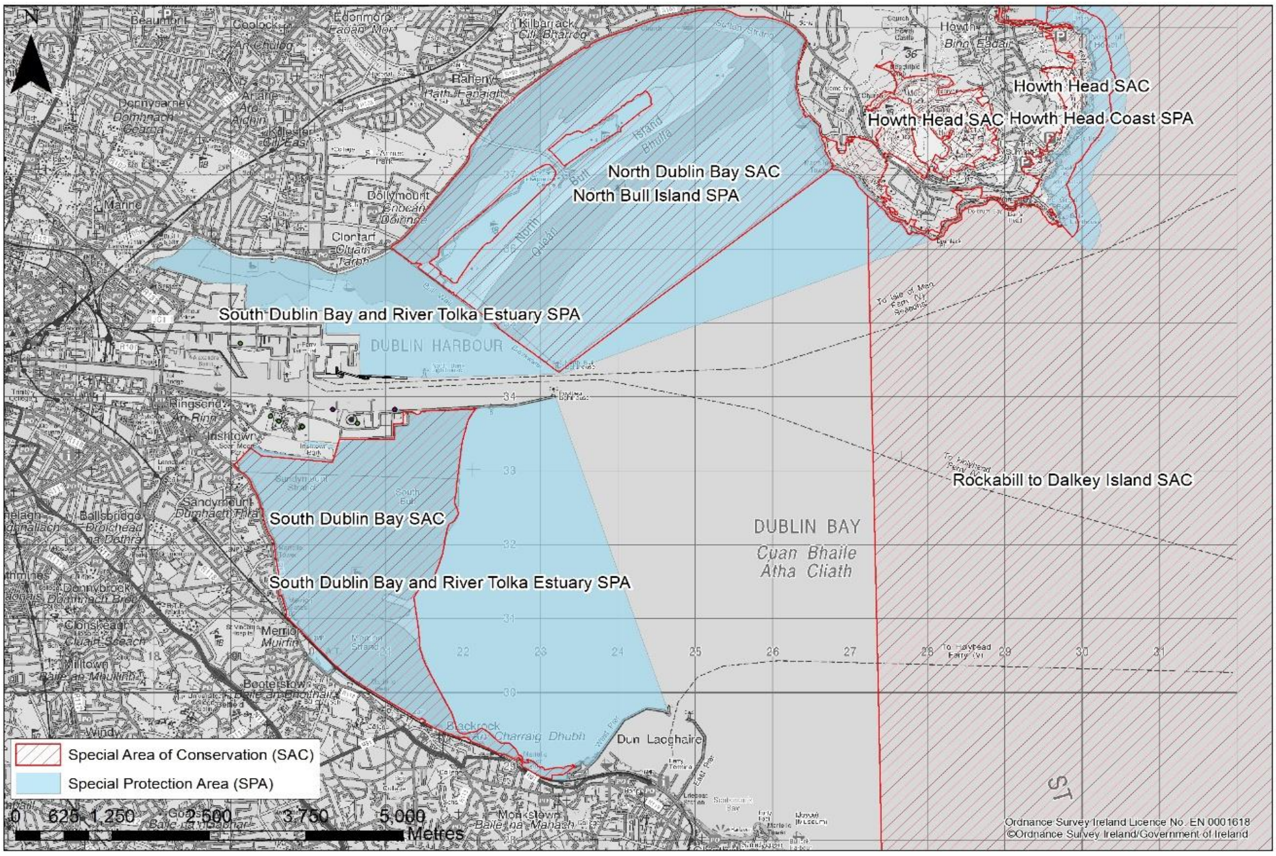


Figure 13.71: Natura 2000 Designated sites surrounding Dublin Port

13.6 Mitigation Measures

13.6.1 Construction Phase Mitigation Measures

As described in Chapter 9, Dublin Port Company completed its first winter dredging season (October 2017 – March 2018) as part of the ABR Project. This dredging campaign was fully compliant with the requirements of the Dumping at Sea, Foreshore and Planning Consents as confirmed by high resolution environmental monitoring results reported in the Annual Environmental Report submitted to the Office of Environmental Enforcement (OEE) in March 2018.

The mitigation for dredging operations in the 3FM Project has been informed by the ABR Project and MP2 Project monitoring and experience working in the same locations.

The following mitigation measures will apply to each dredging campaign in the 3FM Project:

- Loading will be carried out by a backhoe dredger or trailing suction hopper dredger (TSHD).
- The capital dredging activity 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.
- No over-spilling from the vessel will be permitted while the dredging activity is being carried out within the inner Liffey Channel.
- The TSHD pumps will be switched off while the drag head is being lifted and returned to the bottom as the dredger turns between successive lines of dredging to minimise the risk of fish entrainment.
- The dredger's hopper will be filled to a maximum of 4,100 cubic metres (including entrained water) to control suspended solids released at the dumping site. This is equivalent to a maximum quantity per trip of 2,030 tonnes (wet weight).
- Full time monitoring of Marine Mammals within 500 m of loading and dumping operations will be undertaken in accordance with the measures contained in the Guidance to Manage the Risk to Marine Mammals from Man-Made Sound Sources in Irish Waters (NPWS 2014).
- A documented Accident Prevention Procedure will be put in place prior to commencement.
- A documented Emergency Response Procedure will be put in place prior to commencement.
- A full record of loading and dumping tracks and record of the material being dumped will be maintained for each trip.
- Dumping will be carried out through the vessel's hull.
- 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.
- When any dredging is scheduled to take place within a 500 m radius of power station intakes, the relevant stakeholders will be notified so that precautionary measures can be taken if deemed necessary.

Assuming the above mitigation measures are employed during capital dredging and disposal operations, the potential risk to receiving water environment will be negligible thus reducing the significance of environmental impact to Imperceptible.

13.6.2 Operational Phase Mitigation Measures

To mitigate the operational phase impact of the SPAR development as described in Section 13.5.2, suitable scour protection should be developed and implemented within the immediate vicinity of the proposed development.

In circumstances where suitable scour protection is implemented, the operational impacts of the SPAR element of the 3FM Project to coastal processes, in particular, bed morphology and the potential of scouring will be negligible.

13.7 Residual Impact

In circumstances where the mitigation measures are fully implemented during the construction and operational phases as outlined in Section 13.6 the impact of the 3FM Project on the coastal processes within Dublin Port and Dublin Bay will consist of small scale, low magnitude changes in the tidal regime and wave climate.

The 3FM Project is therefore not expected to have a significant effect on coastal processes or make a significant change to the existing morphology.

13.8 Monitoring

As described in this Chapter 9 (Water Quality and Flooding), a water quality monitoring programme will provide additional safeguards to the receiving environment and to confirm the effectiveness of the mitigation measures implemented to address any potential environmental impacts to the receiving environment during the construction phase of the works.

Monitoring will continue during construction to confirm the effectiveness of the mitigation measures identified in this EIAR. Regular, confirmatory visual monitoring and environmental audits will also be undertaken during the construction phase of the works.

In addition, the Port’s existing Environmental Management System (EMS), which is accredited to ISO 14001 standard, will monitor the operational activities to confirm that measures to address operational impacts are effective and provide adequate protection to the sensitive receiving waters.

13.9 Potential Cumulative Impacts

As described in Chapter 20 (Cumulative Impacts), there are several other developments that are proposed within the vicinity of the 3FM Project. Whilst the majority of these relate to terrestrial developments with no pathways to interact with the 3FM Project in context of coastal processes, there are two proposals that could act in combination potentially affect coastal processes in Dublin Port or wider Dublin Bay area. These projects include:

1. The reclamation of a small parcel of land at Pigeon House road which is required by Codling Wind Park Limited (CWPL) to construct a 220 kV substation. This substation is needed to facilitate the transmission of the 900 – 1,500 MW of electricity which would be produced by the proposed Codling Wind Park (CWP) Offshore Wind Farm (OWF) into the existing onshore grid network.
2. In addition to the SPAR which is being proposed as part of the 3FM Project, Dublin City Council also intend to seek permission for an active travel bridge which will span the River Liffey immediately west of the existing Tom Clarke Bridge.

Further to the projects described above, DPC have previously been requested to provide details on the predicted sediment deposition and sediment dispersion from loading and dumping activities, cumulatively from the proposed activities under the 3FM Project and those permitted under (S0004-03 and S0024-02) and any subsequent impacts on the wider environment.

The following sections of this chapter consider the potential cumulative effect between these projects and the 3FM Project on coastal processes, including the potential for cumulative effects associated with dredging with other permitted activities.

13.9.1 CWP Sub-station at Pigeon House

The location, extent and scale of the works proposed by CWP at Pigeon House road is illustrated in Figure 13.72. Whilst the details of this scheme are yet to be finalised, it is understood through extensive consultation with CWP that at a high level, the scheme will involve the demolition and dredging of approximately *c.*170 m^2 of land at the north east of the site (see area hatched orange area in Figure 13.72). As a result, levels in this area will be decreased from between *c.* +3 and +7m to -10 m CD. These levels are commensurate with the dredging required to create Turning Circle as proposed under the 3FM Project. In addition, it is also proposed to reclaim approximately 200 m^2 of land at the south east corner of the Pigeon House site (see area hatch blue in Figure 13.72).

These dredging and reclamation activities associated with this project will be undertaken as part of the 3FM Project, as outlined in the project description detailed in Chapter 5 of this EIAR, independently from the CWP Sub-station project. The 3FM Project coastal processes assessment therefore included any potential impacts from this project and concluded that there will be no cumulative impacts in terms of coastal processes.

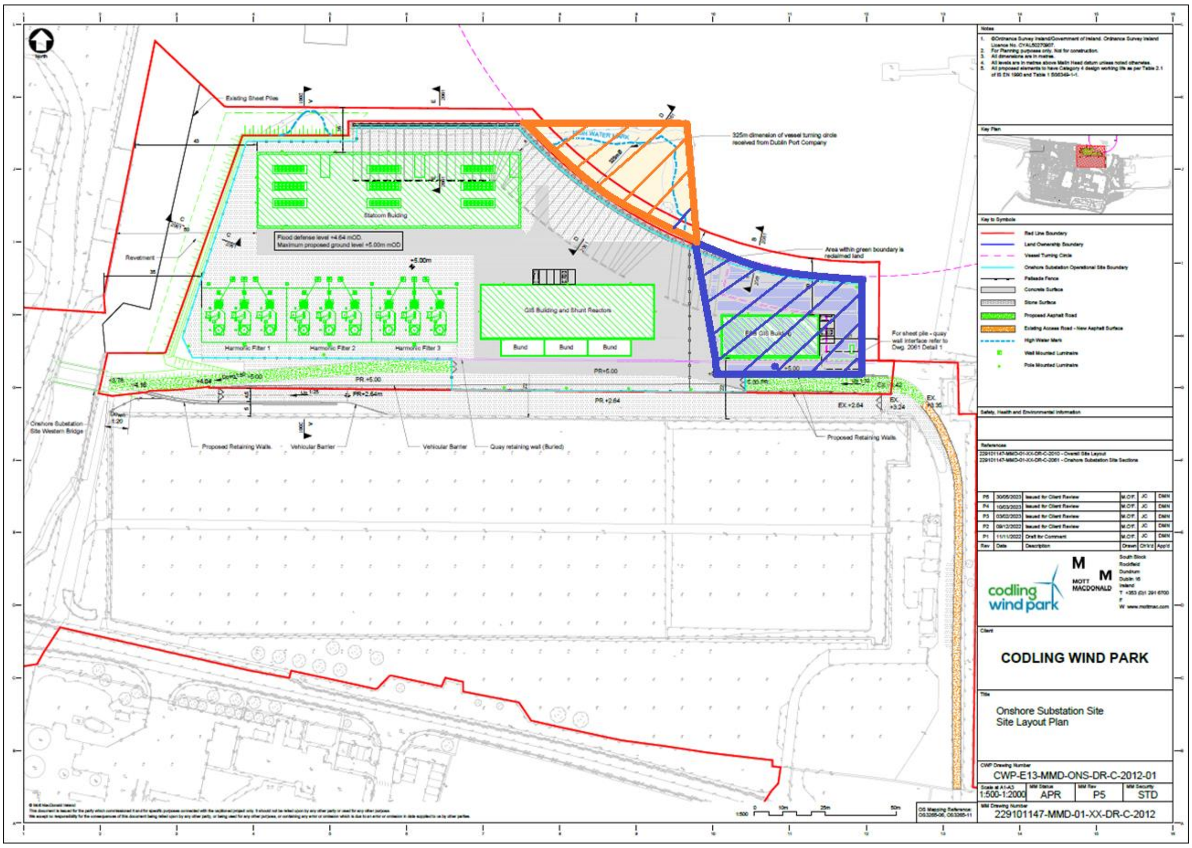


Figure 13.72: Codling Wind Park onshore sub-station site layout plan. Reclamation area hatched blue and demolition/dredge area hatched orange.

13.9.2 Dublin City Council Active travel bridge

Dublin City Council (DCC) intend to seek permission for an active travel bridge which will span the River Liffey immediately west of the existing Tom Clarke Bridge. Whilst details of this scheme are limited, it is understood that an active travel bridge will be designed to accommodate walking, wheeling, cycling and use of non-motorised scooters. Discussions with the designers ROD indicated that based on the preliminary design of the scheme:

- The centreline of this bridge would be located *c.* 20 m west of the existing Tom Clarke bridge.
- The bridge would be supported by one large bascule pier which aligned directly with the existing bascule pier of the Tom Clarke bridge.
- The bridge would be further supported by a series of abutments and landing piers (*c.* 4 in total) which aligned directly with existing supporting structures of the existing Tom Clarke bridge.

Given that the support structures for this bridge will be of similar size and nature and directly aligned with those structures which support the Tom Clark bridge, the change to hydrodynamic streamlines and eddies would be negligible. The preliminary information available at this stage therefore indicates that the potential of any cumulative impacts on coastal processes between the 3FM Project and the Active Travel Bridge would be insignificant.

13.9.3 Cumulative impact of sediment deposition and sediment dispersion

A Section 5(2) Notice was issued to DPC from the EPA on 7th November 2023 requesting additional information so that the Agency may complete a comprehensive assessment of the application. This notice required DPC to

“Provide details on the predicted sediment deposition and sediment dispersion from loading and dumping activities, cumulatively from the proposed activities and those permitted under (S0004-03 and S0024-02) and any subsequent impacts on the wider environment. As a minimum a modelling assessment is required to describe the fate of sediments and the impact on the receiving environment, and address how the activities will be managed to ensure that they will comply with, or will not result in the contravention of the following Directives:

- *The Habitats Directive 82/43/EEC and Birds Directive 2009/147/EEC,*
- *The Water Framework Directive 2000/60/EC,*
- *The Marine Strategy Framework Directive 2008/56/EC.”*

The technical document presented in Appendix 13-4 was produced to undertake a cumulative assessment which considered the following permitted loading and dumping activities:

- Dumping at Sea Permit S0004-03 - Dublin Port 2022-2029 Maintenance Dredging Programme
- Dumping at Sea Permit S0024-02 - MP2 Project Capital Dredging

For robustness, this assessment also included for the capital dredging activities required by the 3FM Project.

It should be noted that since the document presented in Appendix 13-4 was issued to the Environmental Protection Agency (EPA) in January of 2024, the maximum anticipated dredge volumes associated with the 3FM Project have increased from 1,117,000 m^3 to 1,189,000 m^3. This represents a volume increase of *c.* 6% in context of the dredge volume associated with the 3FM Project and a *c.* 2% increase in the overall volume considered in the assessment described in Appendix 13-4. Given this immaterial difference, the findings presented in Appendix 13-4 are still considered relevant to this assessment of potential cumulative impacts.

In summary, Appendix 13-4 assessed the potential cumulative impact of all permitted activities and the 3FM Project in context of:

- Sediment deposition from loading activities.
- Silt deposition arising from each dredging project.
- Sand deposition arising from each dredging project.

The findings of these assessments are summarised in the following Sections.

13.9.3.1 Sediment deposition from loading activities

Considering dredging activities, computational modelling studies were undertaken to predict sediment deposition within the Tolka Estuary as a result of loading activity associated with each of the following capital and maintenance dredging programmes:

- Dublin Harbour Capital Dredging Project (subject of current application).
- Dumping at Sea Permit S0004-03 - Dublin Port 2022-2029 Maintenance Dredging Programme.
- Dumping at Sea Permit S0024-02 - MP2 Project Capital Dredging.
- 3FM Project Capital Dredging (application expected Q3/Q4 2024).

The maximum dredge volumes. programme and key mitigation measures as detailed in Section 2 of Appendix 13-4 were used as input to the computational modelling studies. The output of the computational studies is summarised in Table 13.11.

Table 13.11: Predicted Sediment Deposition within the Tolka Estuary for various capital and maintenance dredging activities

Dredging Campaign	**Predicted Sediment Deposition**	**Maximum deposition depth**	**Reference Document**
Dublin Harbour Capital Dredging Project (S0033-01)	<0.30g/m^2	<0.2µm	Dublin Harbour Capital Dredging Project EIAR, Dumping at Sea Permit Application (August 2021)
MP2 Project (S0024-02)	<0.50g/m^2	*c.*0.33µm	RPS Report on Additional Sediment Plume Modelling, Response to Section 5(2) Notice (November 2021)
Dublin Port 2022 - 2029 Maintenance Dredging Programme (S0004-03)	<0.30g/m^2	<0.2µm	RPS Report on Coastal Processes Risk Assessment, Dumping at Sea Permit Application (December 2020)
3FM Project Capital Dredging (application expected Q3/Q4 2024)	<128g/m^2	85 µm	See Section 13.4 and Appendix 13-4
Comparison with Natural Sedimentation	**30,000g/m^2**	***c.*2cm**	**Dublin Port Maintenance Dredging AER (March 2017)**

13.9.3.2 Silt deposition arising from each dredging project.

Numerical modelling work undertaken previously in support of the Alexandra Basin Redevelopment (ABR) Project (RPS, 2014) found that sediment material to be dredged throughout the Port Area could generally be characterised by three discrete fractions with mean diameters of 200µm, 20µm and 3µm with each fraction constituting 1/3 of the total volume of the dredge material. This specification was based on Particle Size Distributions (PSDs) of sediment samples collected from the Harbour area (RPS, 2014) (Dublin Port Company, 2020).

Based on this earlier work, the sand fraction of the dredge material was found to behave differently to silt material in that the sand fraction remained on the dump site whereas the silt material was dispersed by tidal currents.

Recognising the different dispersion and deposition characteristics of these different fractions, the sediment deposition as a result of disposing the silt and sand dredge material at the dump site was considered separately in this Section and Section 13.9.3.3 respectively.

In respect of silt deposition, the cumulative sediment deposition within Dublin Bay as a result of all four dumping at sea activities is presented in Figure 13.73. As demonstrated by this Figure, the cumulative total deposition of silt material beyond the immediate vicinity of the disposal site is generally less than 0.60g/m^2. This magnitude of deposition translates to a maximum change in bed level thickness of *c.* 0.45µm as illustrated in Figure 13.74. This is less than the width of a human hair and is not measurable in the field.

For context, the estimated natural sediment load from the upstream Liffey catchment is estimated at circa 200,000 tonnes per annum (DPC Maintenance Dredge AER 2017, Dumping at Sea Permit S0004-01). If dispersed over the Port area between East Link and Poolbeg Lighthouse and the Tolka Estuary; this is roughly equivalent to a natural sediment load of 30 kg/m^2 in any year (30,000 g/m^2). This is equivalent to an average depth of 2cm (based on a silt material).

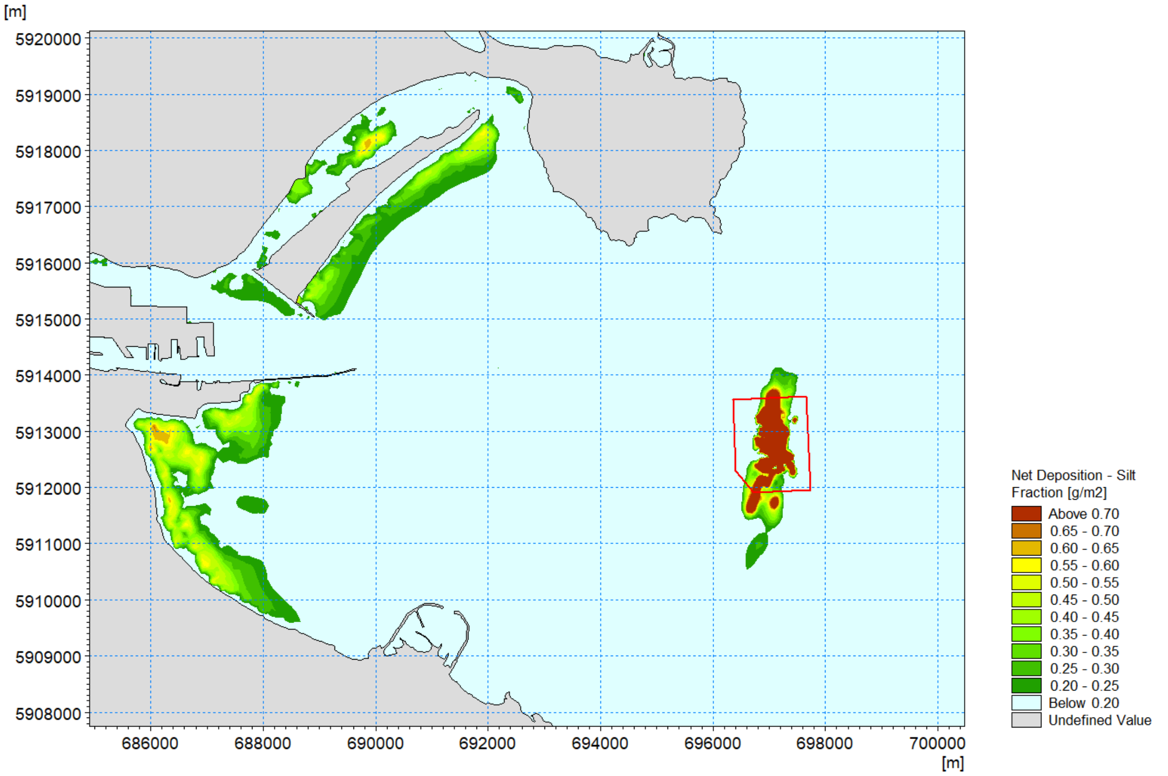


Figure 13.73: Cumulative total deposition of silt material following the dumping at sea activities associated with S0024-02, S0004-03, S0033-01 and the 3FM Project

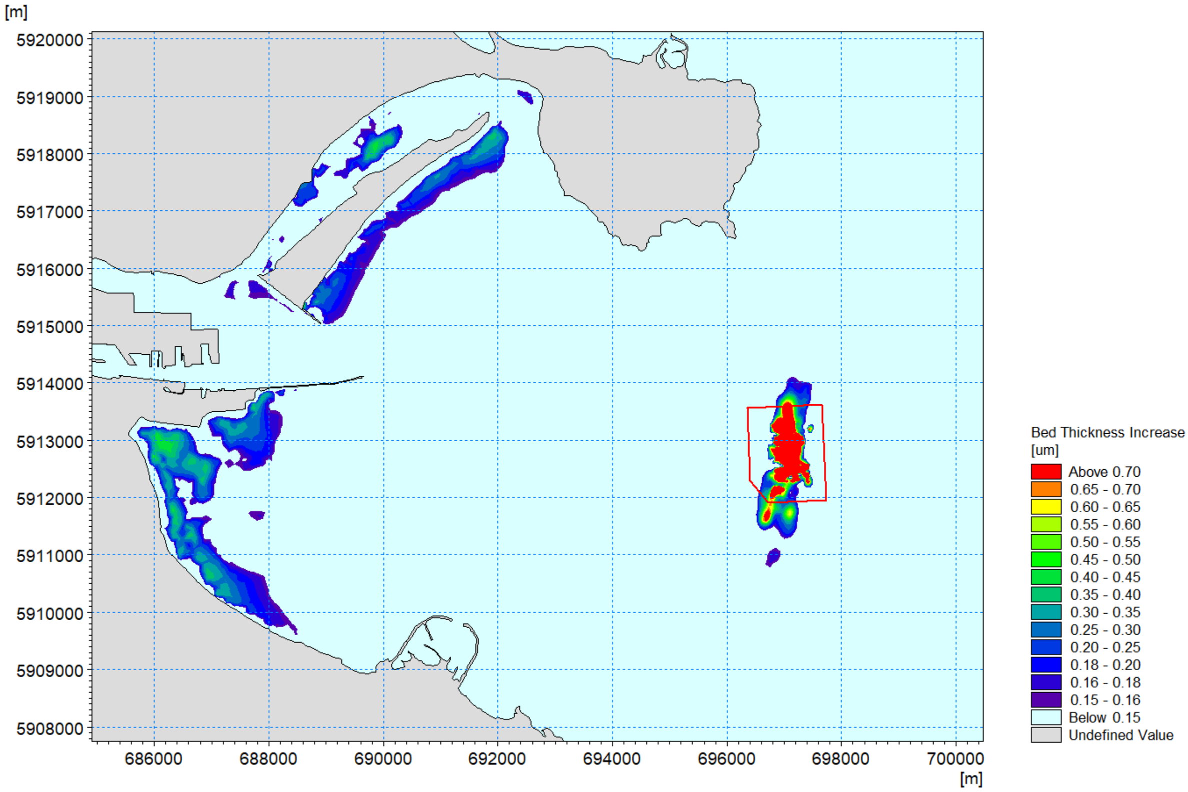


Figure 13.74: Cumulative bed thickness increase as a result of silt deposition from S0024-02, S0004-03, S0033-01 and the 3FM Project

13.9.3.3 Sand deposition arising from each dredging project.

As noted previously, the sand fraction of the dredge material was found to behave differently to silt material in that the sand fraction of dredge material immediately fell and settled on the dump site owing to the high fall velocities associated with this material. This is demonstrated in Figure 13.75 which illustrates the deposition of *c.* 1million cubic metres of sand material across the dump site following the continuous disposal of sand over the course of 6 months.

These findings are in line with other studies which concluded that sand fractions with higher fall velocities and higher critical shear stress parameters (relative to silt material) tend to remain in the locale of the disposal site with minimal re-suspension occurring (CEFAS, 2021).

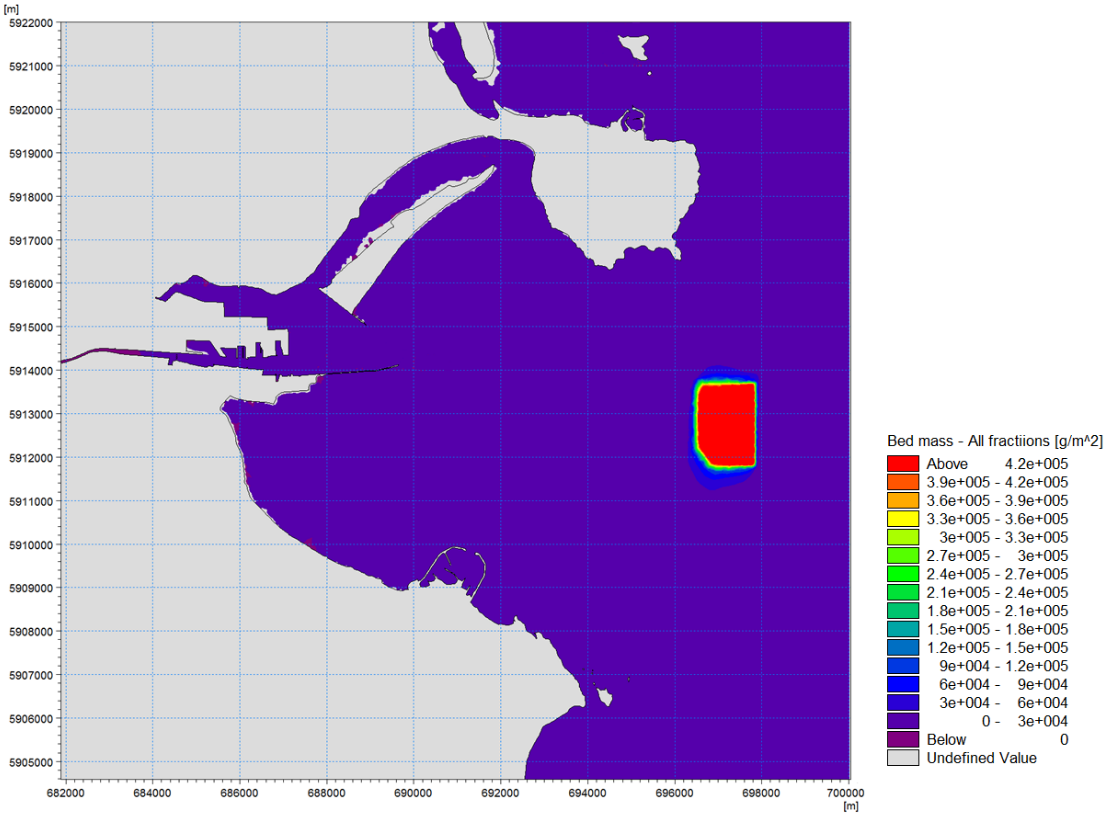


Figure 13.75: Total sand deposition after six months of continuous disposal of sand spoil material

To assess the potential movement of the coarse material on the dump site, RPS utilised a two-stage approach which firstly involved reviewing site-specific high-resolution bathymetric surveys of the dump site to measure changes in seabed elevations and thus derive rates of change. Given that much of the dump site is characterised by well-defined sand waves, the output from this assessment was used as a proxy to determine the long-term potential for sediment erosion and movement. To further support this assessment, RPS undertook a bespoke numerical modelling exercise to quantify the erosion and movement of coarse material based on met-ocean conditions.

This assessment found that sediment transport under tidal conditions alone does not exceed 0.005 m/day regardless of the depth. This further demonstrates that the coarser sand material on the dump site will likely only be mobilised by wave action.

In addition to this assessment, it should be noted that since 2012, the Marine Institute has carried out monitoring to determine macroinvertebrate ecological quality status (EQS) in coastal and transitional waters around the Irish Coast in order to fulfil requirements of the Water Framework Directive (WFD). As part of this programme, sampling must be carried out within each waterbody, including Dublin Bay, at least twice within the 6-year cycle (once every three years).

Based on the sampling and monitoring of 15 individual locations illustrated in Figure 13.46, the seabed material was found to comprise of muddy and fine sand or very fine sands at all stations. Coarse material was found to contribute an insignificant part of the sediment. Furthermore, the benthic communities surveyed in Dublin Bay were characteristic of the shallow muddy fine sand sediments sampled. Taxa common throughout the stations included, amongst others, the polychaetes *Glycera tridactyla, Nephtys hombergii, Spiophanes bombyx* and *Chaetozone christiei.*

The results of the Marine Institute's long-term (since 2012) environmental benthic surveys were therefore found to support the findings of this assessment that the movement of coarse material into Dublin Bay as a result of disposing of dredge material at the dump site is extremely limited and highly unlikely to result in a large-scale deposition event in Dublin Bay.

13.9.3.4 Summary of cumulative impact assessment of sediment deposition and dispersion

As described in Appendix 13-4, when considered in context of natural sedimentation within the Port Area (i.e., 30,000 g/m^2/yr which is equivalent to a deposition rate of *c.*2cm/yr), it is clear that the impact of sediment deposition from all dumping activities is several magnitudes lower than natural sedimentation rates. The impact of predicted sediment deposition from all capital and maintenance dredging dumping activities can therefore be considered to be *de minimis*.

Appendix 13-4 concludes that, the computational modelling studies of the capital and maintenance dredging dumping activities within the licensed dump site located at the approaches to Dublin Bay, west of the Burford Bank, in adherence with the key mitigation measures, will ensure that cumulatively they will comply with, or will not result in the contravention of the following Directives:

- The Habitats Directive 82/43/EEC and Birds Directive 2009/147/EEC,
- The Water Framework Directive 2000/60/EC,
- The Marine Strategy Framework Directive 2008/56/EC.

13.9.4 Inter-related Effects

Effects on coastal processes have the potential to have secondary effects on other receptors and these effects are considered in the topic-specific chapters. The assessment presented therefore informs and is informed by the following technical chapters:

- Chapter 7: Biodiversity including Marine Mammals, Benthic Biodiversity and Fisheries
- Chapter 9: Water Quality and Flooding

During the construction phase increases in suspended sediment concentration as a result of capital dredging works have the potential to impact of marine mammals, fish and shellfish and benthic ecology these are assessed in Chapter 7: Biodiversity. Similarly these activities may impact water quality which is assessed in Chapter 9: Water Quality and Flooding.

During the operation phase potential changes in tidal flow and temperature may impact marine mammals, fish and shellfish and benthic ecology these are assessed in Chapter 7: Biodiversity. The assessment of changes to wave climate and water level has been used to inform the assessment of flood risk, presented in Chapter 9: Water Quality and Flooding.

13.10 Conclusions

The assessment of coastal processes was based on an extensive numerical modelling programme using RPS' in-house suite of MIKE coastal process modelling software developed by the Danish Hydraulic Institute (DHI). Baseline models were calibrated and verified against a range of project specific hydrographic data and subsequently used to assess the construction and operational impacts of the 3FM Project.

The assessment concluded that dredging operations required for the 3FM Project will not result in any significant impact to either water quality in terms of suspend sediments, or the nearby environmentally designated areas in terms of sediment deposition with mitigation measures in place.

In respect to the power station intakes and Ringsend WwTW outfall, any increase in the suspended sediment concentrations was generally very small by comparison with background levels in the Liffey Estuary. The dredging operations are therefore unlikely to have any effect on the quality of intake waters in terms of suspended solids content. However, as customary, DPC will continue to notify the power station operators in advance of each dredging campaign. This will allow operators to temporarily stop abstracting water from the Liffey for a short duration in the event that dredging is required within the immediate vicinity of their intake works.

The assessment of disposal of dredge spoil arising from the 3FM Project at the licenced offshore disposal site located to the west of the Burford Bank at the approaches to Dublin Bay concluded that the disposal operations will not result in any significant increases to the background level of suspended sediments and will not, therefore, impact the existing water quality in the greater Dublin Bay area.

The tidal regime is predicted to remain substantially unchanged post 3FM Project. The risk of impact to the existing tidal regime is therefore determined to be negligible and no mitigation is required.

The assessment of potential changes to the inshore wave climate found that the maximum change in wave heights in Dublin Port during storm events did not exceed ±0.20 m. These changes were confined primarily to the Maritime Village and Area N. There was no discernible change in the wave climate due to the 3FM Project in relevant proximate areas such as Clontarf, Fairview and Ballybough bordering the Tolka Estuary. These changes to the wave climate are not considered significant and will not impact operations within the Port. Furthermore, the change in risk of potential coastal flooding due to the 3FM Project at neighbouring sites is considered to be negligible and no mitigation is required.

Given that there are no significant changes to key coastal processes that govern sediment transport, i.e., tides, waves and water levels, it can be concluded that the 3FM Project will result in no discernible change to the existing sediment transport regime in Dublin Port and the in the greater Dublin Bay area.

The 3FM Project is not expected to act in combination with other nearby developments, including the CWP substation project, Dublin City Council active travel bridge across the River Liffey and other permitted dredging or disposal activities, or to result in any significant impacts to baseline coastal process conditions.

In circumstances where the mitigation measures are fully implemented during the construction and operational phases, the impact of the 3FM Project on the coastal processes within Dublin Port and Dublin Bay will consist of small scale, low magnitude changes in the tidal regime and wave climate. On the basis that the appropriate mitigations measures are fully implemented during the construction and operational phases, the impact of the 3FM Project on coastal processes will be imperceptible.

APPENDIX 13-1 – HYDRAULIC MODELLING SOFTWARE

This appendix describes the modelling systems used in to assess coastal processes in Chapter 13.

1.1 Modelling Software

RPS used a suite of coastal process models, based on the MIKE software developed by DHI to assess the potential impact of the proposed development on the coastal processes within Dublin Port and Bay. The MIKE 21 & 3 systems are state of the art, industry standard, modelling systems based on a flexible mesh approach. This software was developed for applications within oceanographic, coastal and estuarine environments and has been approved by numerous leading institutions and authorities including the US Federal Emergency Management Agency (FEMA).

The Hydrodynamic Module is the basic computational component of the entire MIKE 21 & 3 Flow Model Flexible Mesh (FM) modelling systems providing the basis for the Transport, ECO Lab, Mud Transport and Sand Transport modules.

The assessment presented in Chapter 13 utilised the Hydrodynamic, Mud Transport, Sediment Transport and Spectral Wave modules each of which are described further below. A full scientific description of this modules can be found online at https://manuals.mikepoweredbydhi.help/latest/MIKE_21.htm.

1.1.1 MIKE 21 & MIKE 3 Flexible Mesh (FM) mesh modelling system

This system is capable of simulating water level variations and flows in response to a variety of forcing functions in lakes, estuaries and coastal regions. The HD Module is the basic computational component of the MIKE 21 and MIKE 3 Flow Model systems providing the hydrodynamic basis for the Mud & Sediment Transport and Spectral Wave modules.

The Hydrodynamic module solves the two/three-dimensional incompressible Reynolds averaged Navier-Stokes equations subject to the assumptions of Boussinesq and of hydrostatic pressure. Thus the module consists of continuity, momentum, temperature, salinity and density equations. When being used in three dimensions, the free surface is taken into account using a sigma coordinate transformation approach whereby the vertical layer is divided equally into a discrete number of layers. The system solves the full time-dependent non-linear equations of continuity and conservation of momentum using an implicit ADI finite difference scheme of second-order accuracy. The effects and facilities incorporated within the model include:

- Convective and cross momentum;
- Bottom shear stress;
- Wind shear stress at the surface;
- Barometric pressure gradients;
- Coriollis forces;

- Momentum dispersion (e.g. through the Smagorinsky formulation);
- Wave-induced currents;
- Sources and sinks (mass and momentum);
- Evaporation;
- Flooding and drying.

1.1.2 The Spectral Wave (SW) module

The Spectral Wave (SW) module is a new generation spectral wind-wave model based on unstructured meshes that simulates the growth, decay and transformation of wind-generated waves and swell in offshore and coastal areas.

The MIKE 21 SW module accounts for the following physical phenomena:

- Wave growth by wind action
- Non-linear wave-wave interaction
- Dissipation due to white-capping
- Dissipation due to bottom friction
- Dissipation due to depth-induced wave breaking
- Refraction and shoaling due to depth variations
- Diffraction
- Wave-current interaction
- Effect of time-varying depth and flooding and drying

The discretisation of the governing equation in geographical and spectral is performed using a cell-centred finite volume method. In the geographical domain, an unstructured mesh technique is used. The time integration is performed using a fractional step approach where a multi-sequence explicit method is applied for the propagation of wave action.

The MIKE 21 SW module includes two different formulations:

- Directional decoupled parametric formulation
- Fully spectral formulation

The directional decoupled parametric formulation is based on a parameterization of the wave action conservation equation. The parameterization is made in the frequency domain by introducing the zeroth and first moment of the wave action spectrum as dependent variables following Holthuijsen (1989).

1.1.3 The Sediment Transport (ST) module

The Sediment Transport Module simulates the erosion, transport, settling and deposition of cohesive sediment in marine and estuarine environments and includes key physical processes such as forcing by waves, flocculation and sliding. The module can be used to assess the impact of marine developments on erosion and sedimentation patterns by including common structures such as jetties, piles or dikes. Point sources can also be introduced to represent localised increases in current flows as a result of outfalls or ship movements etc.

1.1.4 The Mud Transport (MT) module

The Mud Transport (MT) module of MIKE 21 Flow Model FM describes erosion, transport and deposition of mud or sand/mud mixtures under the action of currents and waves. The MT module is applicable for:

- Mud fractions alone, and
- Sand/mud mixtures.

The module can be used to simulation a range of relevant processes including:

- Forcing by waves.
- Salt-flocculation.
- Detailed description of the settling process.
- Layered description of the bed.
- Morphological update of the bed.

In the MT-module, the settling velocity varies, according to the salinity, if included, and the concentration taking into account flocculation in the water column. Waves, as calculated by MIKE 21 SW for example, may be included. Furthermore, hindered settling and consolidation in the fluid mud and under-consolidated bed are included in the model. Bed erosion can be either nonuniform, i.e. the erosion of soft and partly consolidated bed, or uniform, i.e. the erosion of a dense and consolidated bed. The bed is described as layered and characterised by the density and shear strength.

1.1.5 Boundary Conditions

The tidal boundary conditions for the 2D pre-project and post-project scenario models were taken from RPS' Irish Seas Tidal Surge Model (ISTSM). This model was developed using flexible mesh technology with the mesh size (model resolution) varying from circa 24km along the offshore Atlantic boundary to circa 200m around the Irish coastline. RPS also utilised their Irish Coastal Protection Strategy Study (ICPSS) east coast wave model to gather wave boundary data for the Dublin Bay model to ensure that the hydrodynamic influence of the offshore Kish and Codling banks were accounted for in the model.

The open sea boundaries were applied to the model as Flather boundaries in which the water level and velocities are specified along the boundary. The format of these boundaries is such that they vary temporally and also spatially along the length of the boundary. The Flather condition was chosen as it is one of the most efficient open boundary conditions as in downscaling coarse model simulations to higher resolution areas. The instabilities, which are often observed when imposing stratified density at a water level boundary, can be avoided using Flather conditions.

At the coastline where the water level intersects the bathymetry, a zero velocity condition was applied, which assumes the no slip condition is assumed to hold, that is, both the normal and tangential velocity components are zero.

For the calibration process the open sea boundaries were applied as Flather boundaries, whilst at the coastline a zero velocity boundary was applied. The open sea boundaries were taken from RPS' ISTSM tidal surge model during what was considered an average lunar month that experience a full range of spring and neap tidal conditions.

For the calibration process mean annual discharge rates for the Liffey, Dodder and Tolka were used - the values of which are presented in Table 1.

Table 1: Mean annual discharge rates from the Liffey, Dodder and Tolka used in the calibration process

Source	**Mean annual discharge rate (m^3/s)**
Liffey	15.6
Dodder	2.3
Tolka	1.4

1.1.6 Bed Roughness

When using the two-dimensional hydrodynamic models, the bed resistance was specified using the Manning number. According to the MIKE 21 manual, the relationship between the Manning number,M, and the Nikuradse roughness length, k_s can be estimated using

$$M = \frac{25.4}{k_s^{1/6}}$$

Using one of the several relationships recommended by Soulsby (1997), over flat beds of sediment, k_s is related to the median grain diameter (D_{50}) as approximately

$$k_s = 2.5\ D_{50}$$

For the three-dimensional models, the bed resistance was specified using the bed roughness height of the sea bed which is dependent on the von Karman constant.

It was therefore possible to impose a uniform bed resistance coefficient at the seabed for both the two and three dimensional models - the value of which was determined using the simple relationships presented above and by calibrating of the Dublin Port model.

In some

1.1.7 Turbulence module

The turbulence model used by MIKE is based on a standard k-epsilon model $(k - \varepsilon)$ with a buoyancy extension. The model uses transport equations for the turbulent kinetic energy (TKE), k, and the dissipation of TKE, ε, to describe the turbulence.

APPENDIX 13-2 – MODEL CALIBRATION AND VALIDATON

This appendix describes the calibration and validation process undertaken to ensure that the hydraulic model systems used to assess the potential impact of the proposed development on coastal processes were accurate and fit for purpose.

1.1 Model Validation

The validation process was undertaken using surface elevation information recorded by the Dublin Port tide gauge and also current regime information recorded by eight individual Acoustic Doppler Current Profilers (ADCPs) that were moored throughout Dublin Bay between 2013 and present as part of various monitoring programmes. The location of the ADCP devices in relation to Dublin Port is illustrated in Figure 1.

The validation process focused on establishing agreement between the model output and recorded observations and thus assessing overall model performance based several key parameters including tidal range, current speed, phase and direction.

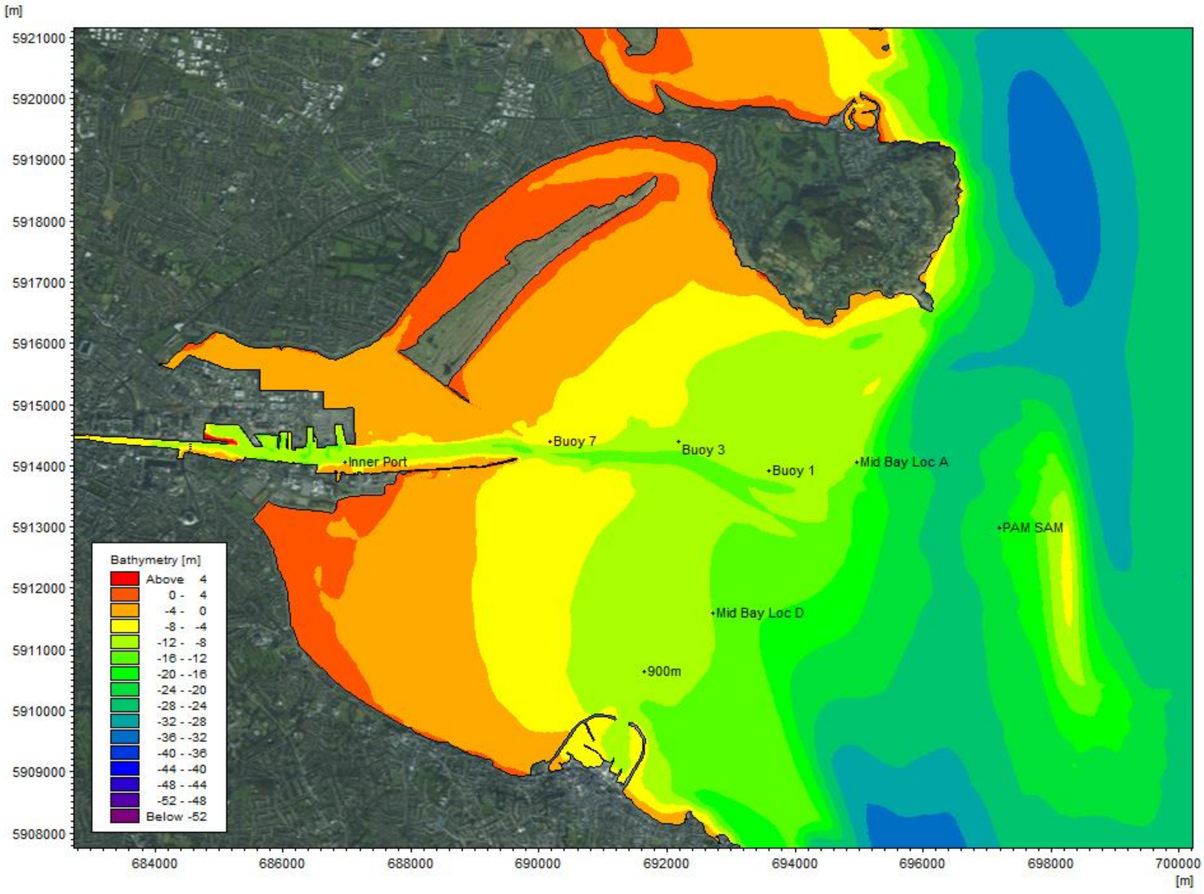


Figure 1: Location of the various measurement recording sites throughout Dublin Bay used to validate RPS' baseline numerical model

1.1.1 Validation of simulated tidal ranges

Figure 2 presents a comparison between surface elevation data recorded by the Dublin Tide Gauge over a typical spring neap tidal cycle in 2016 and surface elevation data simulated by the Dublin Bay numerical model for the same period. As can be seen from this figure the hydrodynamic model simulates the surface elevations in Dublin Port to a very high degree of accuracy.

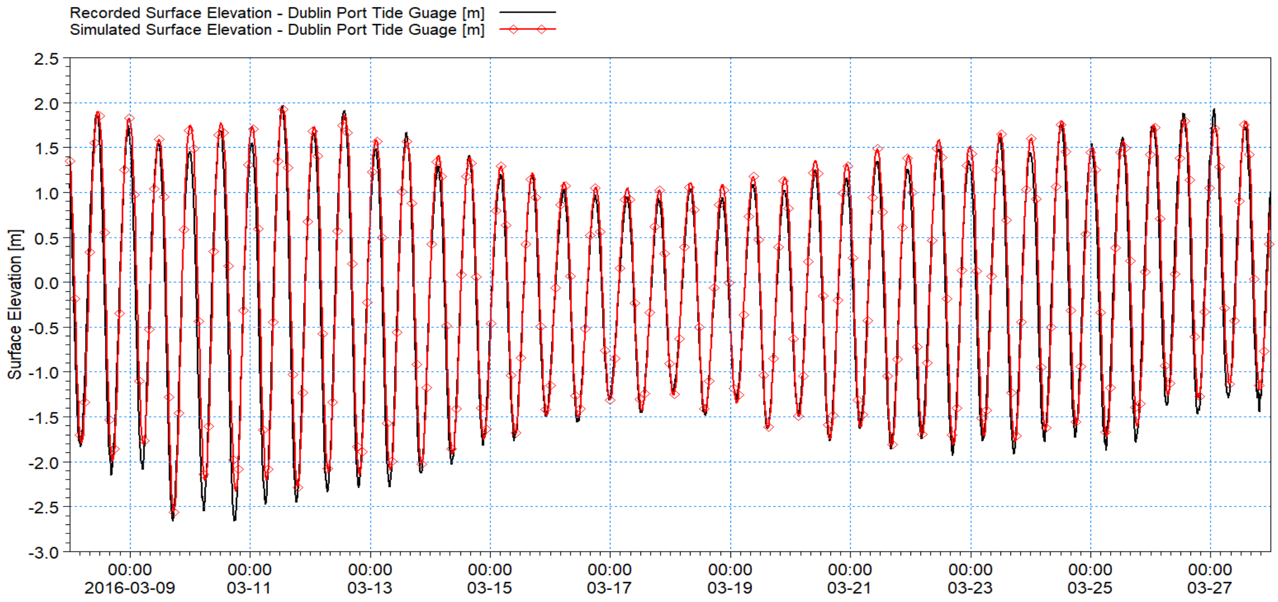


Figure 2: Comparison of recorded and simulated surface elevations at the Dublin Port tide gauge

1.1.2 Validation of simulated current regime

The validation of the simulated tidal current regime was undertaken using data recorded by eight individual ADCP devices that were deployed throughout the model domain at various times between 2013 and present as part of various hydrographic and environmental monitoring programmes. It should therefore be noted that the temporal duration of the validation plots vary depending on the device location.

All ADCP devices were setup to record current speed, phase and direction at multiple depths throughout the water column. The multiple depth recordings were then grouped together to create representative bottom, middle and top layer signals.

To validate the two-dimensional Dublin Bay model, depth averaged simulated data were compared with data recorded at all sites except the inner Port where stratified conditions prevail. In this area, simulated data from RPS' three-dimensional Dublin Bay model were compared with data recorded by the inner Port ADCP across the top, middle and bottom layers of the water column. For convenience an index for the various validation plots across spring and neap tidal conditions has been presented in Table 0.1 overleaf.

Table 0.1: Index of the validation plots at each of the validation sites for spring and neap conditions

Validation Type	Validation Site	Spring Conditions	Neap Conditions
Depth averaged (2D)	Buoy 1	Figure 3	Figure 10
	Buoy 3	Figure 4	Figure 11
	Buoy 7	Figure 5	Figure 12
	Mid Bay A	Figure 6	Figure 13
	Mid Bay D	Figure 7	Figure 14
	VD 900	Figure 8	Figure 15
	PAM SAM	Figure 9	Figure 16
Three dimensional (3D)	Inner Port	Figure 17	Figure 18

Examination of the two-dimensional depth averaged plots used to validate simulate date model outside of the Port demonstrate that the hydrodynamic model predicted current speed, phase and direction during both spring and neap tidal conditions throughout the entire model domain to a very high degree of accuracy. At all validation sites the simulated depth averaged current speed, phase and direction values nearly always falls between the range values observed in the top and bottom layers. It may be noted that there is an minor difference between the modelled and recorded data in the top layer at buoys 3 and 7, however this difference can be attributed to prevailing weather conditions such as high surface winds etc. which would not have been account for in the hydrodynamic model.

Examination of Figure 17 and Figure 18 which illustrate the plots used to validate RPS' baseline three-dimensional model inside of Dublin Port demonstrate that the actual current speed, phase and direction are all well predicted by the hydrodynamic model. The minor difference observed in current speeds and directions within the top layer of the model is due prevailing weather conditions which would not have been accounted for in the model.

A close inspection of the recorded current speeds and directions within Dublin Port indicates the presence of a salt wedge within the Liffey channel; this is a classic phenomenon observed at the mouth of any estuary or fresh water river that meets the sea. As demonstrated in Figure 19 to Figure 22 which illustrate the salinity of bottom, middle and top layers of the water column at various phases of a typical spring tidal cycle, RPS' three dimensional model simulates this dynamic pycnocline process very well.

Overall the validation process demonstrated that RPS' two dimensional and three dimensional baseline models of Dublin Bay simulated the current speed, phase, range and direction to a high degree of accuracy throughout the entire model domain. The current regime within the inner harbour flow is complex with some level of circulation, stratification and bi-directional flows; however these phenomena are all well represented by the model. The validation process therefore considered the 2D and 3D baseline models to be fit for purpose and adequate to assess the coastal processes in Dublin Port in context of the 3FM Project.

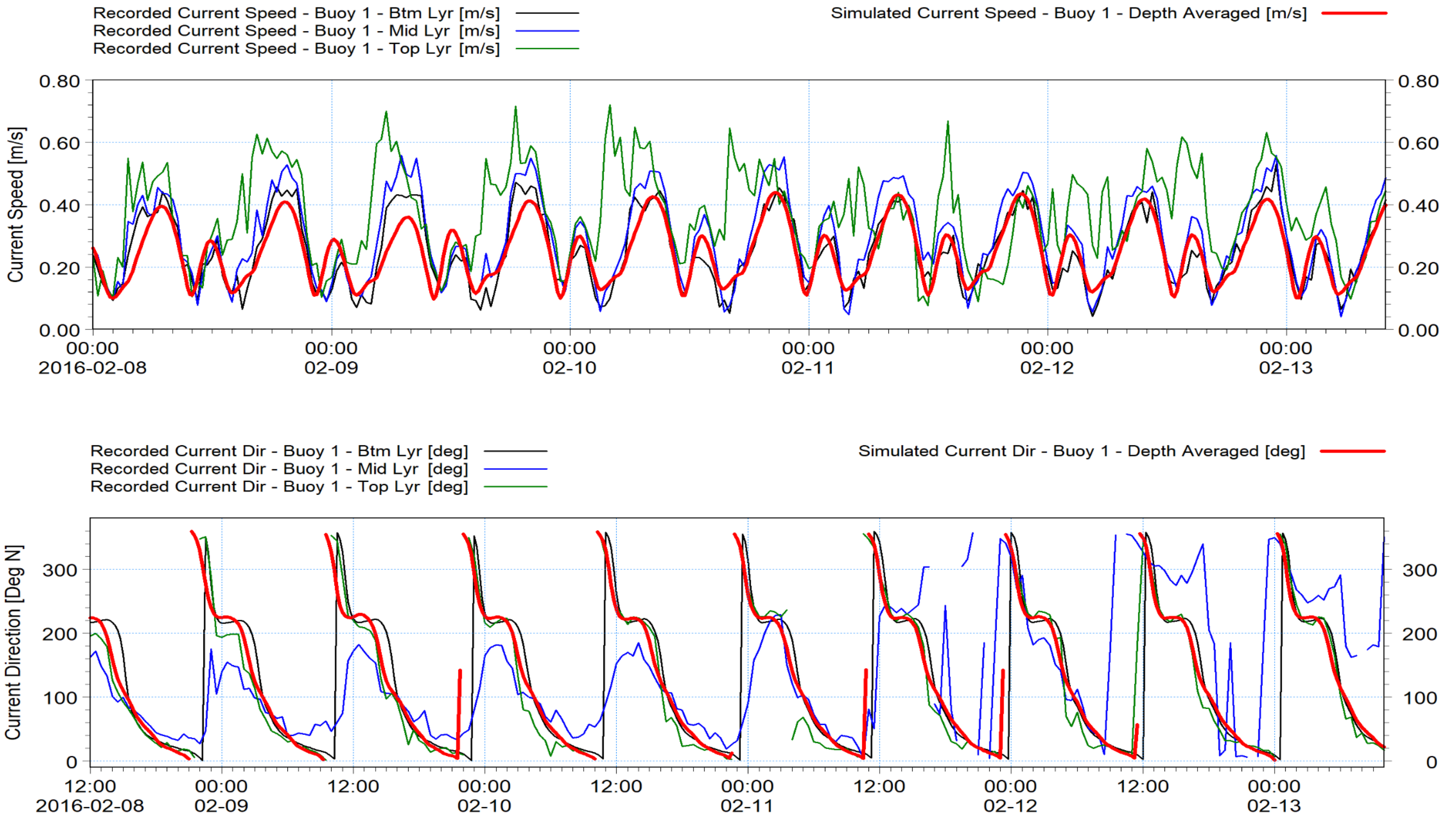
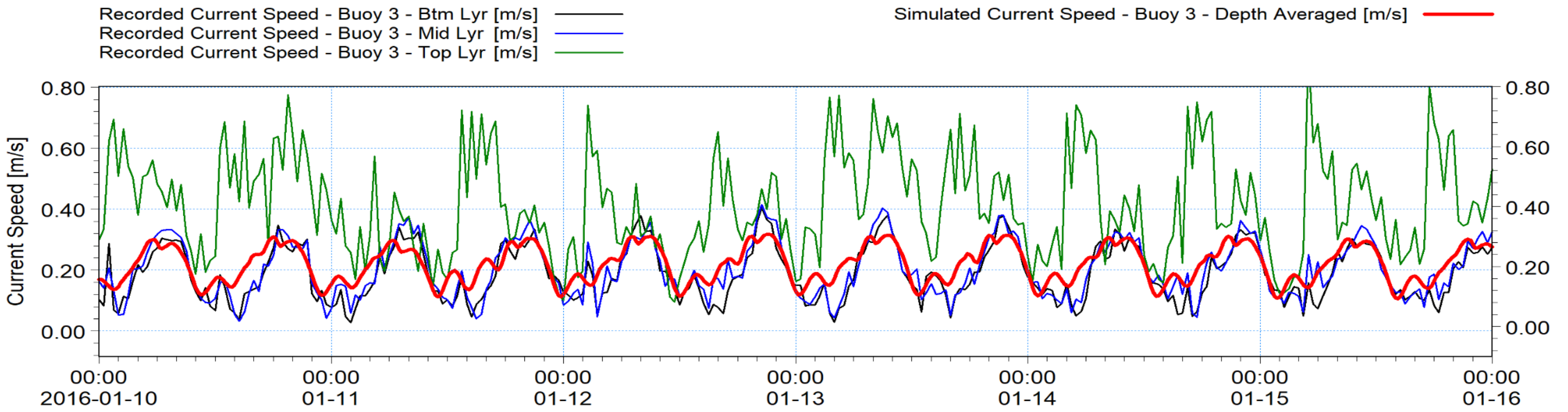


Figure 3: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 1 - Spring Tides



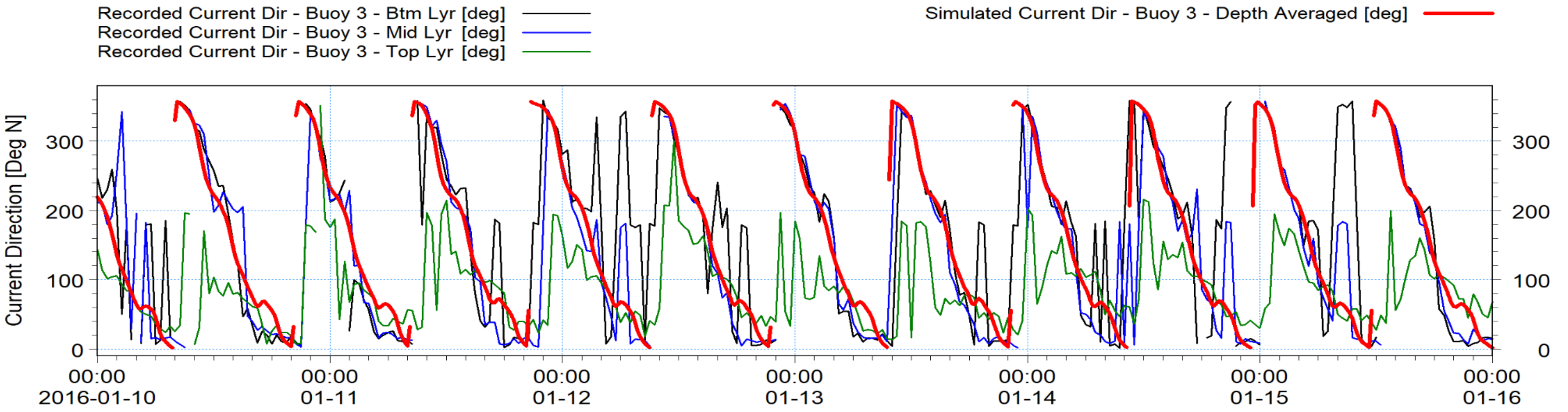


Figure 4: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 3 - Spring Tides

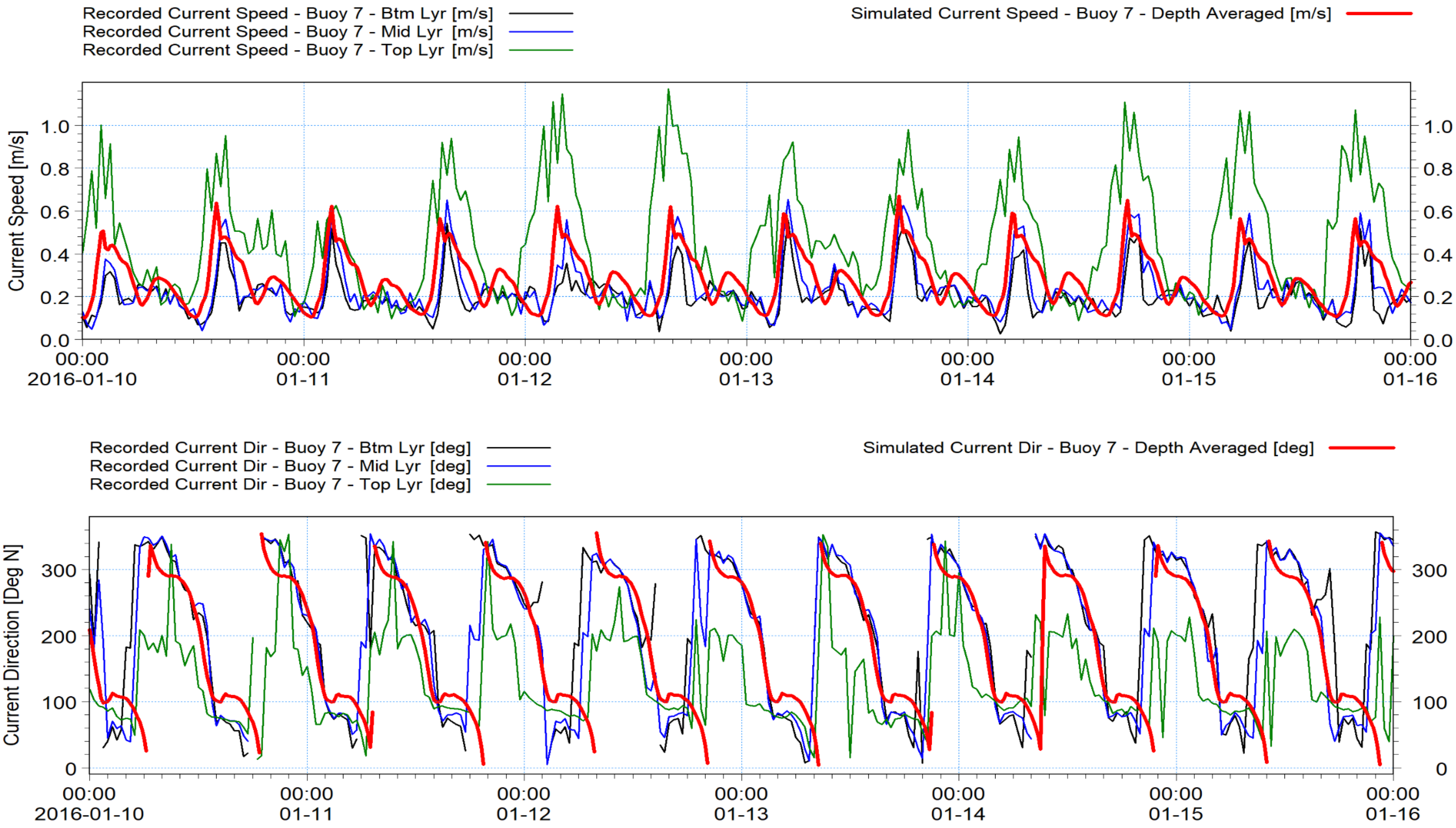


Figure 5: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 7 -Spring Tides

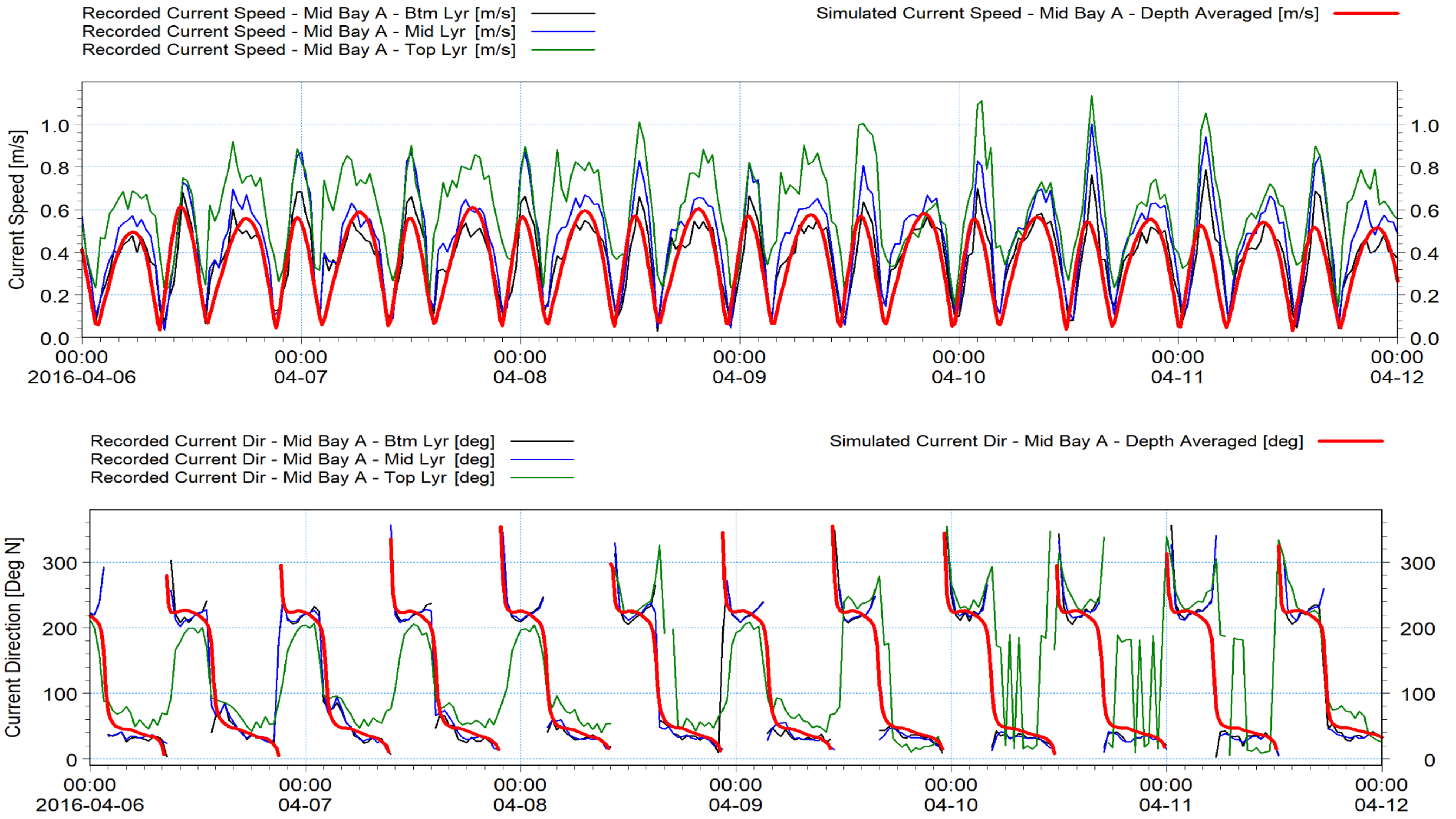
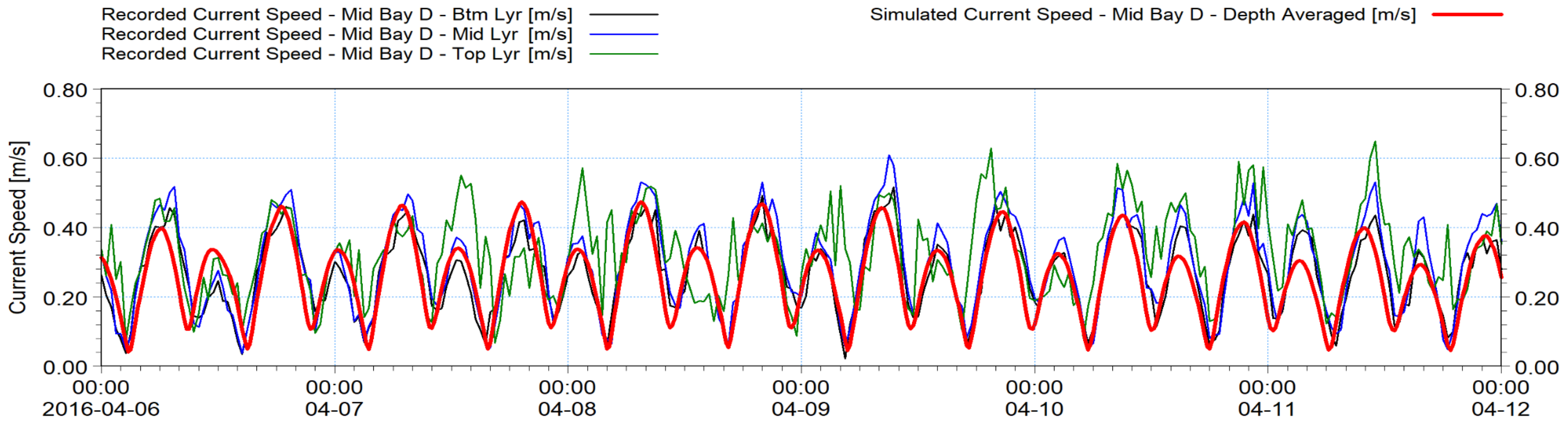


Figure 6: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Mid Bay A - Spring Tides



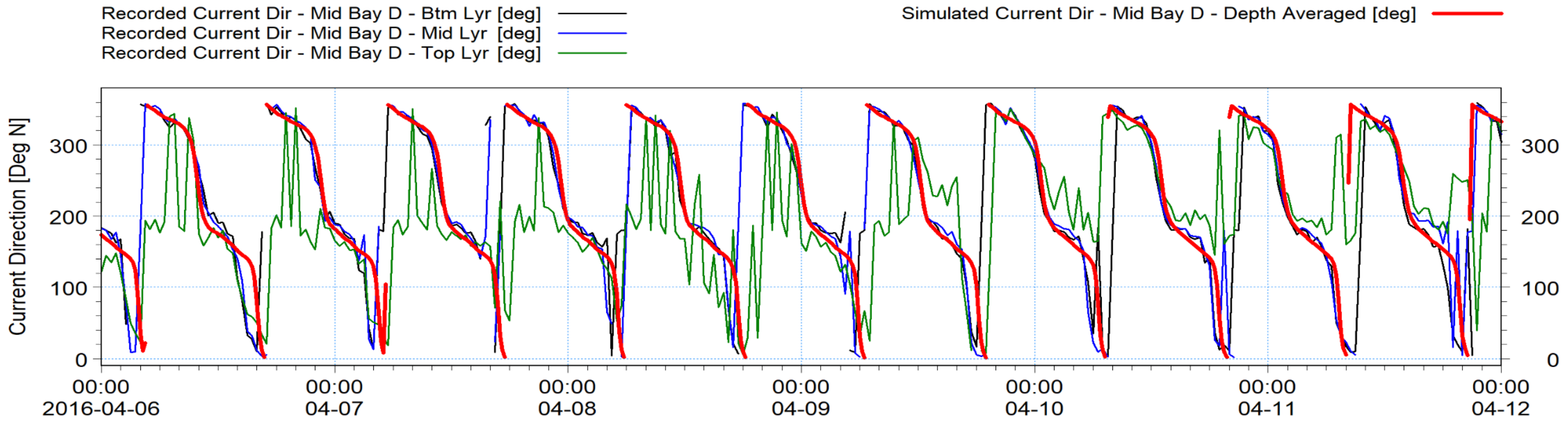


Figure 7: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Mid Bay D - Spring Tides

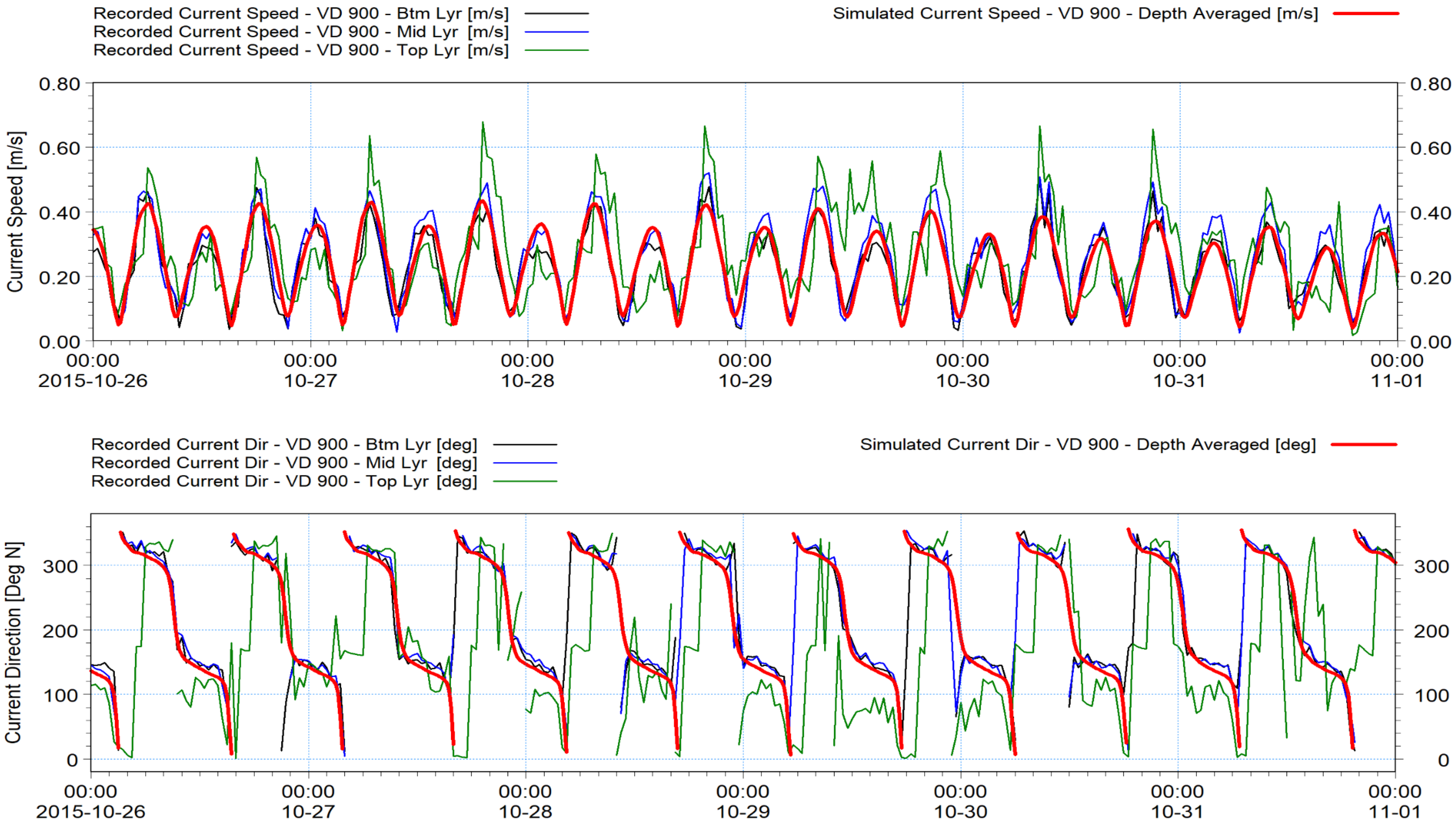


Figure 8: Comparison of recorded and simulated current speeds (upper) and directions (lower) at VD 900 -Spring Tides

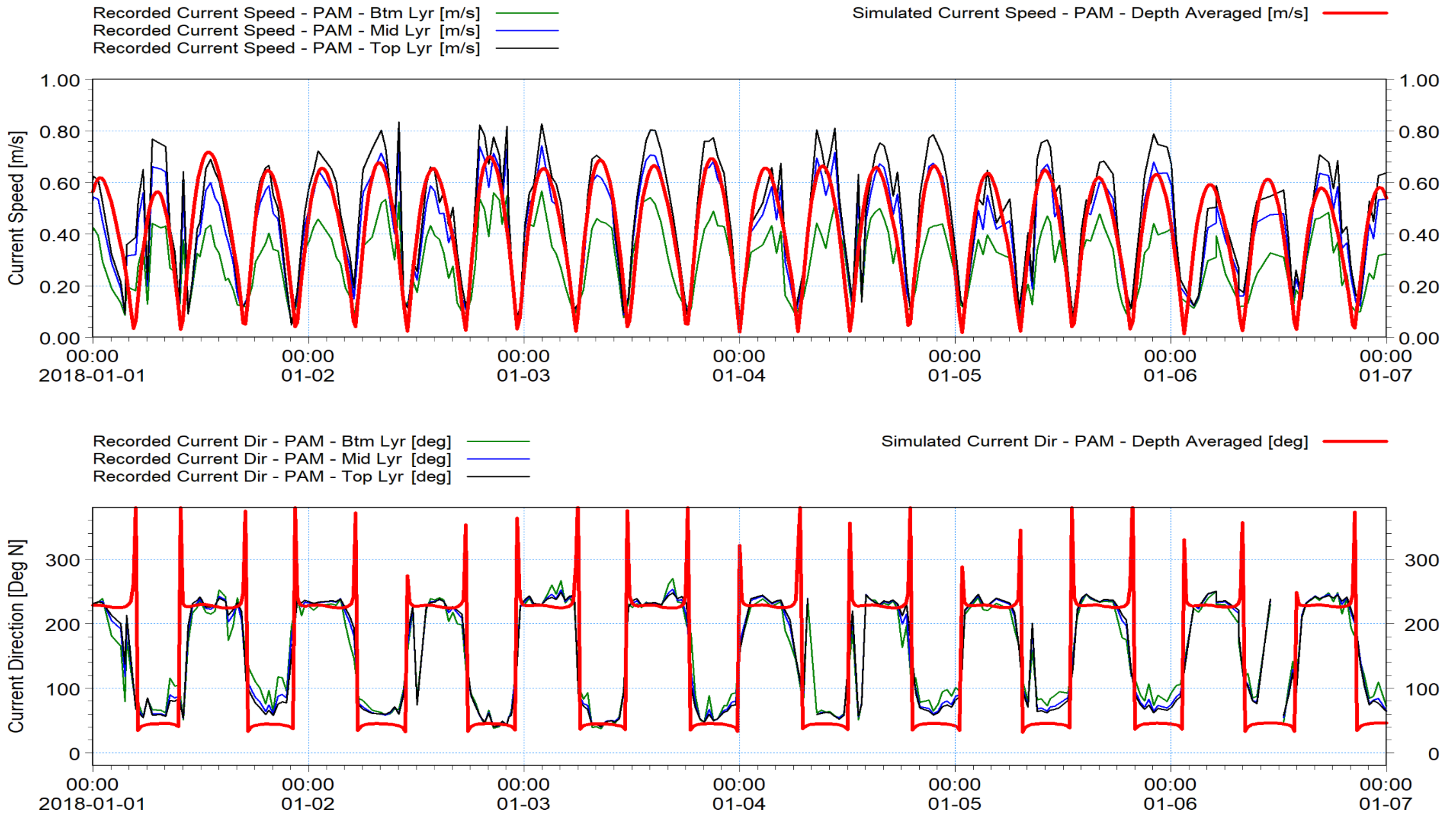
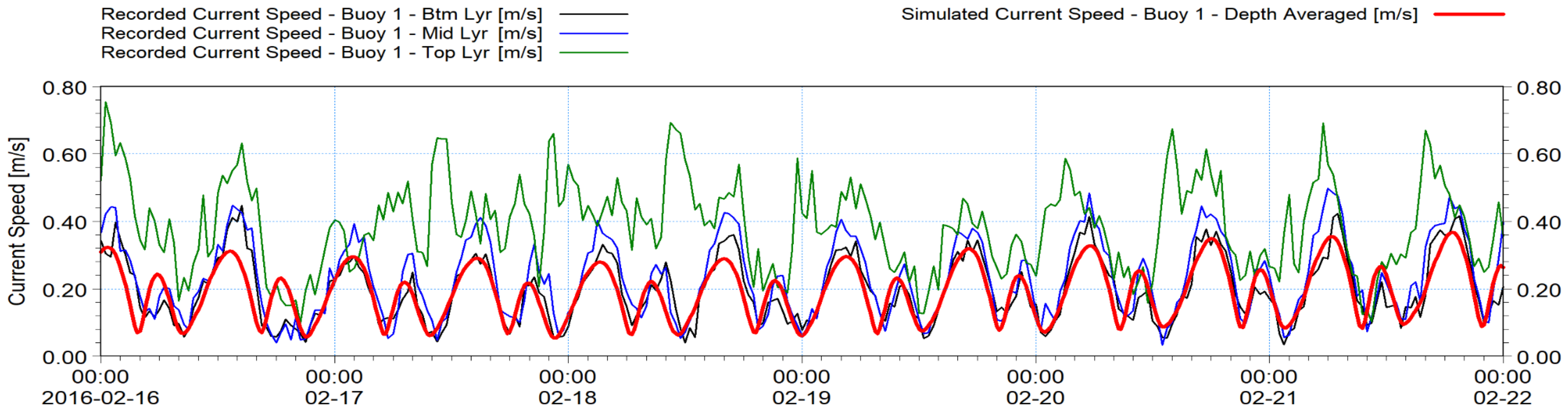


Figure 9: Comparison of recorded and simulated current speeds (upper) and directions (lower) at PAM Site -Spring Tides



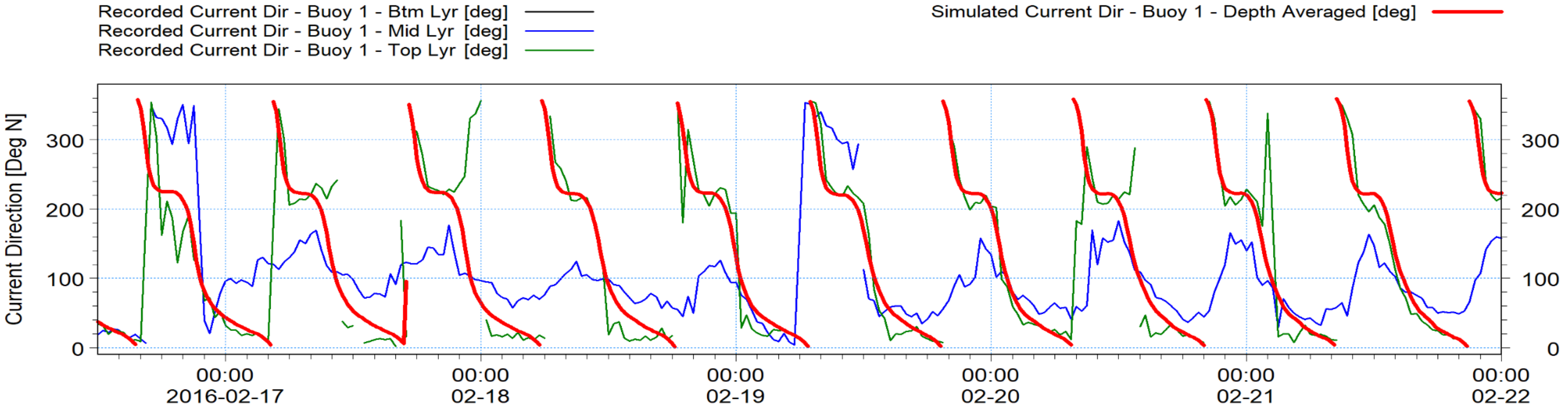


Figure 10: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 1 -Neap Tides

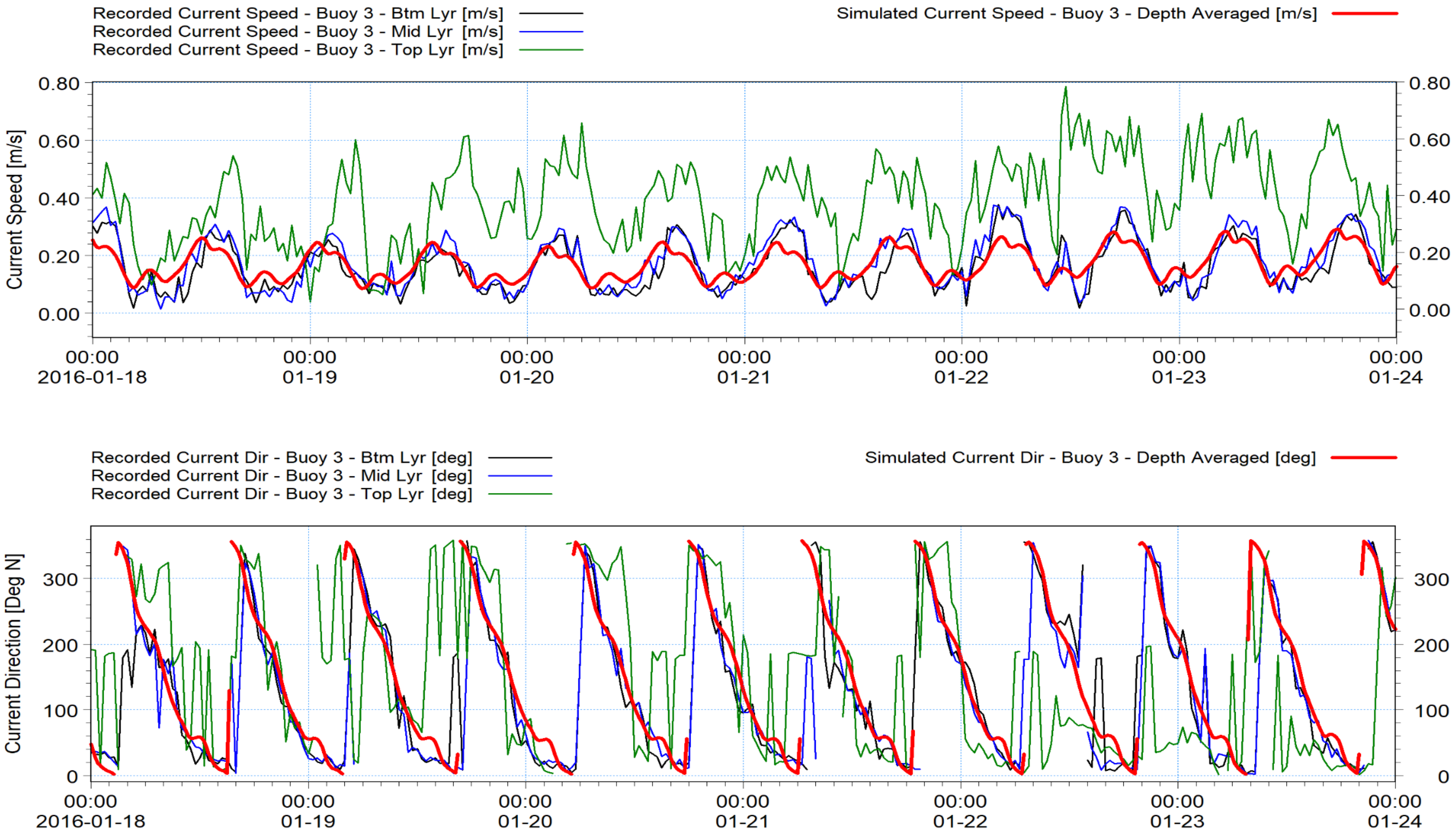
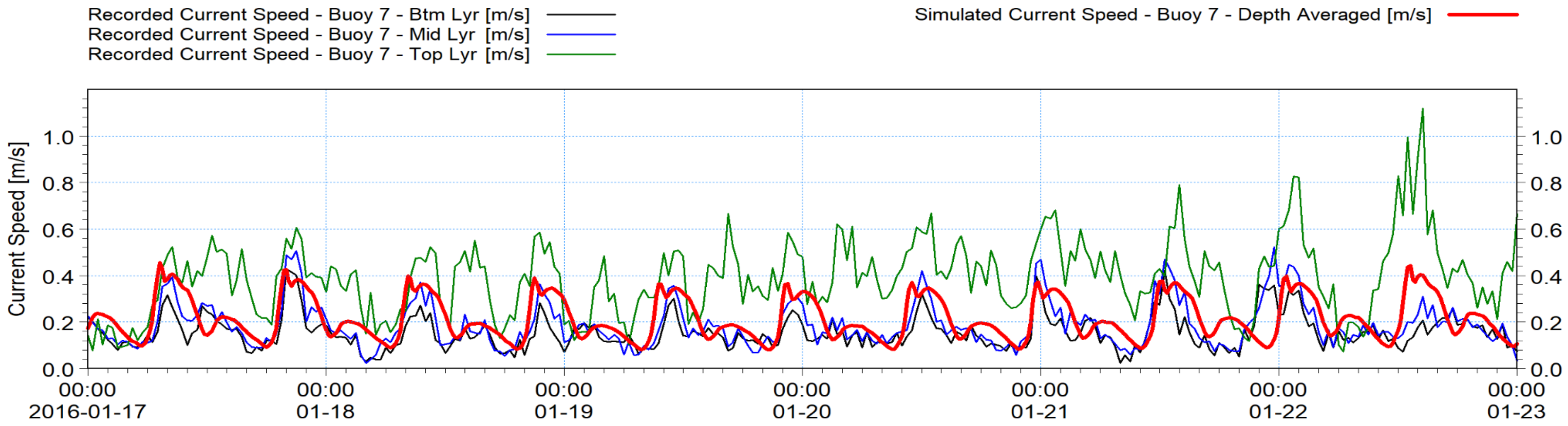


Figure 11: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 3 -Neap Tides



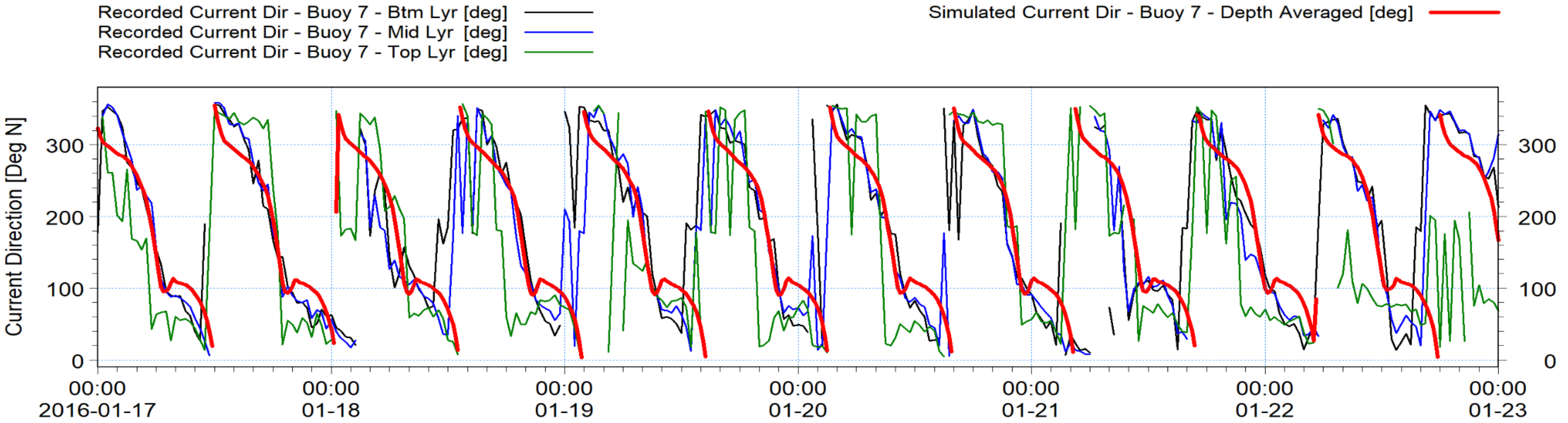


Figure 12: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Buoy 7 - Neap Tides

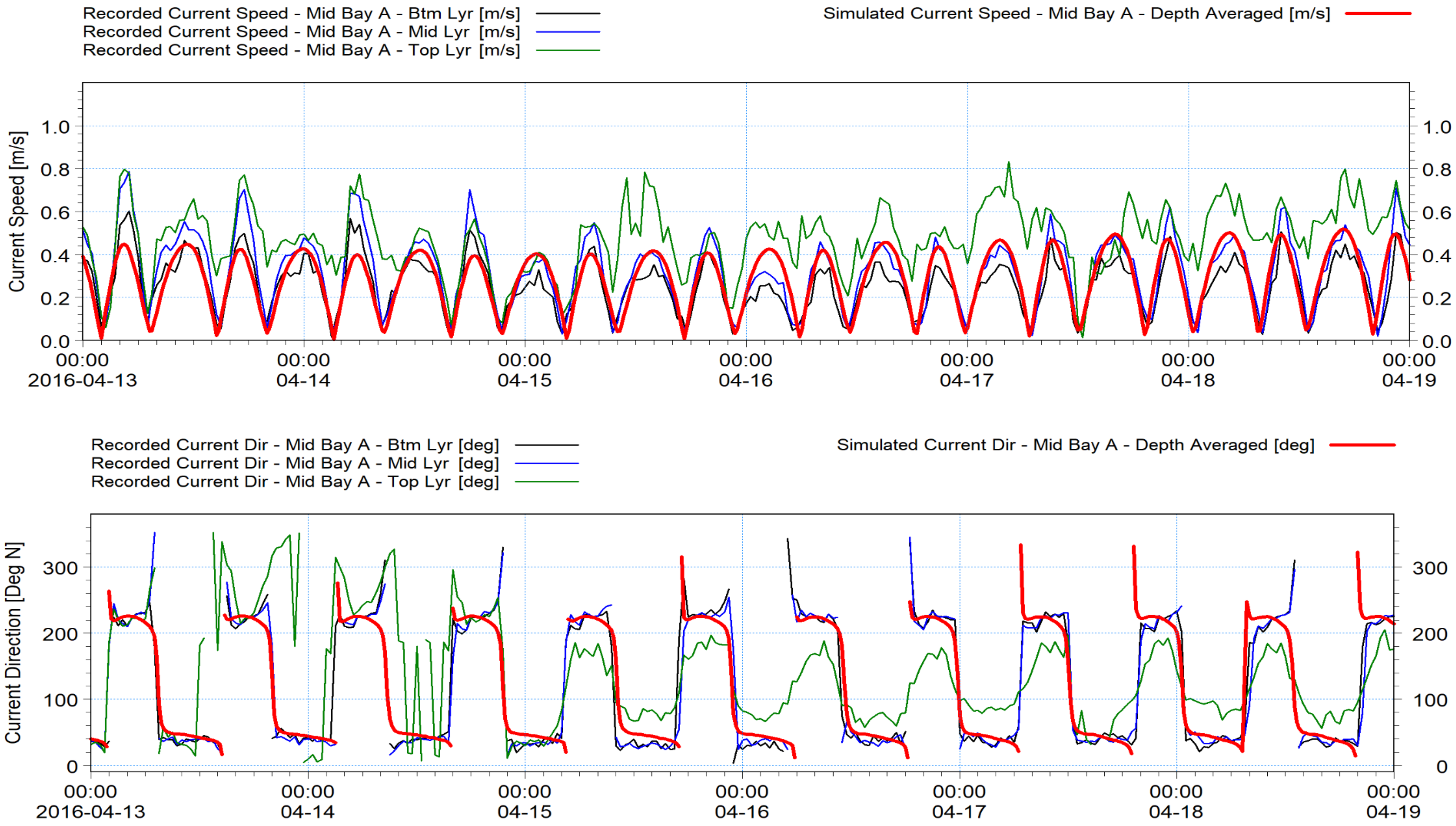


Figure 13: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Mid Bay A -Neap Tides

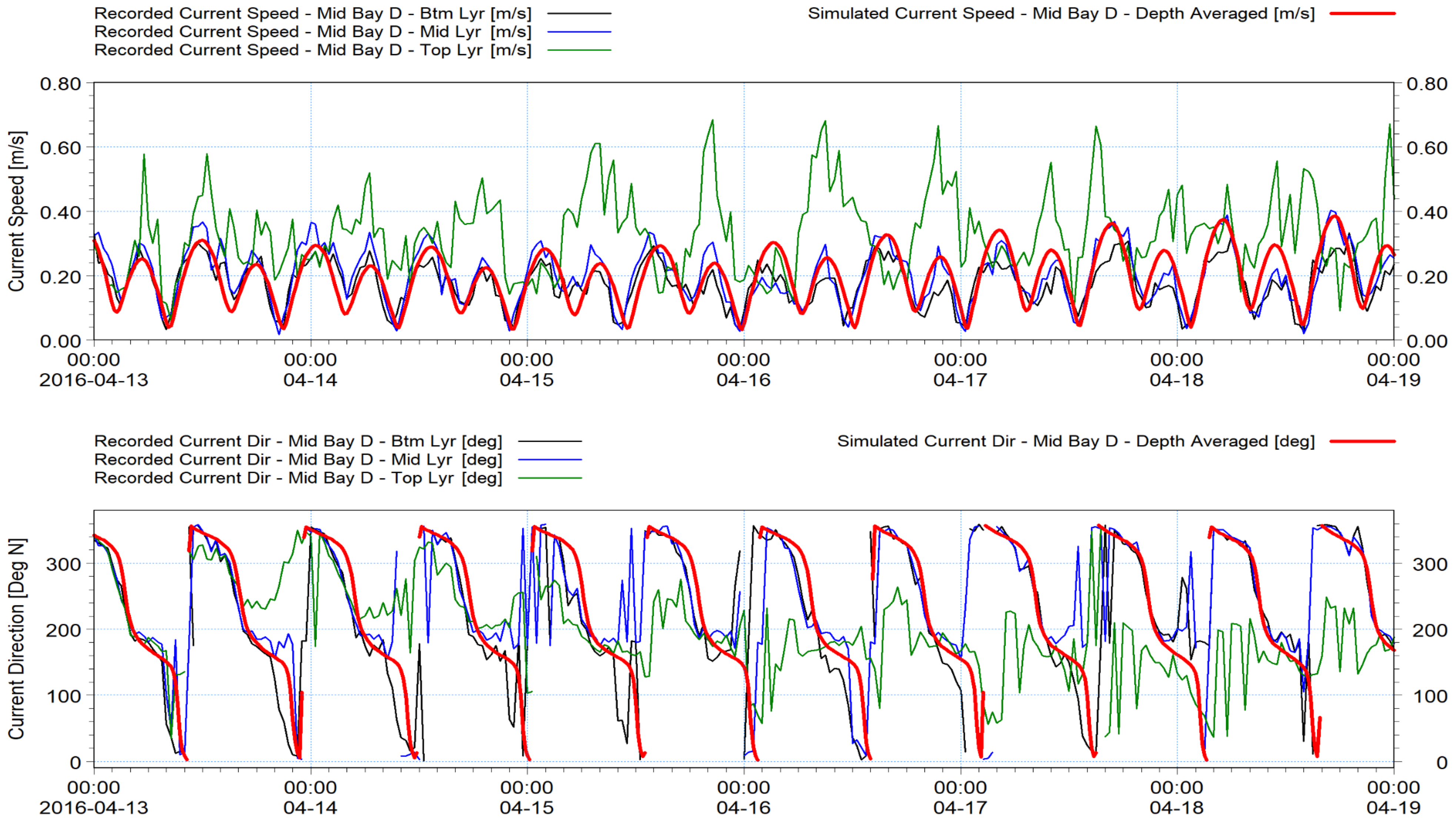


Figure 14: Comparison of recorded and simulated current speeds (upper) and directions (lower) at Mid Bay D -Neap Tides

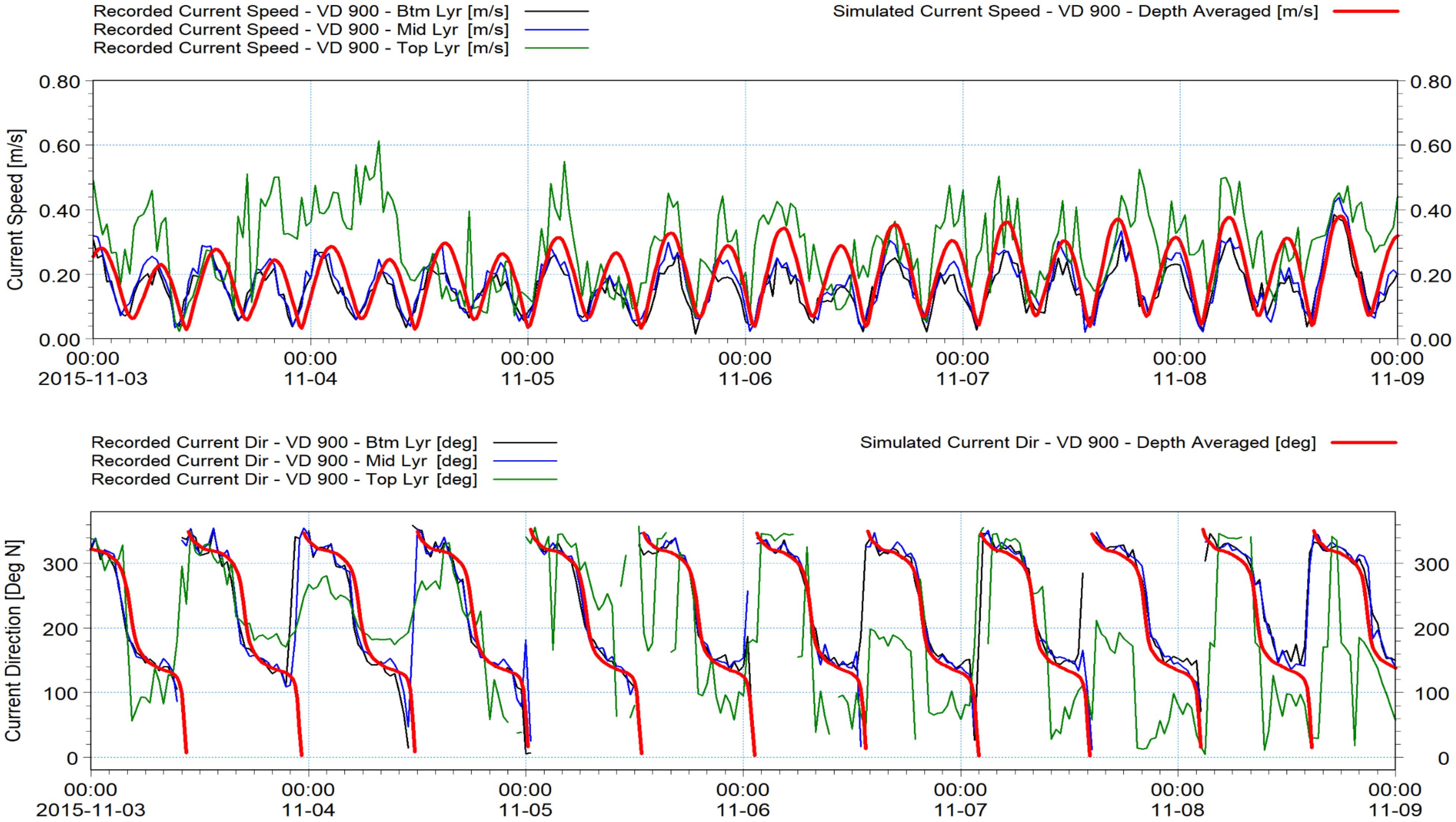


Figure 15: Comparison of recorded and simulated current speeds (upper) and directions (lower) at VD 900 -Neap Tides

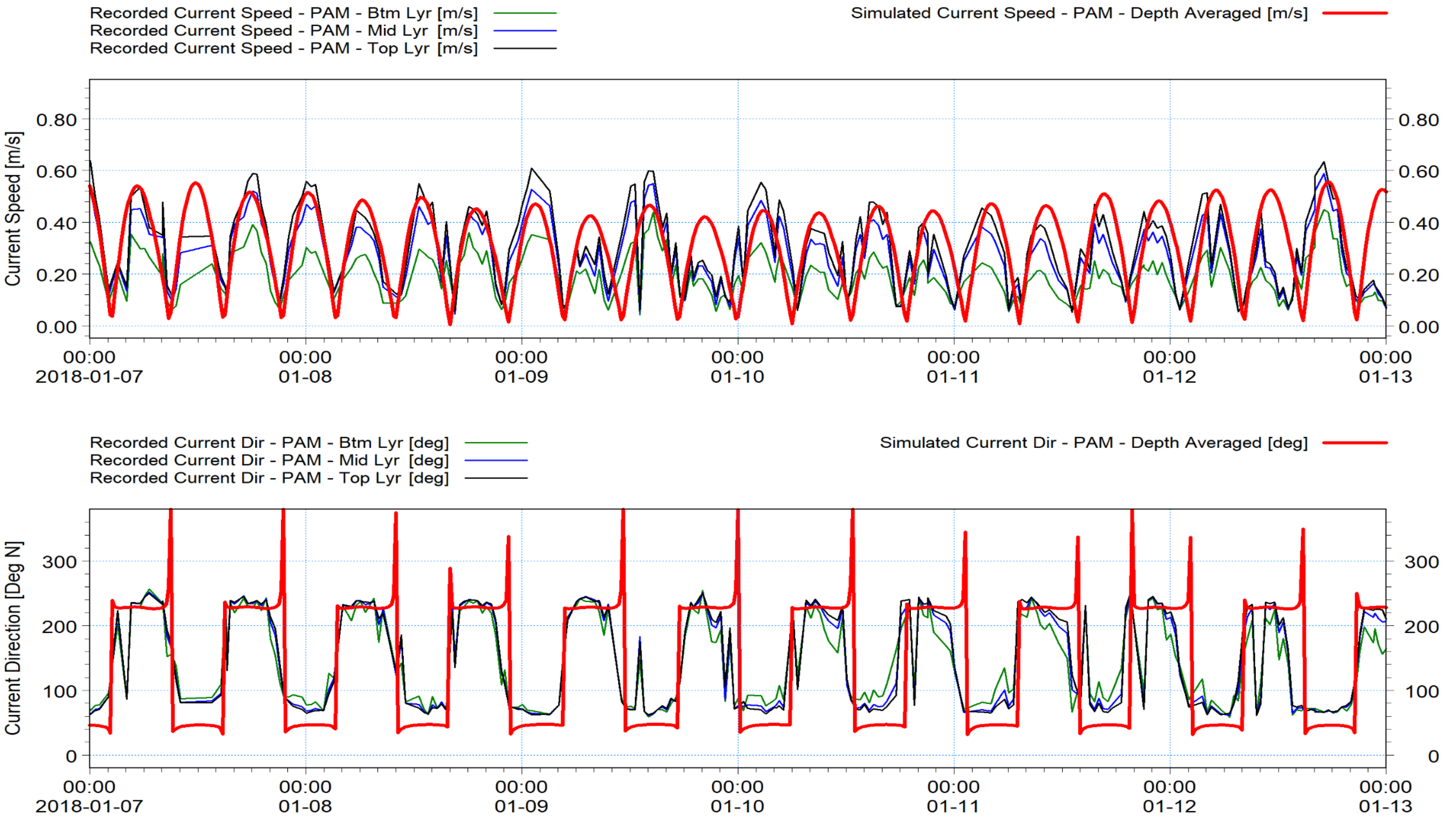
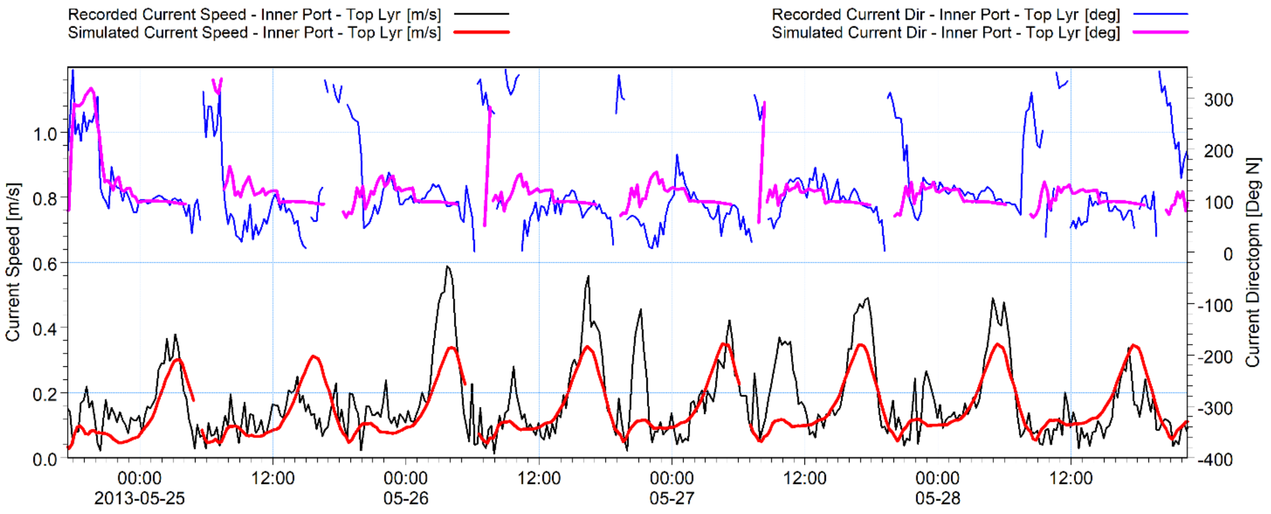
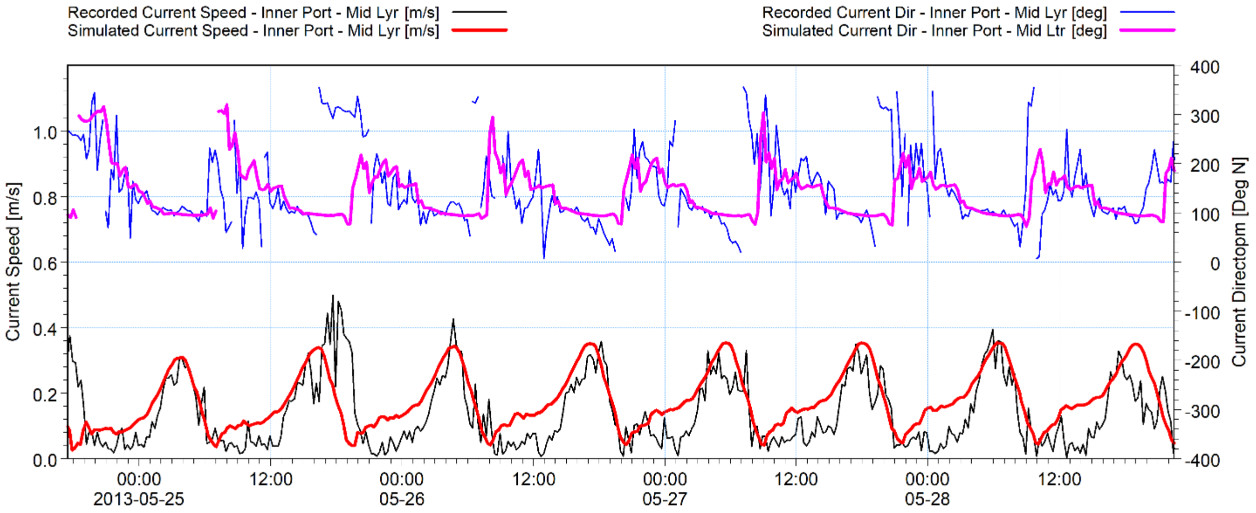


Figure 16: Comparison of recorded and simulated current speeds (upper) and directions (lower) at PAM Site -Neap Tides





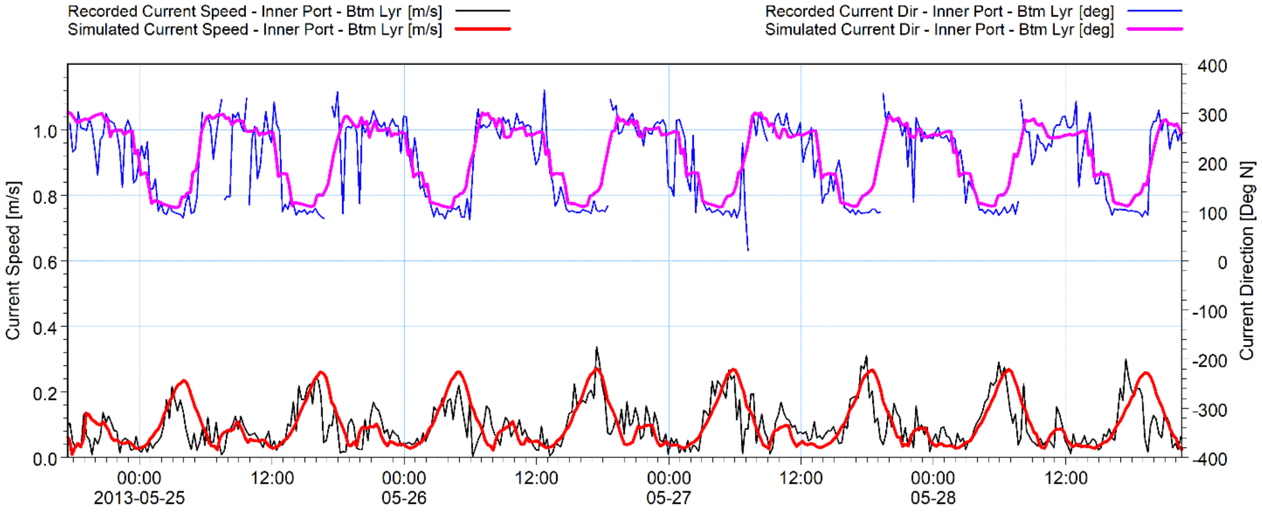


Figure 17: Comparison of recorded and simulated current speeds and directions throughout the top, middle and bottom layers of the water column at the Inner Port ADCP - Spring Tides

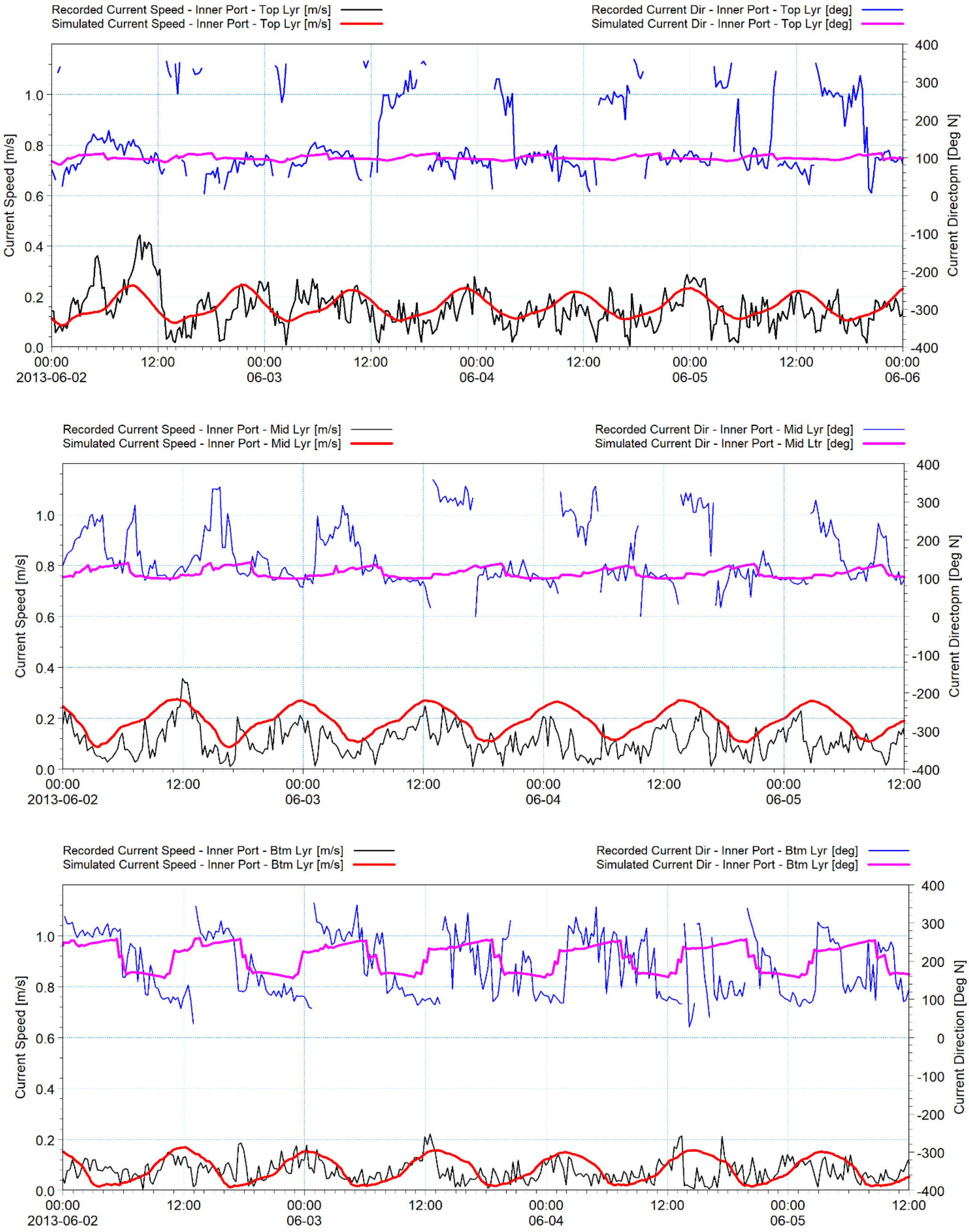
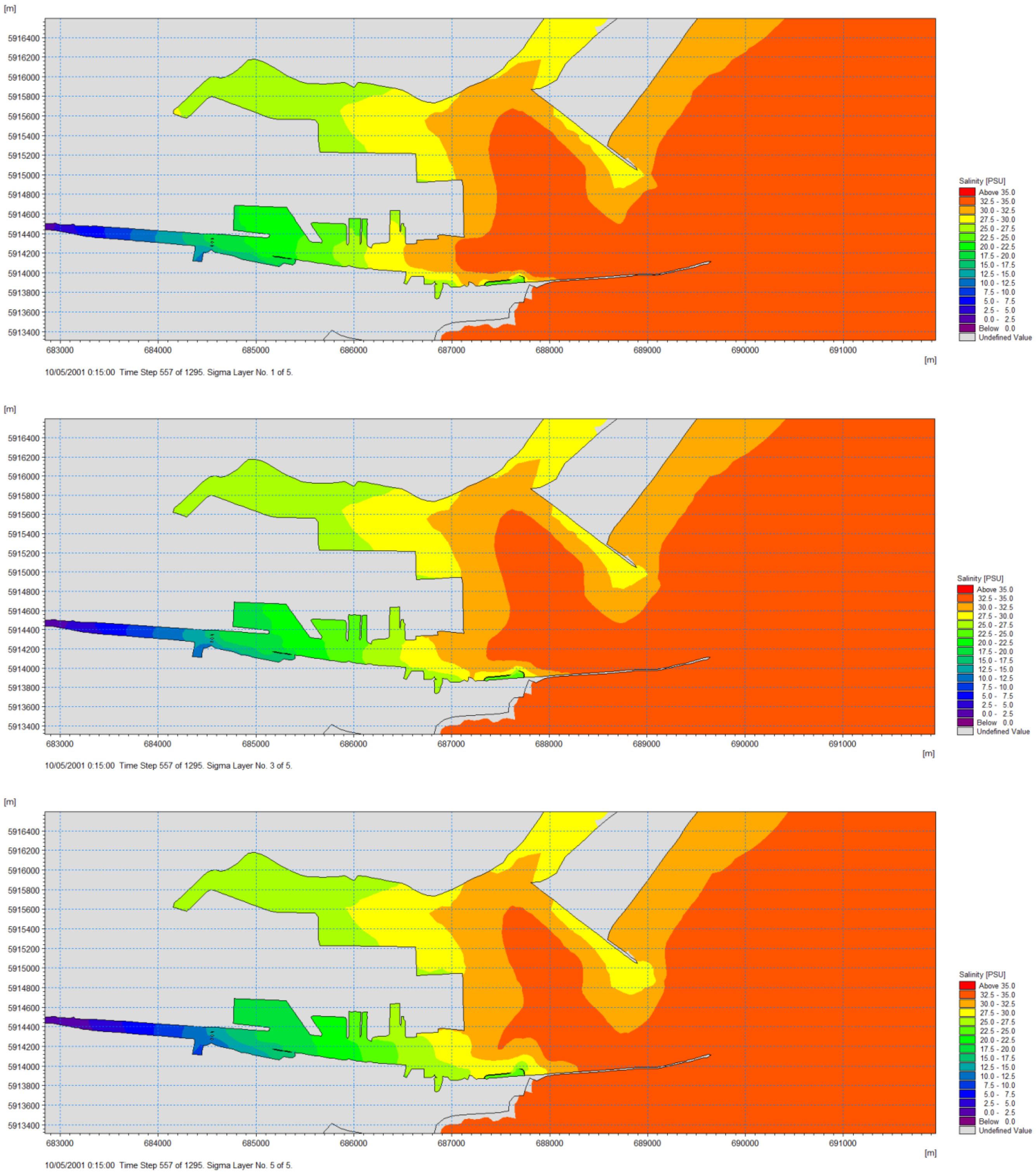


Figure 18: Comparison of recorded and simulated current speeds and directions throughout the top, middle and bottom layers of the water column at the Inner Port ADCP - Neap Tides

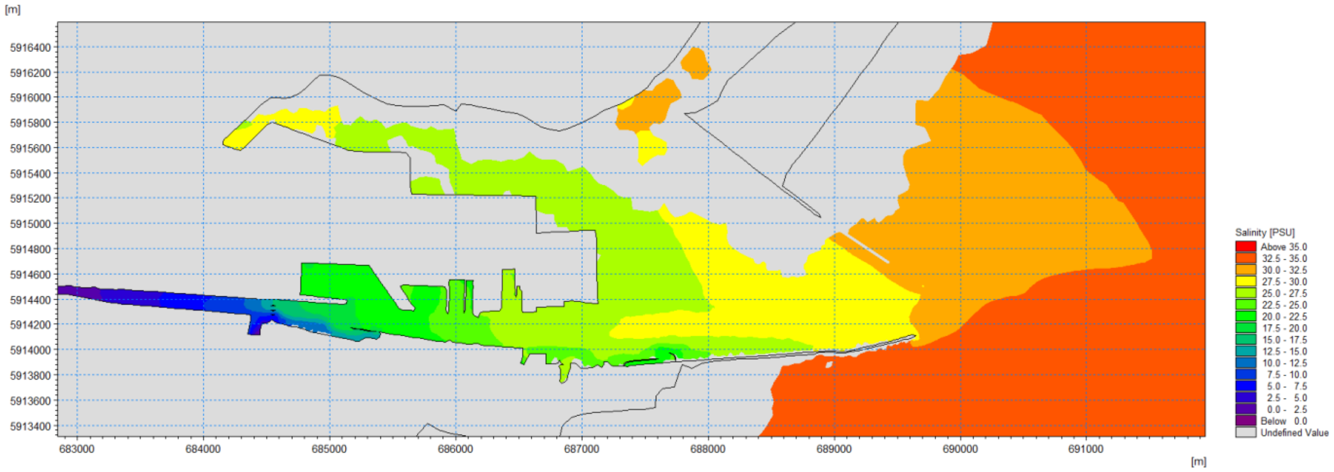


10/05/2001 0:15:00 Time Step 557 of 1295. Sigma Layer No. 1 of 5.

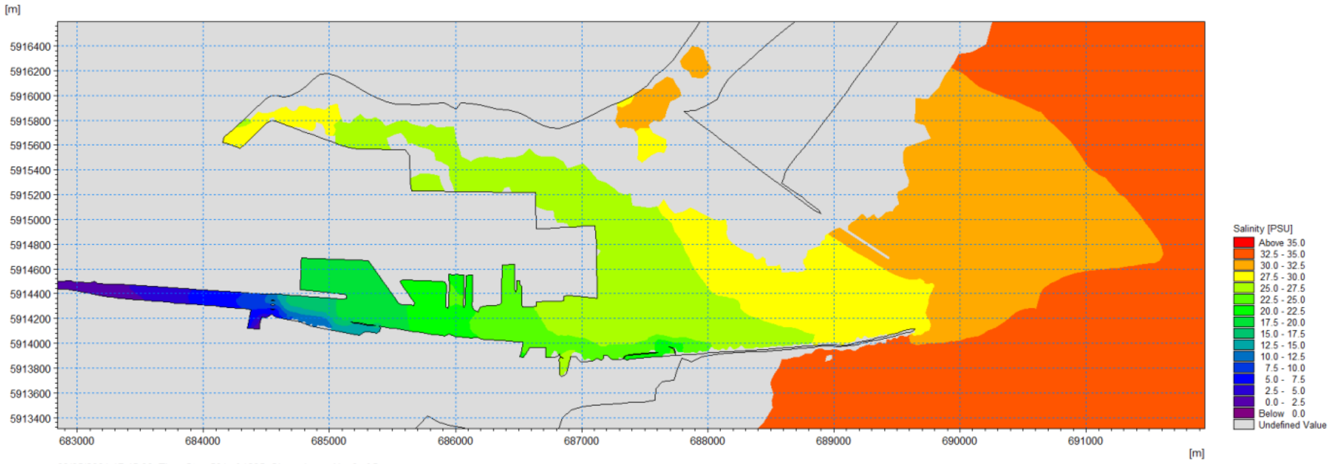
10/05/2001 0:15:00 Time Step 557 of 1295. Sigma Layer No. 3 of 5.

10/05/2001 0:15:00 Time Step 557 of 1295. Sigma Layer No. 5 of 5.

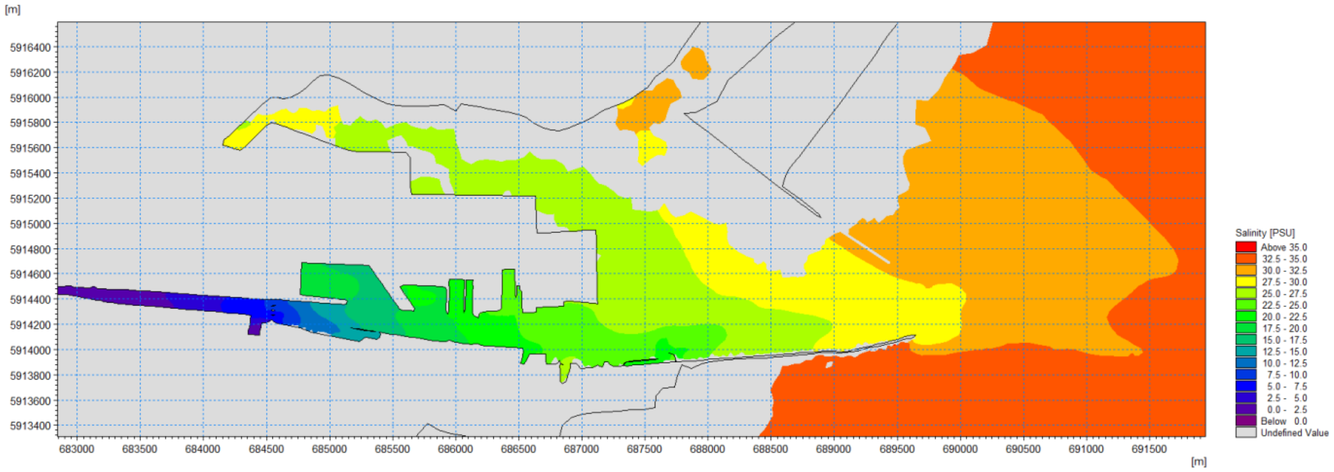
Figure 19: Salinity of the bottom, middle and surface layers respectively during a typical high spring tide



09/05/2001 17:45:00 Time Step 531 of 1295. Sigma Layer No. 1 of 5.

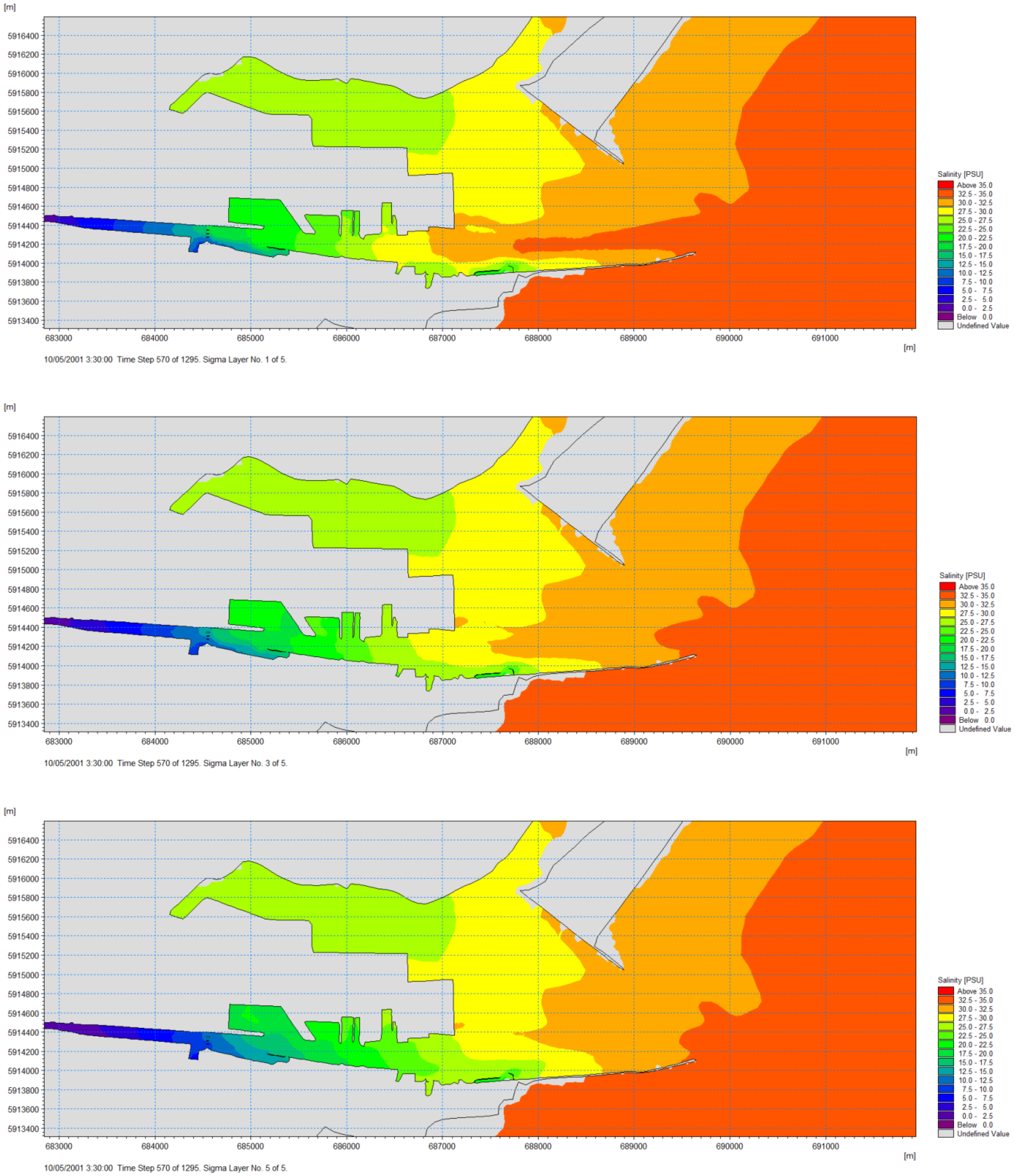


09/05/2001 17:45:00 Time Step 531 of 1295. Sigma Layer No. 3 of 5.



09/05/2001 17:45:00 Time Step 531 of 1295. Sigma Layer No. 5 of 5.

Figure 20: Salinity of the bottom, middle and surface layers respectively during a typical low spring tide

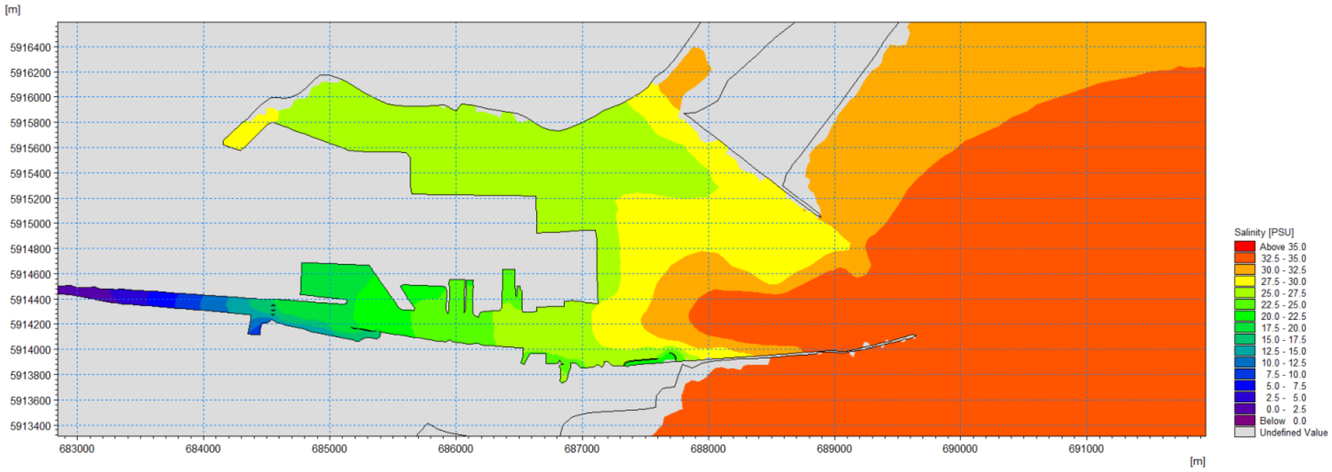


10/05/2001 3:30:00 Time Step 570 of 1295. Sigma Layer No. 1 of 5.

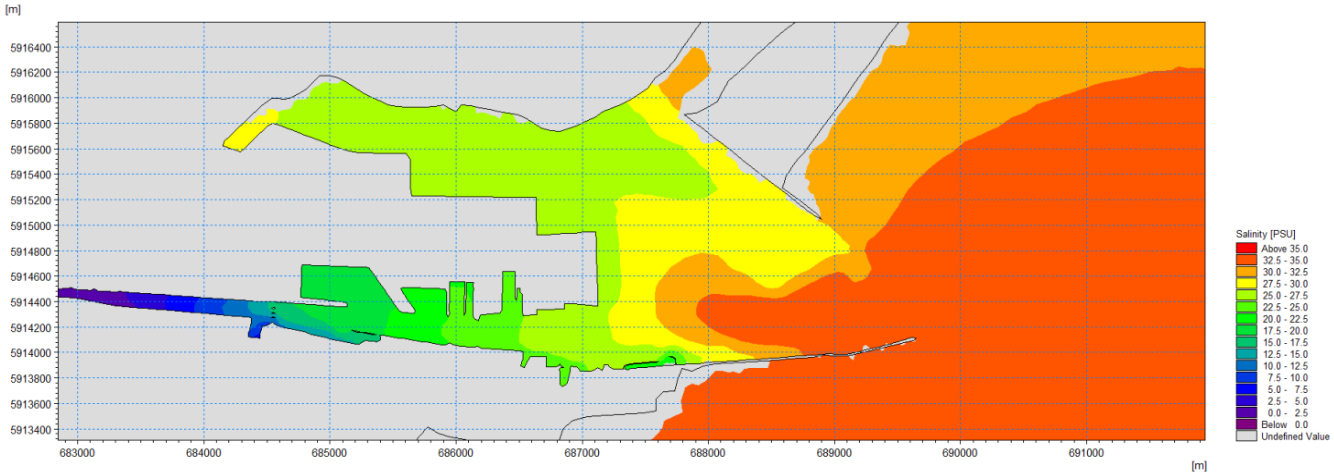
10/05/2001 3:30:00 Time Step 570 of 1295. Sigma Layer No. 3 of 5.

10/05/2001 3:30:00 Time Step 570 of 1295. Sigma Layer No. 5 of 5.

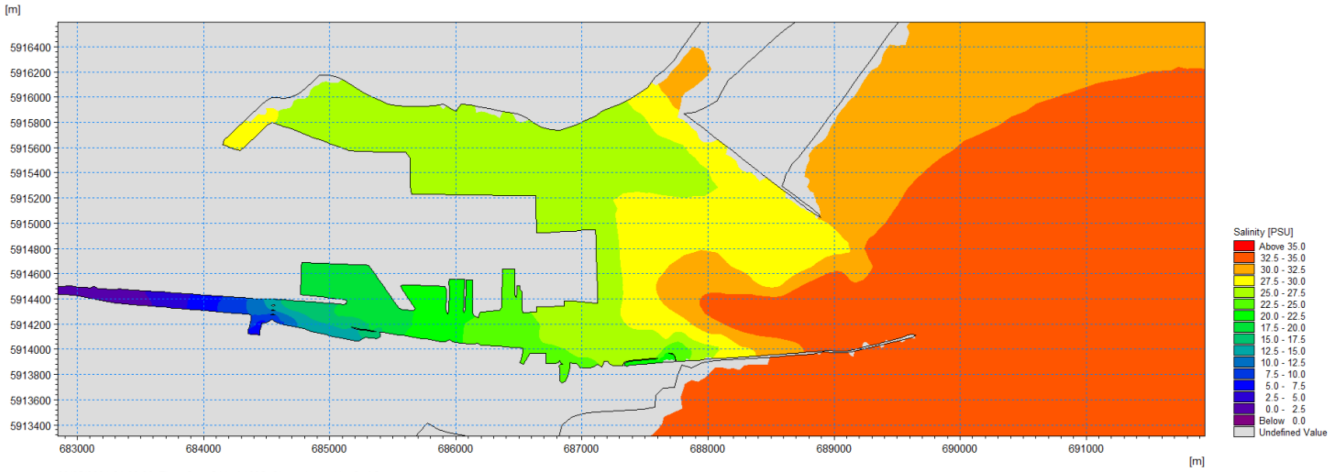
Figure 21: Salinity of the bottom, middle and surface layers respectively during a typical mid-ebb spring tide



09/05/2001 21:00:00 Time Step 544 of 1295. Sigma Layer No. 1 of 5.



09/05/2001 21:00:00 Time Step 544 of 1295. Sigma Layer No. 3 of 5.



09/05/2001 21:00:00 Time Step 544 of 1295. Sigma Layer No. 5 of 5.

Figure 22: Salinity of the bottom, middle and surface layers respectively during a typical mid-flood spring tide

DUBLIN PORT 3FM

Thermal Plume Validation Report

IBE2022
29 May 2024

rpsgroup.com

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
Rev 00	Draft	NRS	KC	AKB	21/03/2024
Rev01	Updated modelling	NRS	KC	AKB	30/04/2024
Rev02	Final	NRS	KC	AKB	29/05/2024

Approval for issue

A. Bell	x. Bell	31/05/2024

The report has been prepared for the exclusive use and benefit of our client and solely for the purpose for which it is provided. Unless otherwise agreed in writing by R P S Group Limited, any of its subsidiaries, or a related entity (collectively 'RPS') no part of this report should be reproduced, distributed or communicated to any third party. RPS does not accept any liability if this report is used for an alternative purpose from which it is intended, nor to any third party in respect of this report. The report does not account for any changes relating to the subject matter of the report, or any legislative or regulatory changes that have occurred since the report was produced and that may affect the report.

The report has been prepared using the information provided to RPS by its client, or others on behalf of its client. To the fullest extent permitted by law, RPS shall not be liable for any loss or damage suffered by the client arising from fraud, misrepresentation, withholding of information material relevant to the report or required by RPS, or other default relating to such information, whether on the client's part or that of the other information sources, unless such fraud, misrepresentation, withholding or such other default is evident to RPS without further enquiry. It is expressly stated that no independent verification of any documents or information supplied by the client or others on behalf of the client has been made. The report shall be used for general information only.

Prepared by:

RPS

Dr Naomi Shannon
Principal Engineer - Water Environment and Flood Risk Management

Elmwood House
74 Boucher Road, Belfast
Co. Antrim BT12 6RZ

E naomi.shannon@rps.tetratech.com

Prepared for:

Dublin Port Company

Máiréad Rushe
Project Manager,
Programme Management Office

Port Centre, Alexandra Rd,
North Dock, Dublin, D01 H4C6,
Ireland

T +353 (0) 1 8876075

Contents

Tables

Figures

Appendices

1 THERMAL PLUME MODELLING VALIDATION

1.1 Purpose of this Report

A numerical modelling study is being undertaken to quantify the potential impact of the proposed Dublin Port 3FM development on the existing tidal flows and thermal stratification due to both freshwater river inflows and outfall discharges and intakes. Prior to assessing the potential impact of the 3FM development it was critical to first calibrate the thermal plume model based on the present-day scenario. To assist with this work package, ESB supplied three thermal plume survey reports to enable model verification and therefore increase confidence in the outcomes of the numerical modelling studies.

This report details phases of development, the most recent of which occurred in April 2024 following additional feedback from ESB, and the validation between the thermal plume modelling and surveys.

1.2 Model Structure

The modelling was undertaken using the DHI MIKE modelling software suite. The model was implemented using a three dimensional (3D) model domain and included density driven flow – both in terms of salinity and temperature. It was of particular importance to establish accurate tidal flows in Dublin Port given the complex interaction of multiple freshwater rivers that flow into Dublin Port which contributes to dynamic temporally and spatially varying pycnocline throughout much of the Port area. To achieve this, RPS developed two individual numerical models using the Hydrodynamic (HD) module within MIKE 21 to simulate water level variations and flows into Dublin Port, for each of the following timeframes to correspond with the survey periods:

- 10th August – 13th August 2016
- 19th April – 25th April 2018
- 5th April – 11th April 2019

The first "outer tidal" model was developed for the purpose of deriving a suitable tidal boundary condition to apply to the mode detailed "inner" model of Dublin Bay and Dublin Port. The "outer" model (shown in Figure 1.1) uses mesh sizes varying from 250,000 m^2 (equivalent to 500m x 500m squares) at the outer boundary of the model down to a finer 225 m^2 (equivalent to 15m x 15m squares). The outer tidal hydrodynamic model was run using boundary conditions extracted from RPS' in-house storm surge forecast model.

Figure 1.2 illustrates the second inner model bathymetry and Dublin Bay boundary and was developed with a finer mesh resolution in Dublin Port around the thermal plume and freshwater outfalls.

The rate of discharge from the rivers Liffey, Tolka and Dodder were initially defined as constant discharges based on the average rates summarised in Table 1.1. However, these rates were subsequently updated to utilise timeseries information as provided by ESB for the additional modelling described in Section 1.4.4.

Table 1.1: River Discharge Rates [cumecs]

	2016	2018	2019
Liffey	17.99	16.41	7.79
Dodder	0.76	2.17	2.40
Tolka	0.22	1.13	1.80

The background temperatures used in the model simulations are shown in Table 1.2 below, alongside the background temperatures measured.

Table 1.2: Background Temperature

	2016	2018	2019
Background Temperature	**°C**	**°C**	**°C**
2016 Survey	15.57 - 16.45		
2018 Survey Spring		9.2°C - 12.42	
2018 Survey Neap		9.28 – 10.81	
2019 Survey			8.6 – 9.6
RPS models	16.0	9.5	9.5

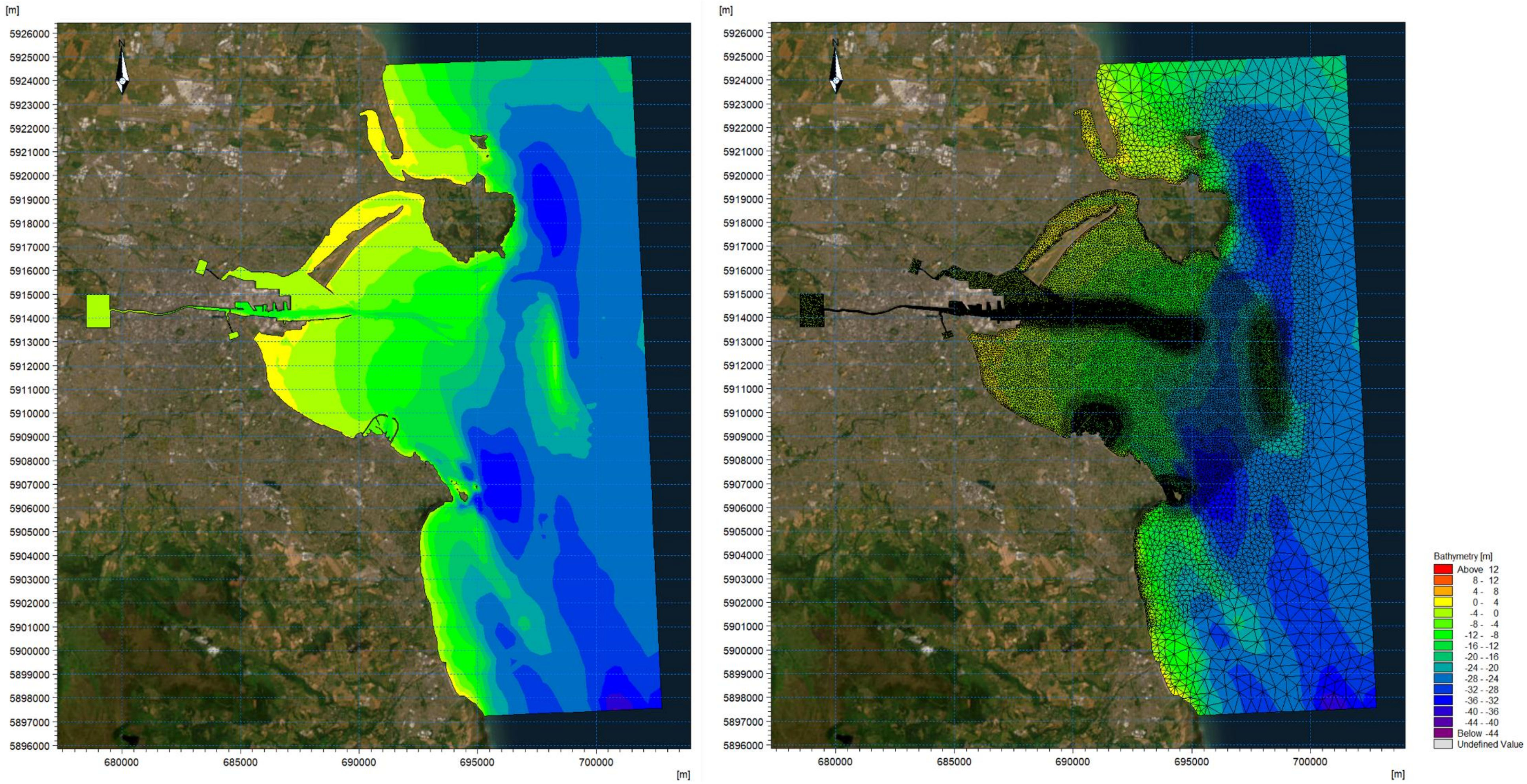


Figure 1.1: Outer model bathymetry and mesh (right).

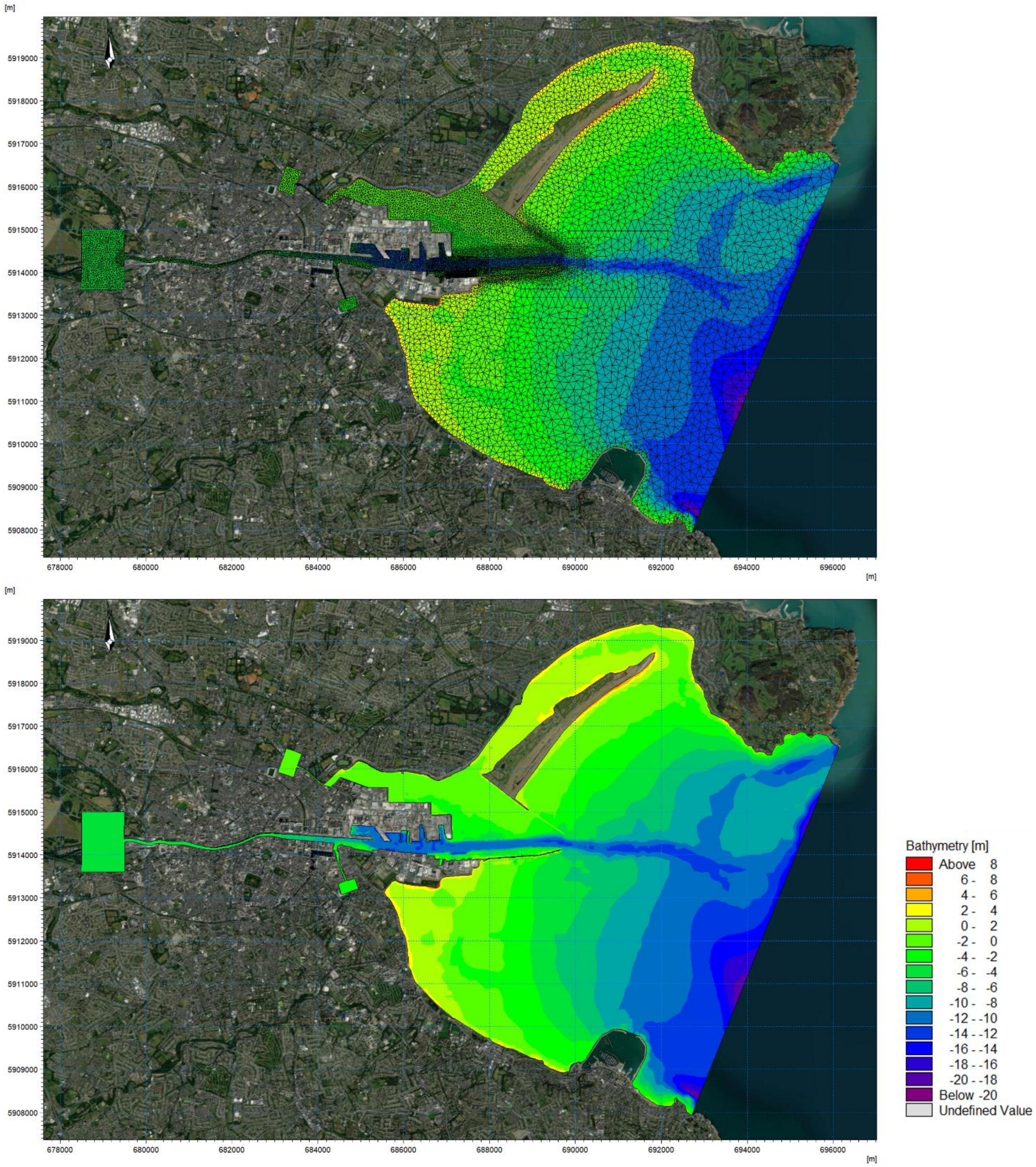


Figure 1.2: Inner model bathymetry and mesh (top).

1.3 Hydrodynamic Model Verification

No project specific Acoustic Doppler Current Profiler (ADCP) information for the survey periods described in Section 1.2 was made available for this study. RPS therefore validated the hydrodynamic accuracy of the models, described in the previous section, by comparing simulated surface elevations within Dublin Port with measured levels from the Dublin Port tidal gauge from the National Tide Gauge Network.

It should be noted that the hydrodynamic model had previously been calibrated and determined fit for purpose as part of the Alexandra Basin Re-development (ABR) and Masterplan 2 (MP2) projects using ADCP data for different periods. This calibration process was considered acceptable by Dublin Port Company, the Marine Institute and An Bord Pleanála. For the purposes of brevity, the extensive calibration process has not been repeated in this document which instead focuses on the thermal plume survey dates.

Figure 1.3 to Figure 1.5 represent the modelled tide levels (blue trace) plotted against the Dublin Port tide gauge levels (black trace) for each period with the survey periods being indicated in red. It can be seen that the surface elevations from the hydrodynamic model (HD) correlate well both in terms of tidal excursion and phase with the measured data. On occasion there is some deviation from the measured data, however this is likely to be as a result of temporally varying river flows and/or localised meteorological influences; as the wind recorded at Dublin airport was applied across the entire model extent and therefore forms a simplified wind field.

Notwithstanding this, the model was found to correspond with the recorded tidal elevations and particularly well on the day of each thermal plume survey that the model was verified against (indicated in red). It was therefore concluded that the numerical models developed for this study were fit for purpose.

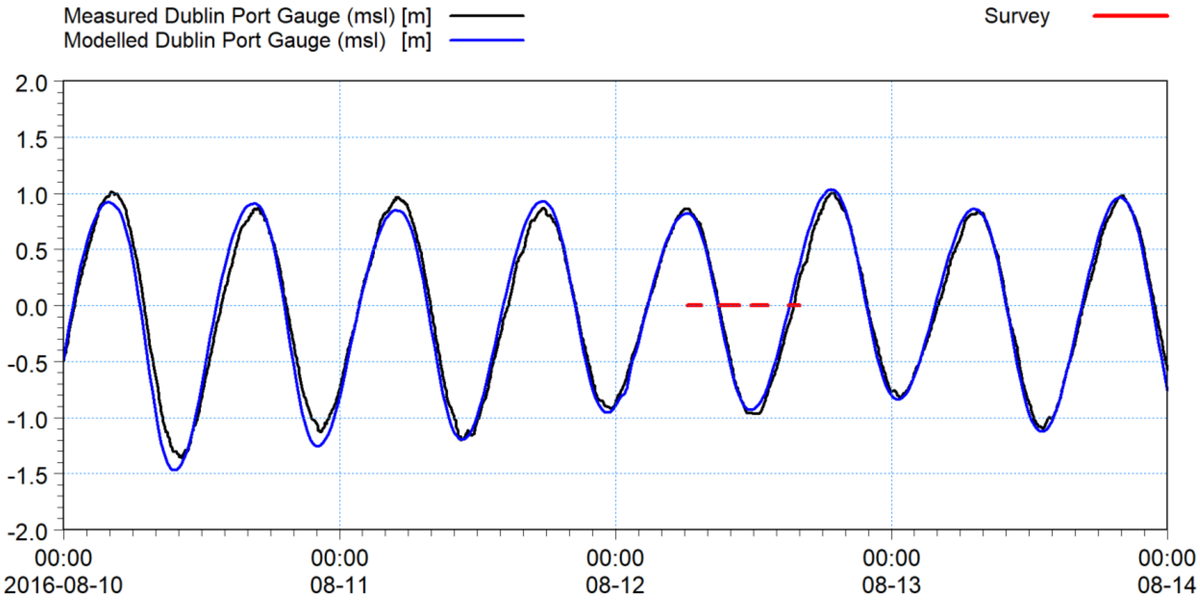


Figure 1.3: Verification of predicted tidal heights for the 2016 survey period.

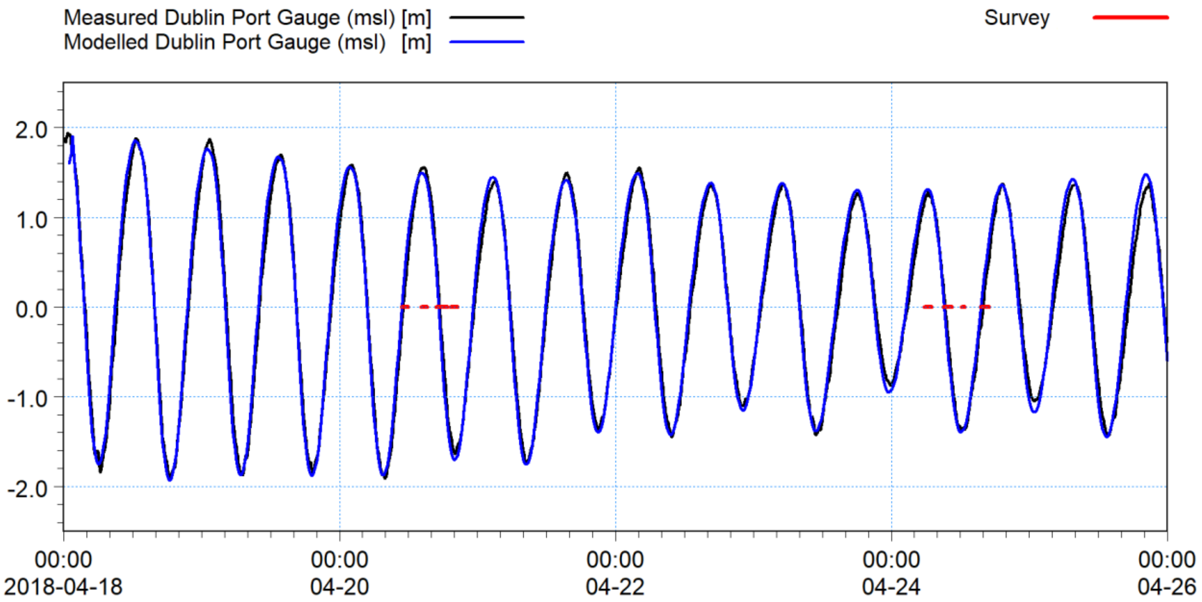


Figure 1.4: Verification of predicted tidal heights for the 2018 survey period.

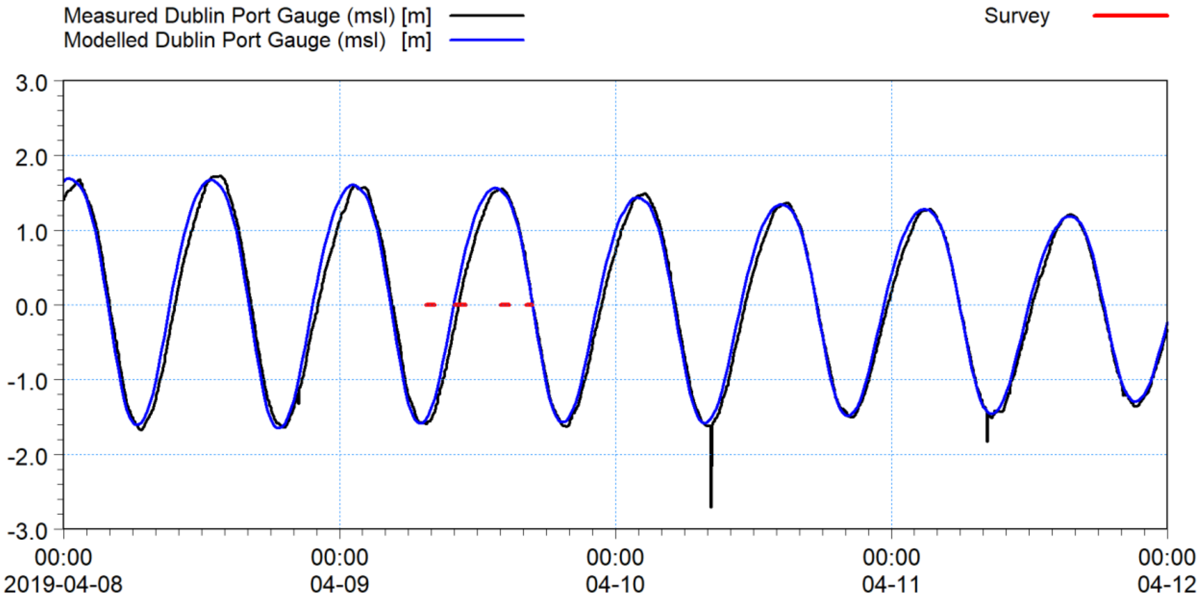


Figure 1.5: Verification of predicted tidal heights for the 2019 survey period.

1.4 Thermal Plume Modelling Results

This section of the document will examine the model performance relating to thermal plumes surveys presented in the following three reports:

- Survey reports:
    - ESB International (2017) Dublin Bay Power Plant: Thermal Plume Survey.
    - Irish Hydrodata (2018) Covanta Dublin Wate to Energy Facility: Thermal Plume Surveys of April 20th and 24th 2018.
    - Irish Hydrodata (2019) Poolbeg CCGT: Thermal Plume Survey of April 9th, 2019.

Figure 1.7 below shows the location of each facilities thermal/freshwater discharge and Table 1.3 outlines which facilities were actively discharging during each of the survey periods reported. The Dublin Bay Power Station, Dublin Waste to Energy and Poolbeg CCGT are all saline thermal discharges whilst Ringsend WWTP is a freshwater discharge. Time series data relating to flow rates and temperature for the various discharges during the survey periods was supplied by ESB and was utilised in the modelling[1].

There were two thermal discharges active during the 2016 survey: ESB's Dublin Bay Power facility and Irish Water's Waste Water Treatment Plant (WWTP). The full set of the final model output corresponding to the survey data is presented in Appendix A.

There were three facilities discharging during the 2018 survey times: ESB's Dublin Bay Power facility, Irish Water's WWTP and the Dublin Waste to Energy facility. The full set of the final model output corresponding to the survey data is presented in Appendix B. This includes both thermal contour plots and dip profiles collected during spring and neap surveys.

There were three facilities discharging during the 2019 survey times: Poolbeg CCGT, Irish Water's WWTP and the Dublin Waste to Energy facility. Appendix C presents final model output corresponding approximately to the survey contours, noting that the model layers will vary in depth from the surface depending on the bathymetry (still water depth) and tidal state (instantaneous water depth). It should also be noted that the plotting scale used in the figures corresponds with that implemented in the survey report (which varies from the preceding survey reports).

The model bathymetry was derived from a number of data sources which included survey data in the vicinity of the Poolbeg CCGT discharge. Bed levels are higher in this region and this area frequently dries out depending on phase of tide, as illustrated in Figure 1.6.

Figure 1.6: Drying out within the vicinity of Poolbeg CCGT outfall location.

---

[1] Limited measured flow data for the Rivers Liffey, Dodder and Tolka were also provided and used for relevant periods of simulations. The river discharge rates summarised in Table 1.1 were used for periods without specific data.

Figure 1.7: Thermal plume outfall locations.

Table 1.3: Thermal discharges active during each survey period.

	2016	2018	2019
WWTP	✓	✓	✓
Dublin Waste to Energy		✓	✓
Dublin Bay Power	✓	✓	
Poolbeg CCGT			✓

1.4.1 Initial Modelling

Modelling was undertaken for the three survey periods using the model discretisation as described in Section 1.2. The MIKE 3D modelling system utilises a layered vertical mesh to describe the flow and dispersion in the water column. Initial modelling was undertaken with six sigma layers of equal weighting, i.e. the water column was divided into six equal layers which depended on bed level and varied in depth as changes in water level due to tidal flow occurred. Figure 1.8 shows the location of section A-B which the sigma layers are presented in Figure 1.9 to illustrate the vertical mesh discretisation.

Varying wind data as recorded at Dublin Airport was applied to each model simulation presented in this report.

The initial modelling provided a good representation of the behaviour of the stratified flow as illustrated in the following figures. These figures present the modelled output in the surface layer for mid-flood tide, high water, mid-ebb tide and low water during the spring tide survey undertaken in April 2018. Each figure is accompanied by the corresponding survey contour plot for the surface layer. It should be noted that surveys were recoded to Greenwich Mean Time (GMT) whilst modelling was undertaken for Universal Time (UT) and, as the survey was undertaken during summer time, there is a one hour difference in the timing of records.

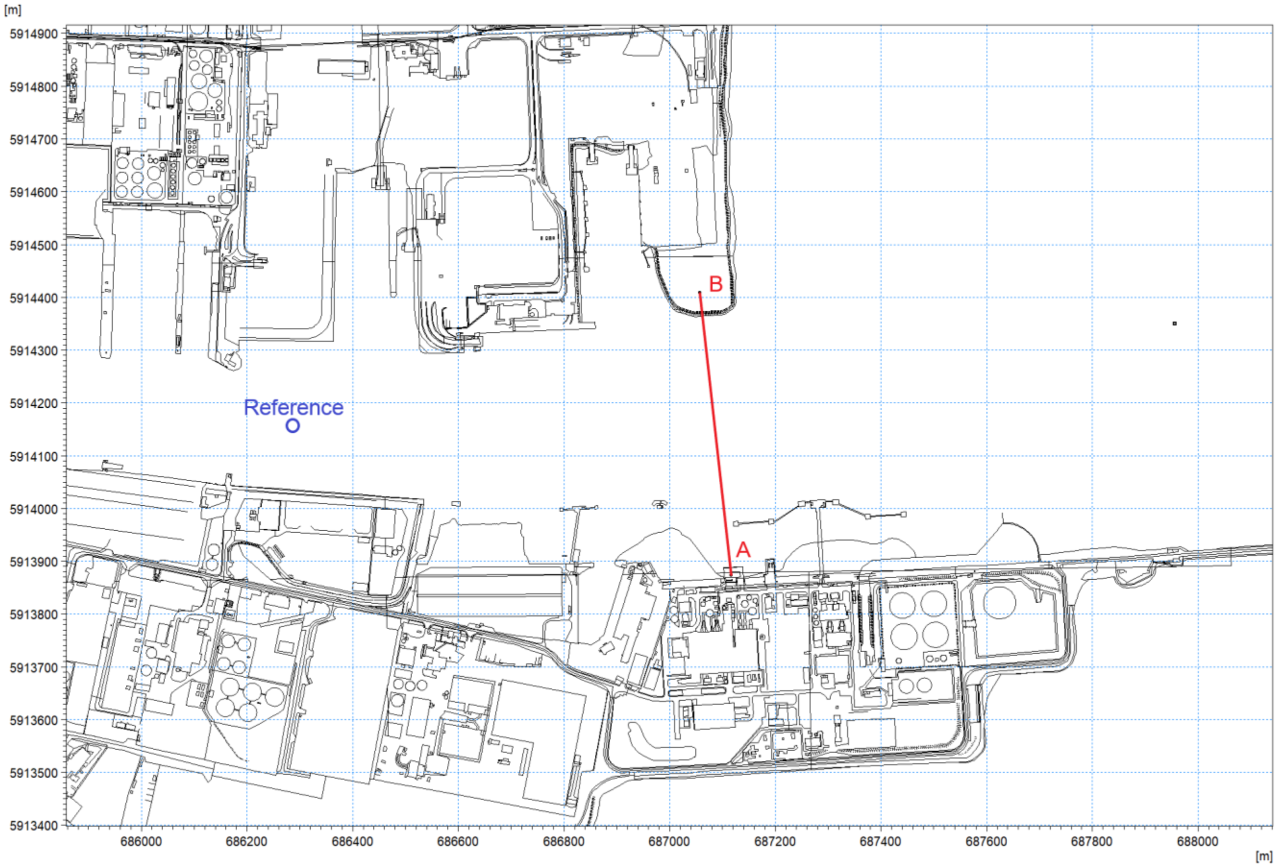


Figure 1.8: Location of section to illustrate sigma layer definition.

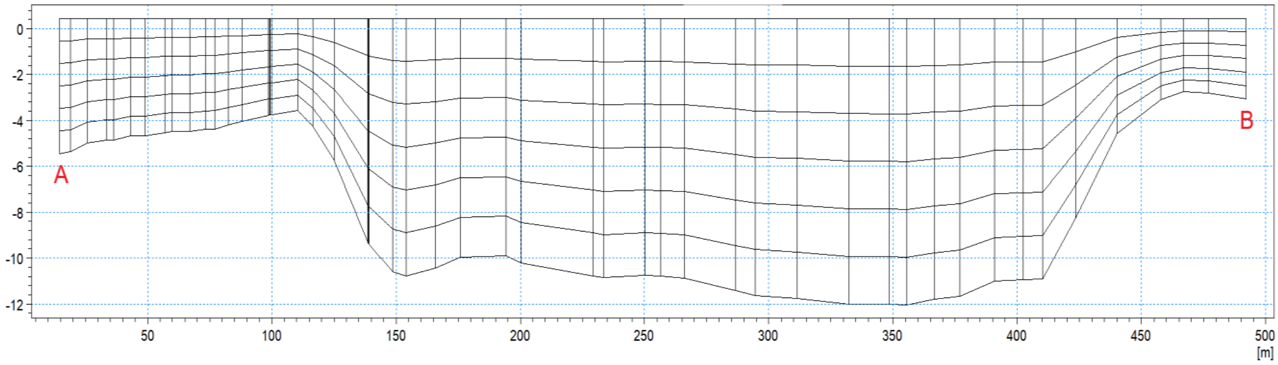


Figure 1.9: Initial thermal modelling equidistant sigma layers.

It was noted from the survey reports that there was a variation in the thermal characteristics of the plume across the top 2m surveyed water depth.

With the application of the equal sigma layers, when the plume is dispersed towards the deeper water in the navigation channel all survey layers effectively lie within one model layer therefore further discretisation was applied to the model domain to provide an improved approximation of plume behaviour.

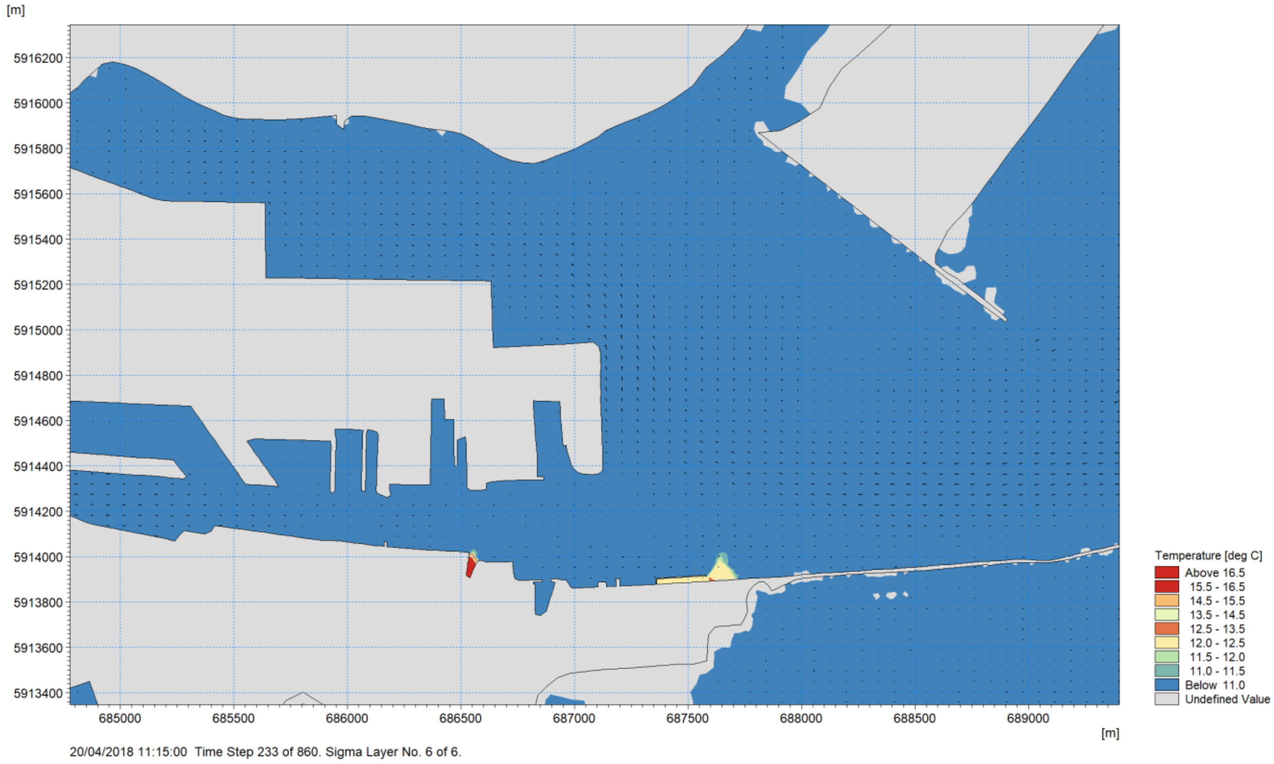


Figure 1.10: Preliminary model output: Temperature of surface layer mid-flood spring tide.

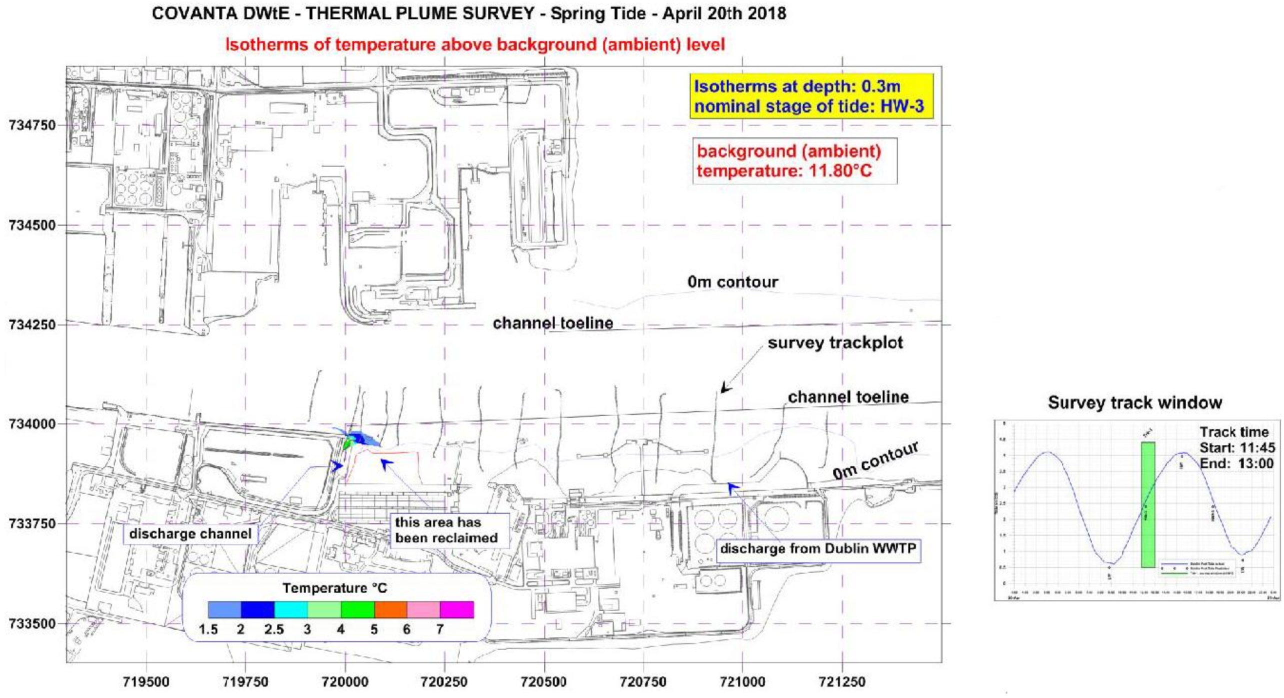


Figure 1.11: Survey contour: Excess temperature of surface layer mid-flood spring tide.

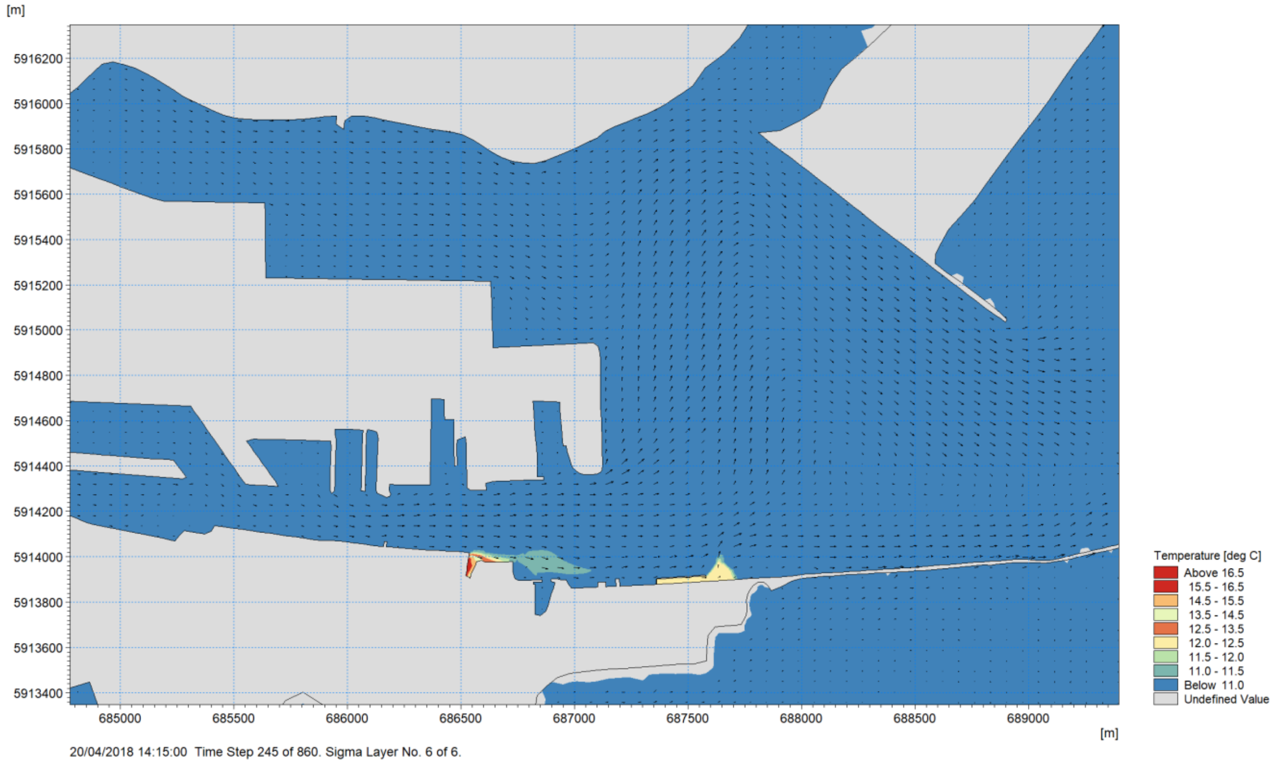


Figure 1.12: Preliminary model output: Temperature of surface layer high water spring tide.

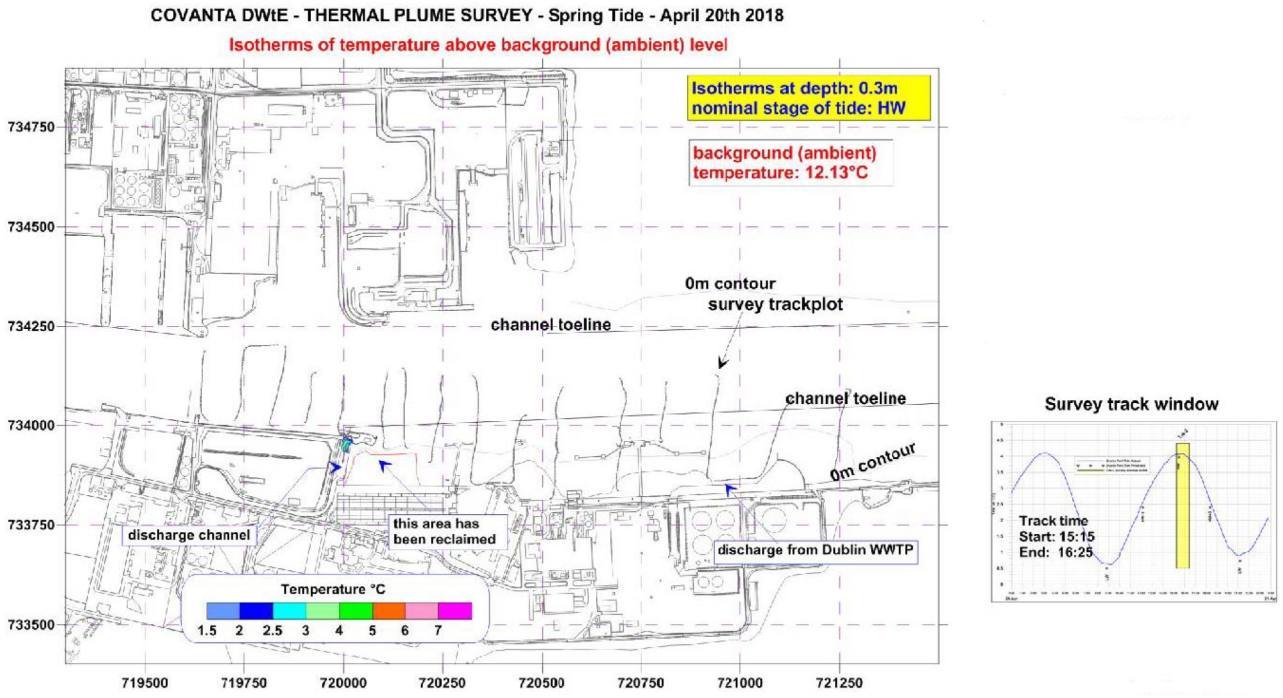


Figure 1.13: Survey contour: Excess temperature of surface layer high water spring tide.

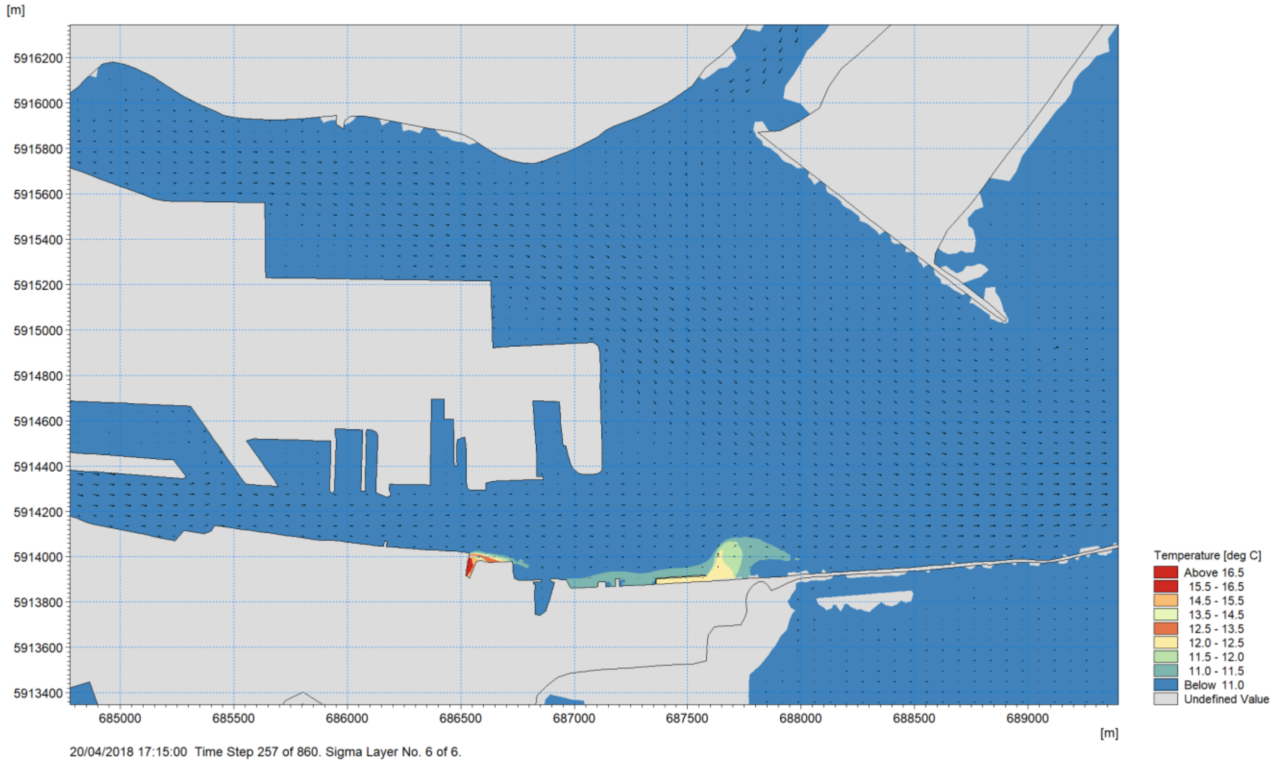


Figure 1.14: Preliminary model output: Temperature of surface layer mid-ebb spring tide.

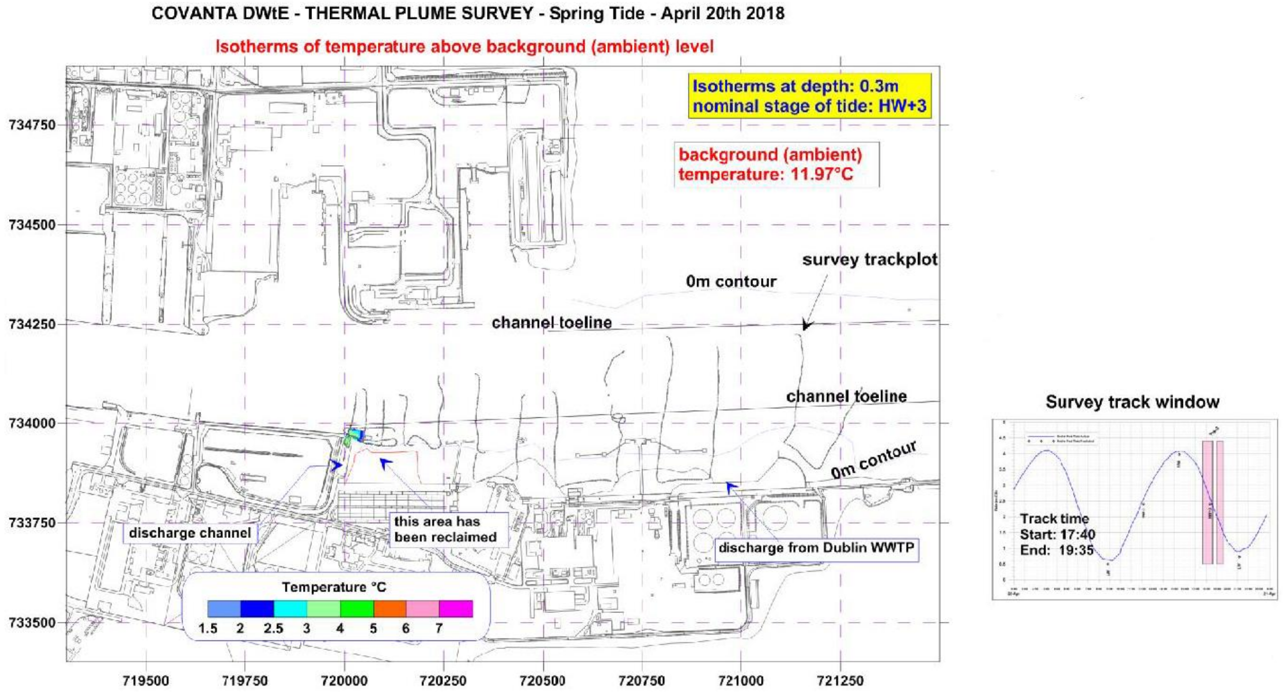


Figure 1.15: Survey contour: Excess temperature of surface layer mid-ebb spring tide.

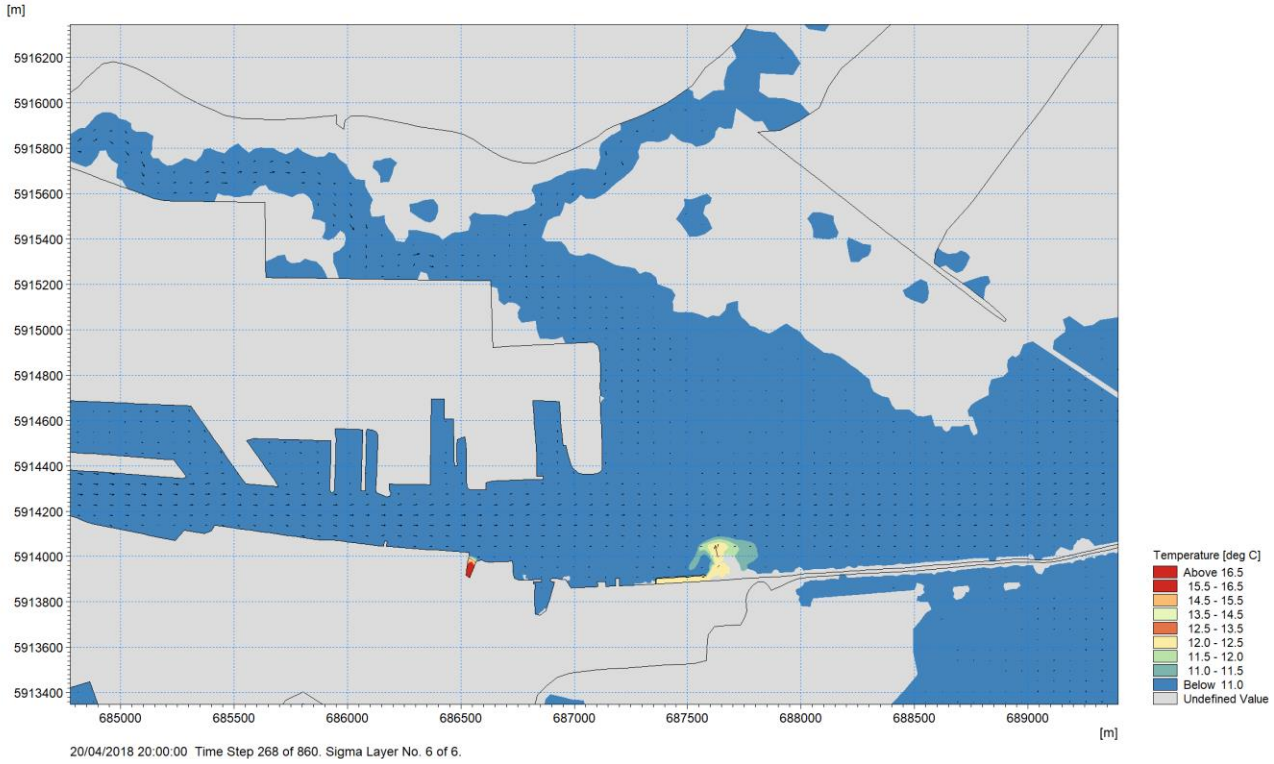


Figure 1.16: Preliminary model output: Temperature of surface layer low water spring tide.

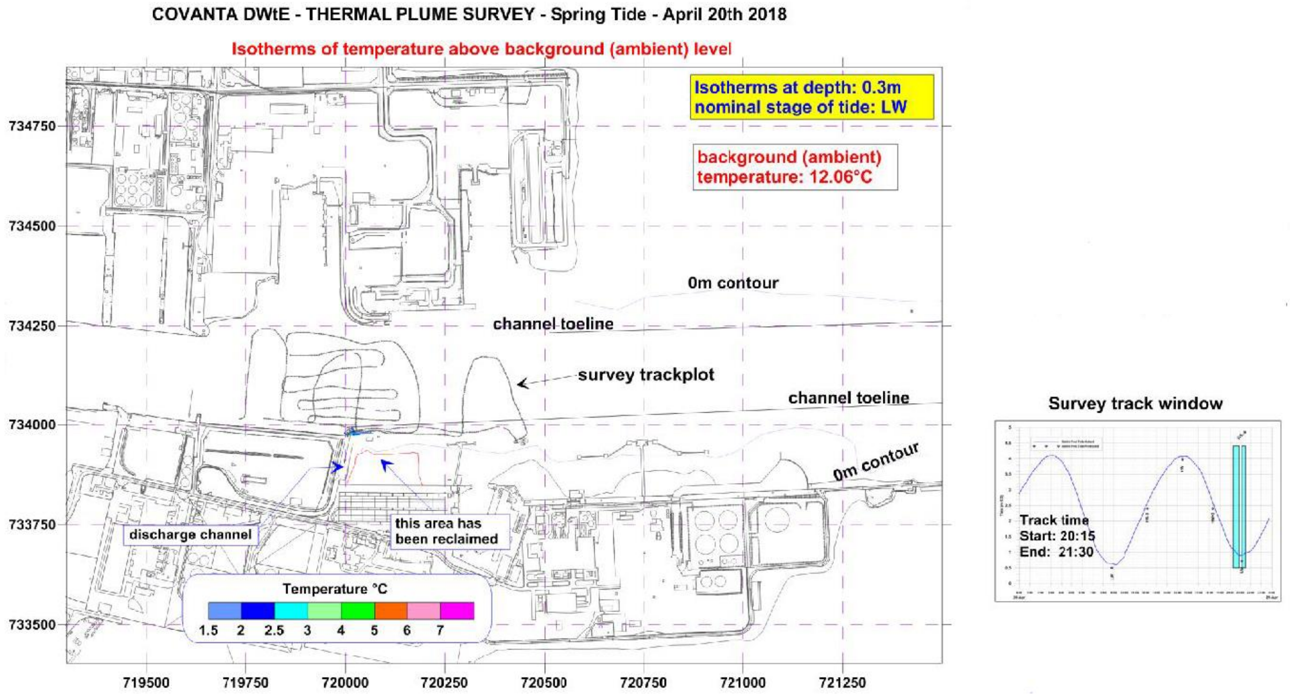


Figure 1.17: Survey contour: Excess temperature of surface layer low water spring tide.

1.4.2 Further Modelling

Having liaised with ESB regarding initial thermal plume modelling results, queries were raised regarding the ability of six equally spaced vertical layers being able to accurately resolve the vertical dispersion and stratifying effects observed within Dublin Port. To examine this, initial model simulations were further refined and updated to better represent density driven processes within Dublin Port.

The survey reports provided data typically at 0.3m, 1m and 2m levels from the surface so, although it was not possible to fix model layers relative to the water surface, the sigma layers were adjusted to provide information more comparable to that recorded. The same number of layers was implemented as in the preliminary modelling; however layers were concentrated near the surface.

As the discretisation determines the resolution of hydrodynamics as well as the thermal characteristics, the bed layer was maintained at the previous setting to preserve model accuracy in terms of flow and baseline stratification within the Liffey. As previously, the layer thicknesses varied through the tidal cycle but the proportions of the water column occupied by each layer remained consistent. Figure 1.18 illustrates the same channel cross-section, at the same stage of the tide, as shown in Figure 1.8 but with the revised sigma layer distribution (with the original equidistant vertical structure illustrated in Figure 1.9).

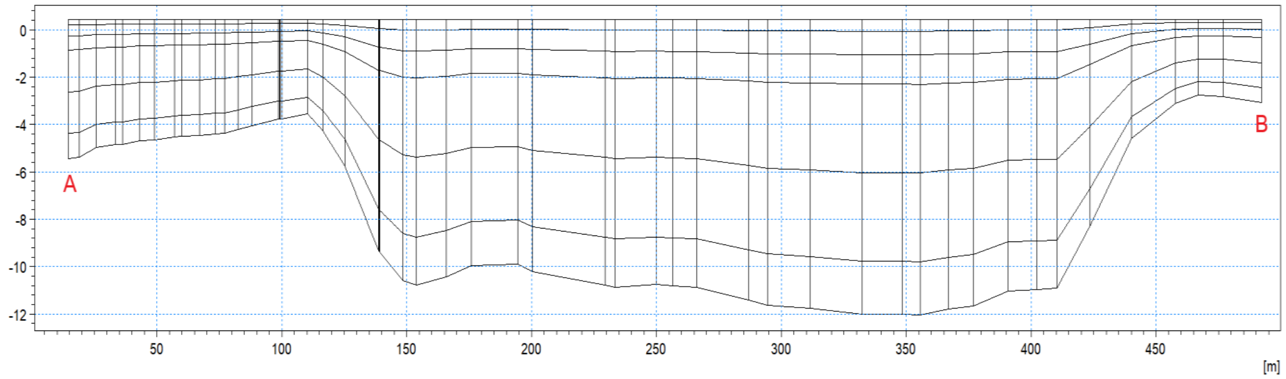


Figure 1.18: Further thermal modelling sigma layers variation through water column.

In order to verify the model against the survey data presented in the reports a similar data processing exercise was undertaken to the measured data. This had the benefit of taking some account of the variations in background temperature experienced in the receiving water which would not be replicated within the model without detailed information on both sea and river temperatures and salinities in the period prior to and during the survey.

As temperature is not a neutral tracer, a reference temperature profile was extracted from the model at the location indicated in Figure 1.8 (a similar location to the survey dip sections in the 2016 and 2018 surveys) at the timestep immediately prior to each individual survey period. The resulting model data was then adjusted to provide ‘excess temperature’ i.e. that above the background reference value. As with the measured data, this was undertaken for each survey pass for each stage of the tide. The data was then plotted for layer six (surface), five and typically four which corresponded most closely to the surveyed levels. The figures use the same output area, colour palette and mapping data for ease of comparison as only the reported data was available.

When making comparisons between the modelled and measured datasets it is recognised that survey data supplied to RPS is limited to survey trackplots owing to constraints associated with working within a busy port area and in some cases surveys were undertaken over prolonged periods (up to 1.5 hours). It is therefore important to acknowledge that the instantaneous nature of the model output means that model outputs will may not *fully* correspond with the extent of the survey. This is particularly evident during slack water surveys where underlying flow conditions are in a state of fluctuation and those where thermal plumes may be disrupted by marine traffic which is not reflected in the models. Where plumes are concentrated in shallower areas the model layer most representative of the survey level at the location of the plume is presented; this is particularly significant during low water.

1.4.2.1 2016 Survey Report

The thermal plume survey for the ESB (2017) Report, was conducted on 12th August 2016 to measure the thermal discharge from the Dublin Bay Power facility, during a neap tide and during the following tide conditions:

- High water
- Mid-Ebb (high water plus 3 hours)
- Low water
- Mid-Flood (high water minus 3 hours)

The survey was conducted during neap tides as they are considered a worst-case scenario in terms of thermal plumes as spring tides would provide greater dispersion potential. The survey track for each tidal condition lasted between 60 and 100 minutes, with the thermistor string attached at three fixed depths (0.3m, 1.0m and 2.0m). Background temperature levels were measured upstream of the plume prior to each track commencing and ranged from 15.57°C to 16.45°C.

There were two thermal discharges active during this survey: ESB's Dublin Bay Power facility and Irish Water's Waste Water Treatment Plant (WWTP).

1.4.2.2 2018 Survey Report

Irish Hydrodata Ltd. conducted a thermal plume survey for Covanta Dublin Waste to Energy on the 20th April 2018 during a spring tide and on the 24th April 2018 during a neap tide, at the following four phases of the tide:

- Low water
- Mid-Flood (high water minus 3 hours)
- High water
- Mid-Ebb (high water plus 3 hours)

There were three facilities discharging during these survey times: ESB's Dublin Bay Power facility, Irish Water's WWTP and the Dublin Waste to Energy facility. Three thermistors were attached 0.3m, 1.0m and 2.0m and one track run for each tidal condition which lasted between 70 and 115 minutes. Background temperature levels were measured upstream of the plume prior to each track commencing and ranged from 9.2°C to 12.42°C. The survey report included both thermal contour plots and dip profiles collected during spring and neap surveys.

1.4.2.3 2019 Survey Report

Irish Hydrodata Ltd. conducted a thermal plume survey for ESB Generation and Wholesale Markets (ESB GWM) of the Poolbeg Combined Cycle Gas Turbine (CCGT) power station, on the 9th of April 2019 over the following four stages of a single tidal cycle:

- Low water
- Mid-Flood (high water minus 3 hours)
- High water
- Mid-Ebb (high water plus 3 hours)

Three facilities were discharging during these survey times: Poolbeg CCGT, Irish Water's WWTP and the Dublin Waste to Energy facility. Four thermistors were used at depths of 0.3m, 0.6m, 0.9m, 1.2m and 1.8m, one track run for each tidal condition which lasted between 30 and 60 minutes. The background temperature levels measured ranged from 8.6°C to 9.6°C.

Appendix C presents model output corresponding approximately to the 0.3m, 0.9m and 1.8m survey contours, again noting that the model layers will vary in depth from the surface depending on the bathymetry (still water depth) and tidal state (instantaneous water depth). It should also be noted that the plotting scale used in the figures corresponds with that implemented in the survey report (which varies from the preceding survey reports).

1.4.3 Thermal Plume Modelling Discussion

Over the course of the three surveys a significant volume of data was collected and reproduction of the survey reports *en masse* would not be conducive to clear assessment as the datasets were only available as an electronic document of limited resolution therefore a sample of the model output is discussed here. The appendices of this document may be compared with those relating to the three survey report documents.

It was noted that the use of the shallow surface sigma layer was beneficial in identifying where, even though the thermal discharges are buoyant due to temperature, they do not necessarily dominate the surface layer. This is particularly relevant with regards to the Dublin Bay Waste to Energy and Power Station discharge; where the saline thermal discharge from cooling is discharged into a stratified flow where freshwater river discharges are present. Freshwater being significantly less dense than saline water, even with an increased temperature than the receiving water body. Therefore the freshwater discharge from Ringsend WWTP may exhibit different characteristics to those from the saline cooling water discharges.

The following series of figures are presented for the thermal plume survey undertaken for the spring tide during April 2018. For each tidal stage two pairs of plots are presented; first, the modelled surface and near surface layers which approximately correspond with the 0.3m and 1m survey are presented, the corresponding survey contours are presented in the second pair of plots.

It can be seen in each case that the thermal plume from the Dublin Bay Waste to Energy and Power Station is more extensive below the initial surface layer. Whereas for the WWTP, as the discharge is a freshwater source, it exhibits a greater plume extent on the surface layer. It also appears that the excess temperatures >1.5°C from the WWTP do not fall within the survey tracks.

Figure 1.19: Thermal plume 20th April 2018 – excess temperature at mid-flood circa 0.3m depth.

Figure 1.20: Thermal plume 20th April 2018 – excess temperature at mid-flood circa 1m depth.

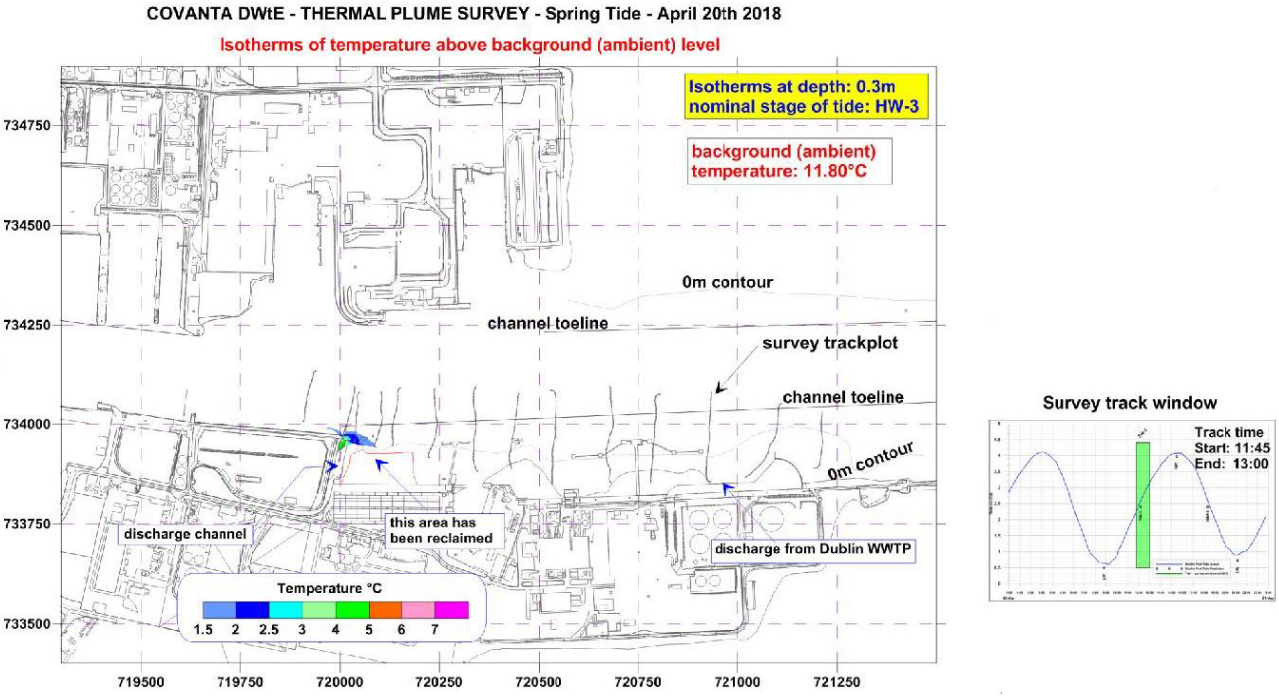


Figure 1.21: Survey contour 20th April 2018 – excess temperature at mid-flood 0.3m depth.

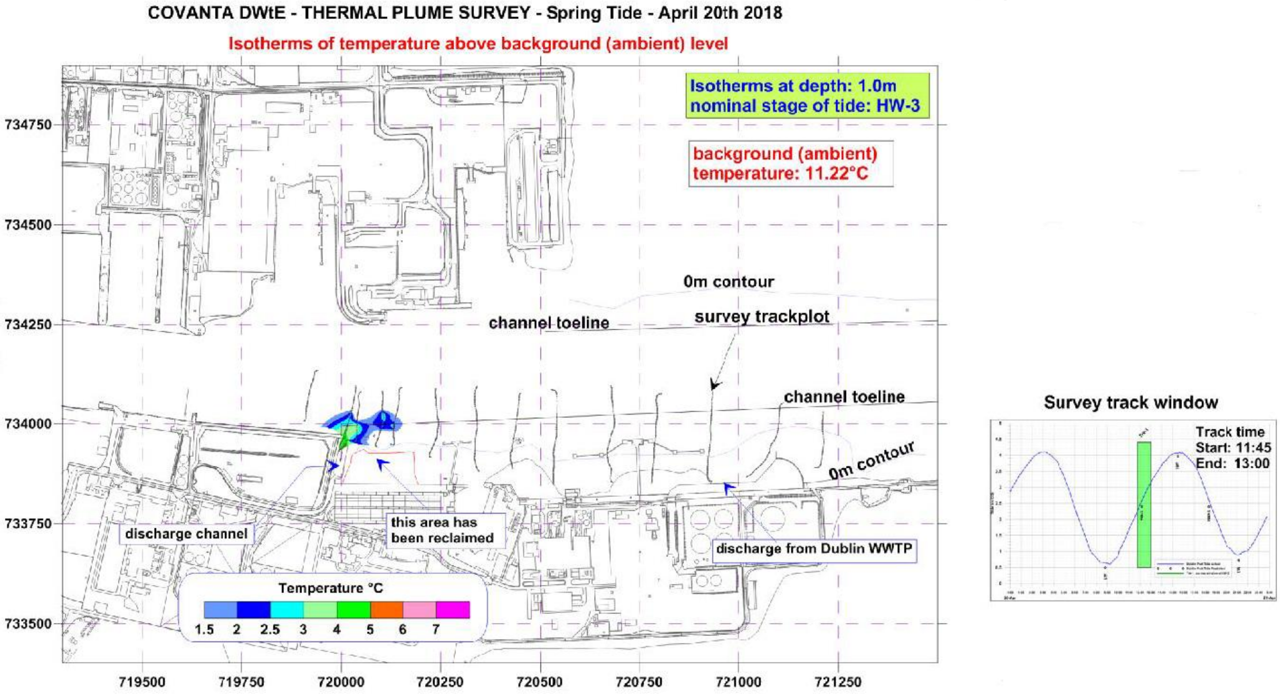


Figure 1.22: Survey contour 20th April 2018 – excess temperature at mid-flood 1m depth.

Figure 1.23: Thermal plume 20th April 2018 – excess temperature at high water circa 0.3m depth.

Figure 1.24: Thermal plume 20th April 2018 – excess temperature at high water circa 1m depth.

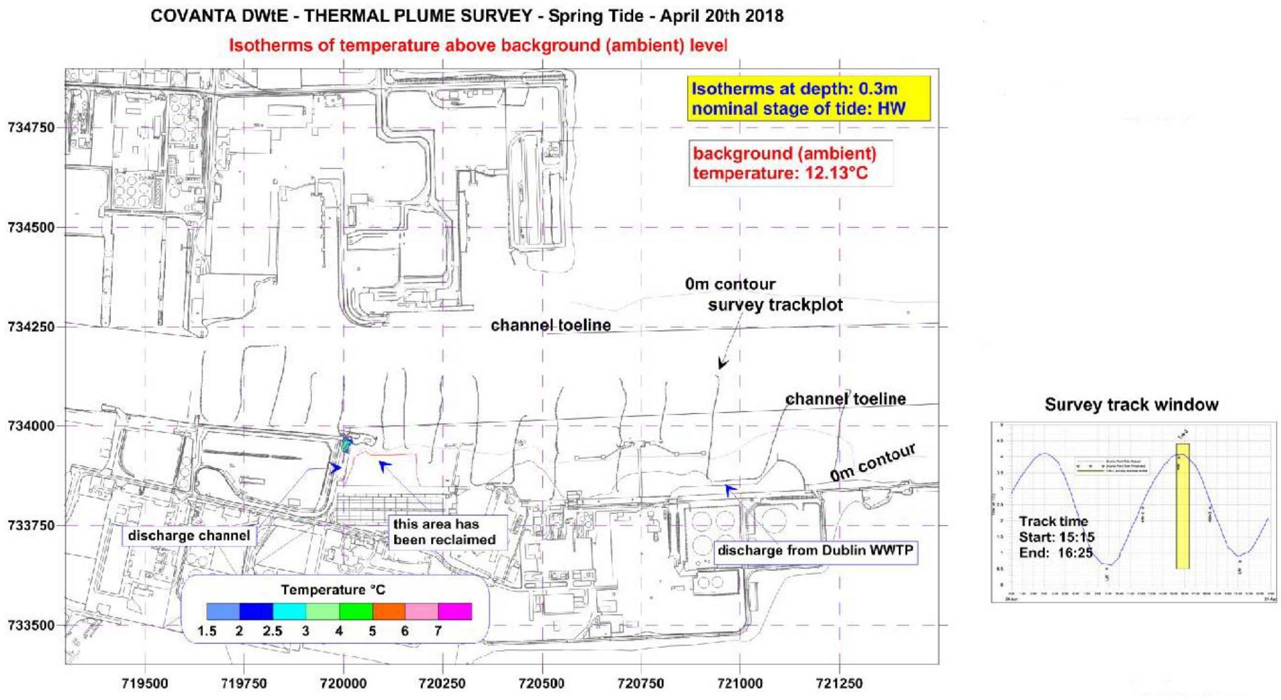


Figure 1.25: Survey contour 20th April 2018 – excess temperature at high water 0.3m depth.

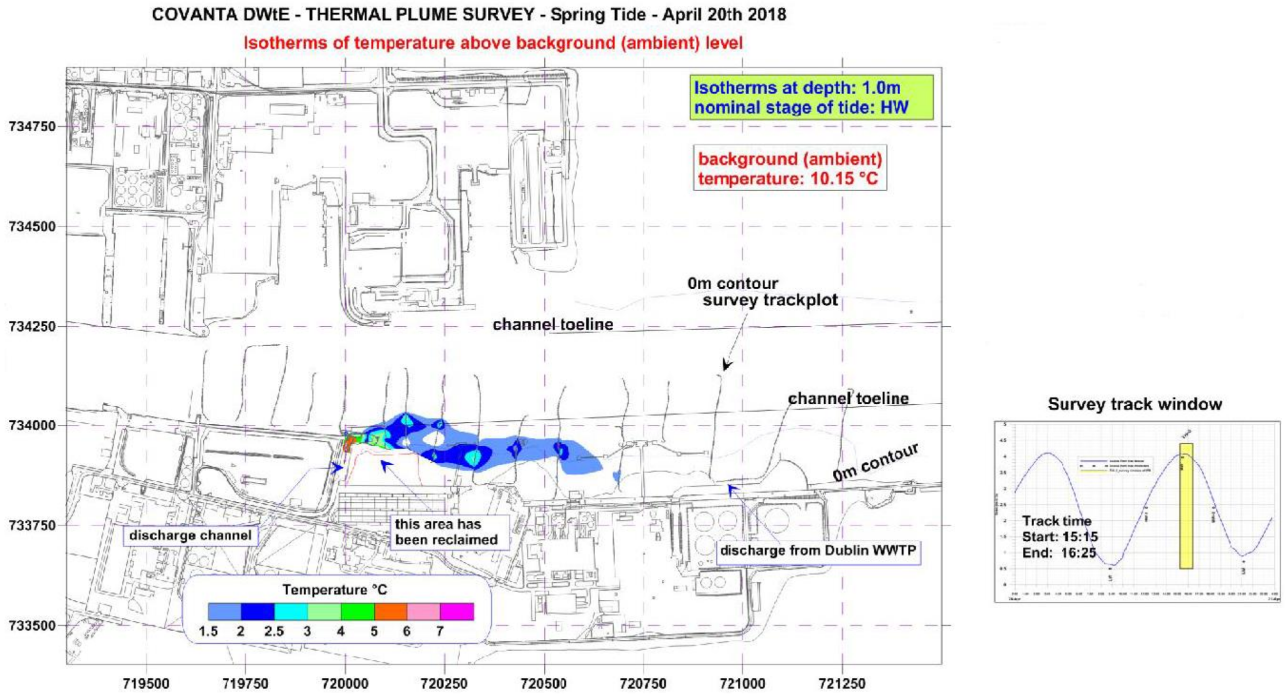


Figure 1.26: Survey contour 20th April 2018 – excess temperature at high water 1m depth.

Figure 1.27: Thermal plume 20th April 2018 – excess temperature at mid-ebb circa 0.3m depth.

Figure 1.28: Thermal plume 20th April 2018 – excess temperature at mid-ebb circa 1m depth.

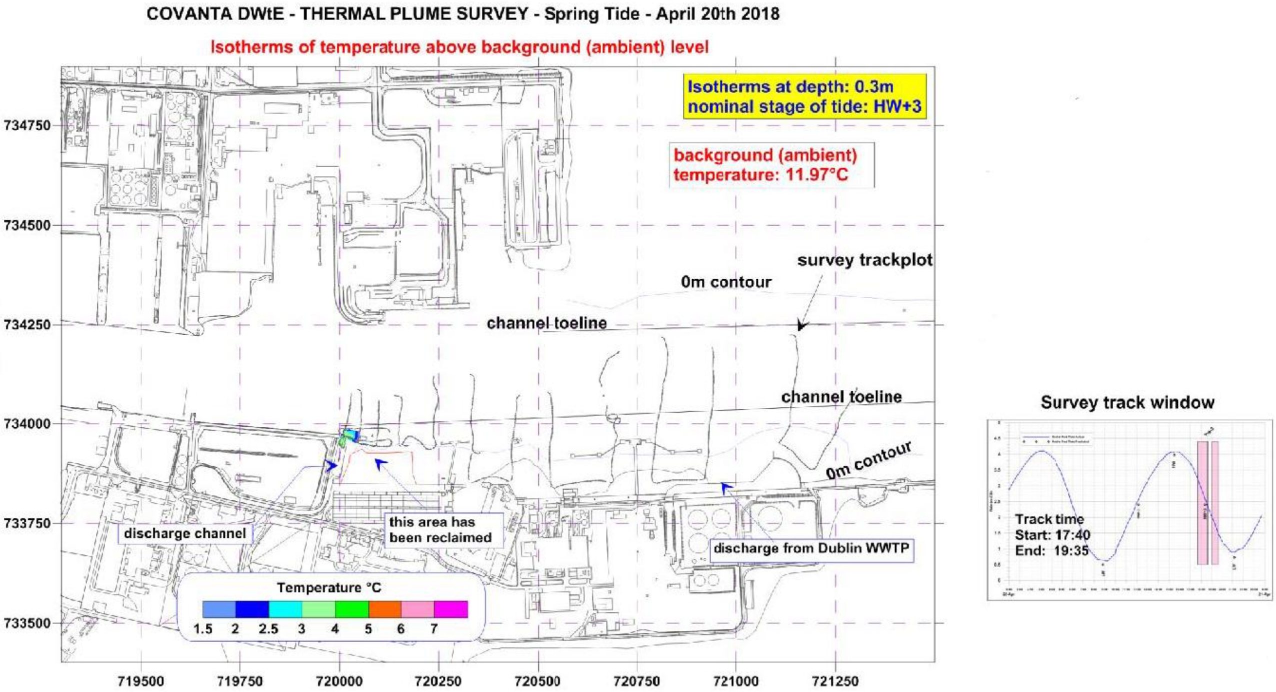


Figure 1.29: Survey contour 20th April 2018 – excess temperature at mid-ebb 0.3m depth.

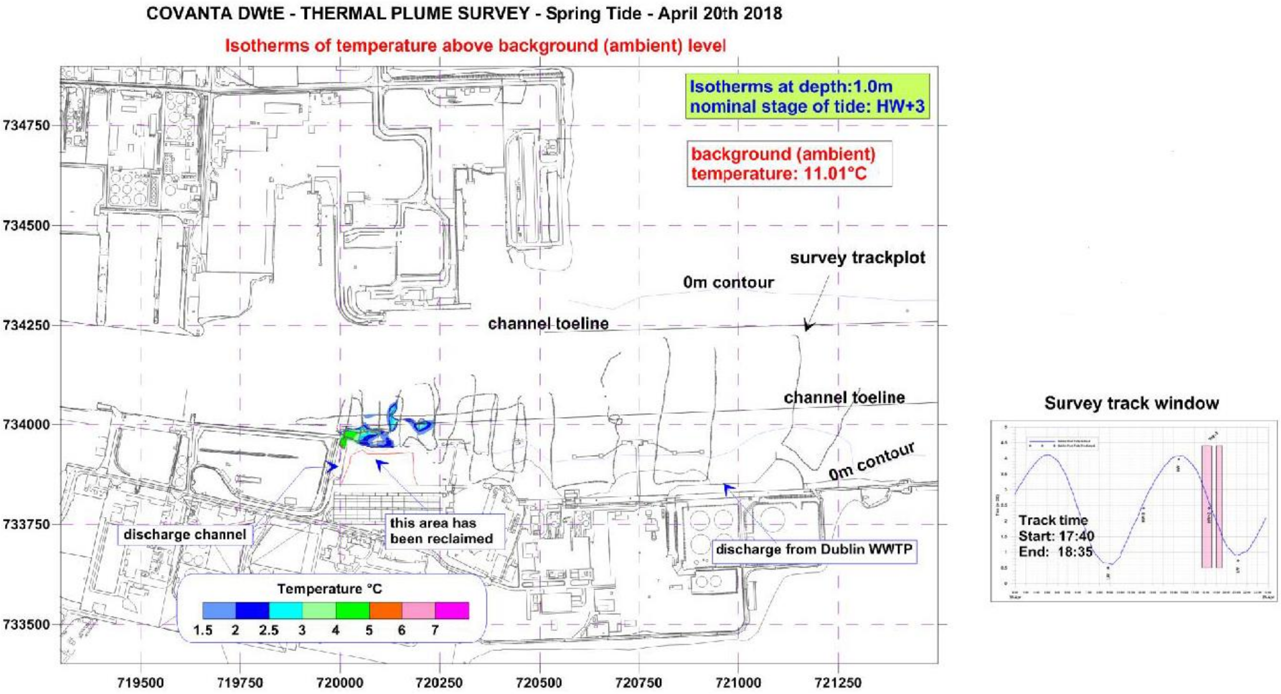


Figure 1.30: Survey contour 20th April 2018 – excess temperature at mid-ebb 1m depth.

Figure 1.31: Thermal plume 20th April 2018 – excess temperature at low water circa 0.3m depth.

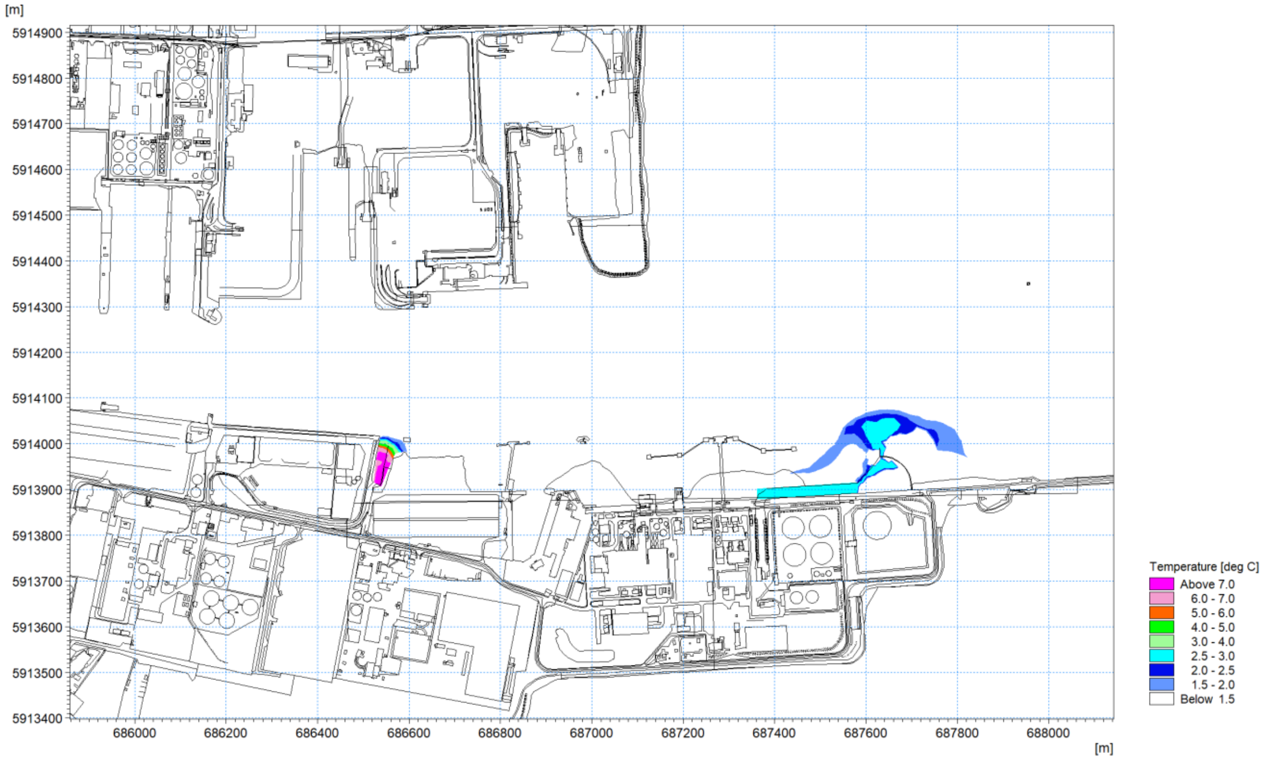


Figure 1.32: Thermal plume 20th April 2018 – excess temperature at low water circa 1m depth.

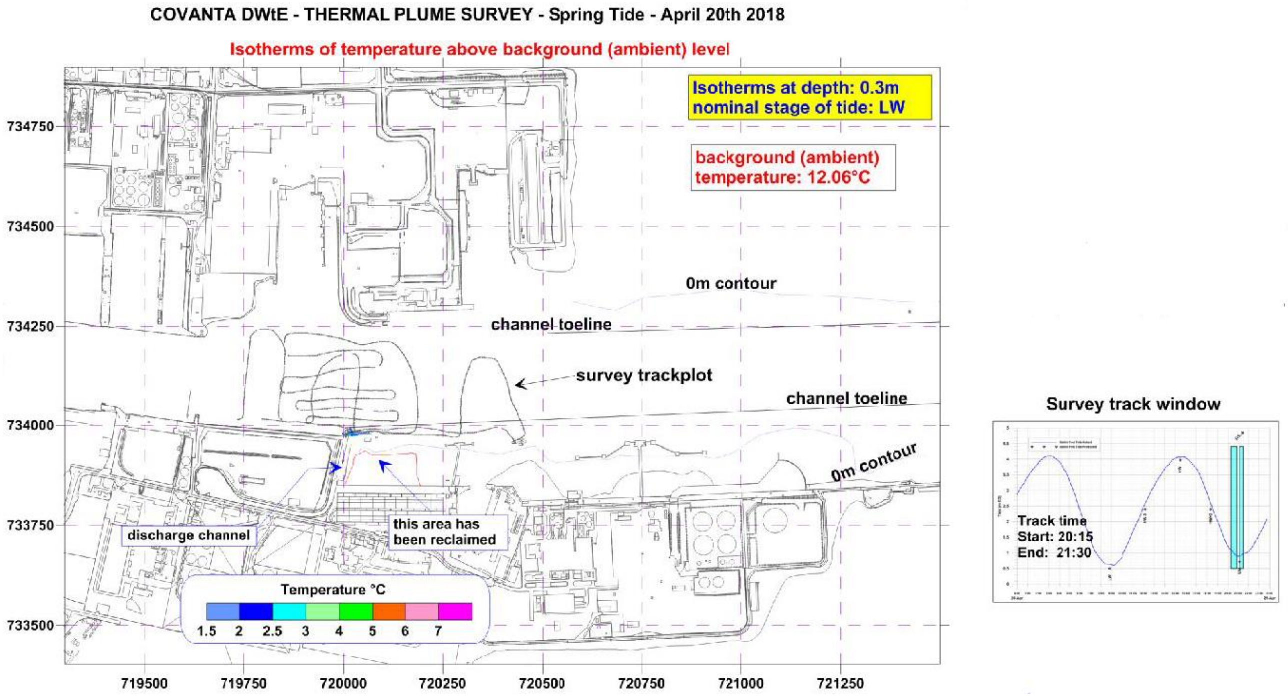


Figure 1.33: Survey contour 20th April 2018 – excess temperature at low water 0.3m depth.

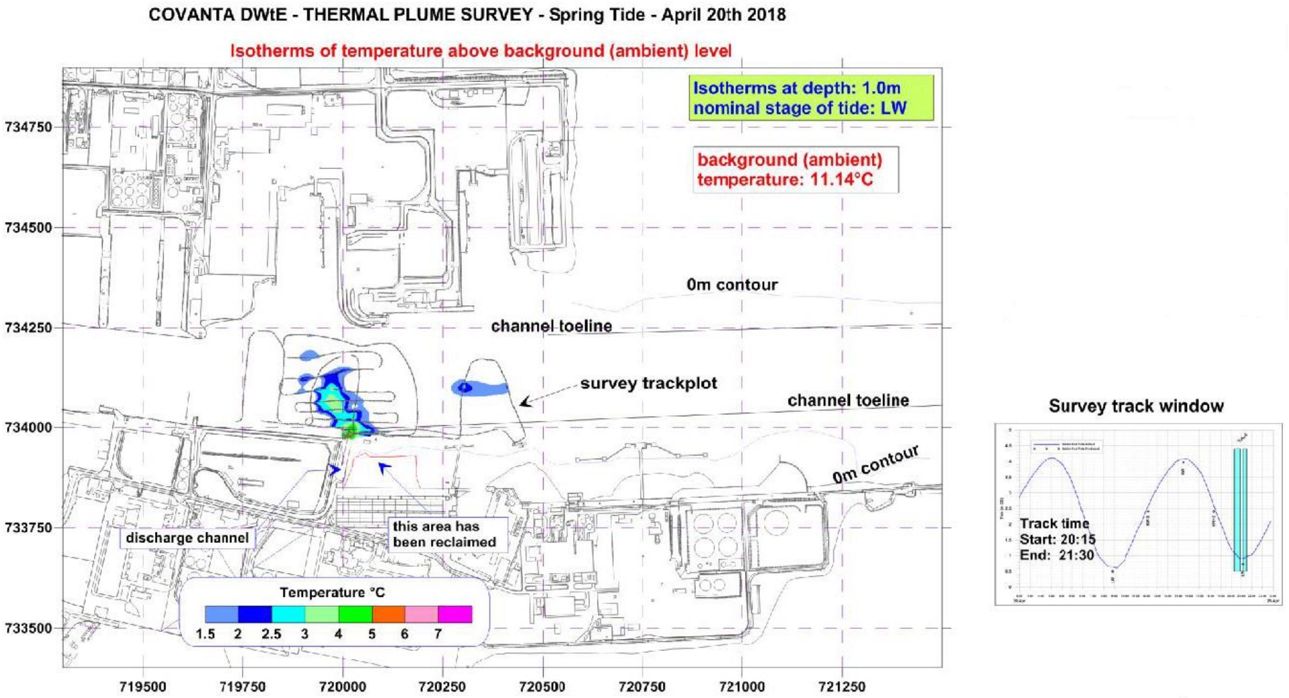


Figure 1.34: Survey contour 20th April 2018 – excess temperature at low water 1m depth.

In addition to the plume dispersion which is driven by a temperature differential there are also more complex flows driven by density stratification. An example of this is demonstrated during the thermal plume survey undertaken during the neap tide during April 2018. During the flood tide, when tidal flow occurs in a westerly direction the thermal plume from the Dublin Waste to Energy and Power Station is seen to be advected to the east at the surface with a much less marked dispersion pattern at lower levels, as illustrated in Figure 1.35 to Figure 1.37. It is noted however that during this period there was heavy traffic which may have influenced the survey (a process which would not have been represented in the numerical simulations).

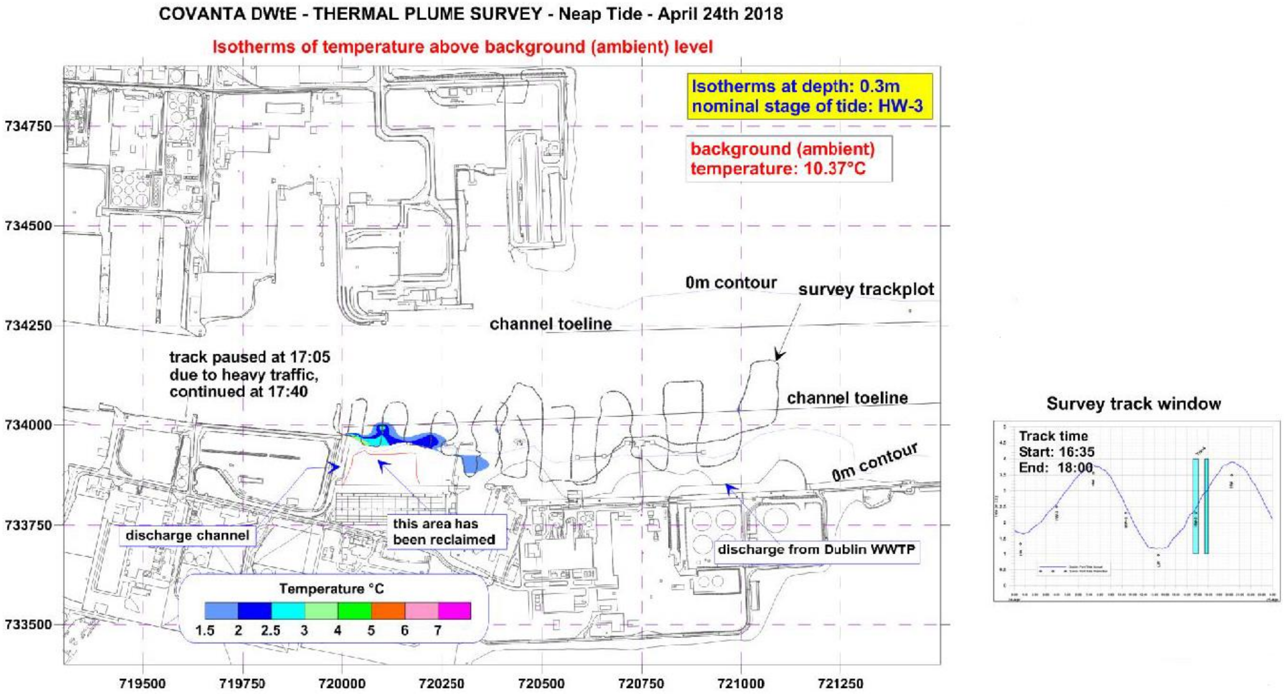


Figure 1.35: Survey contour 24th April 2018 – excess temperature at mid-flood 0.3m depth.

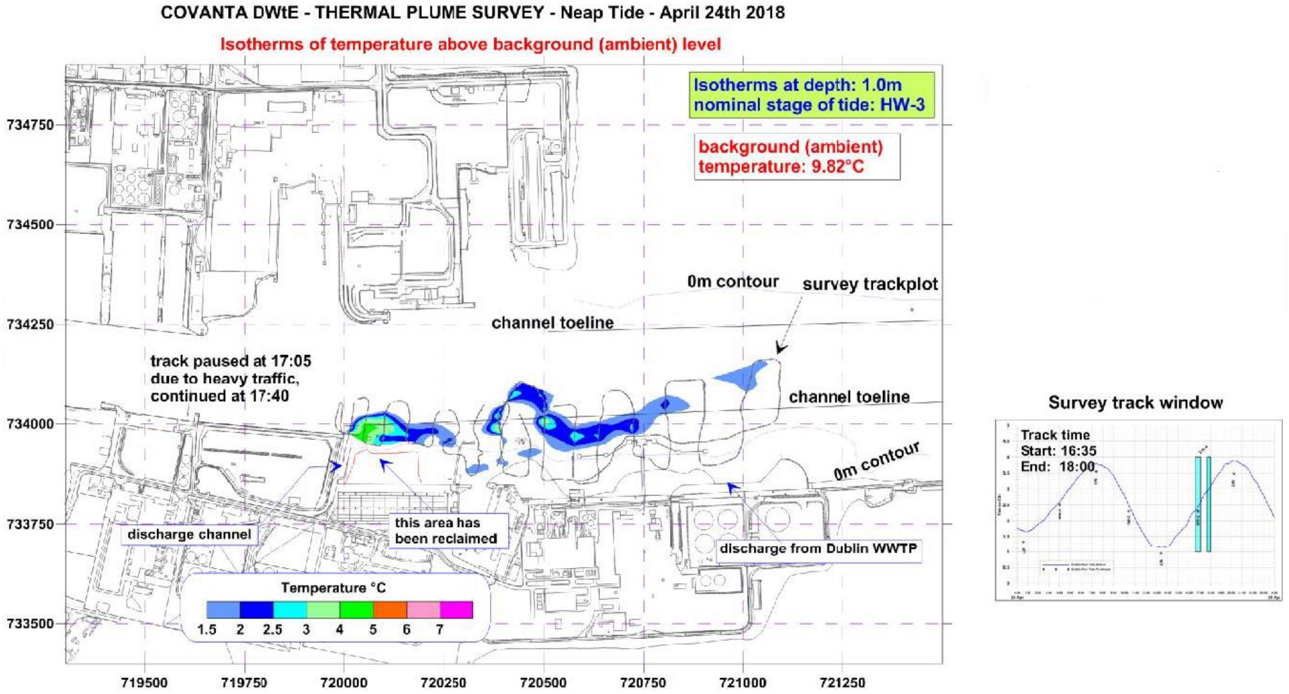


Figure 1.36: Survey contour 24th April 2018 – excess temperature at mid-flood 1m depth.

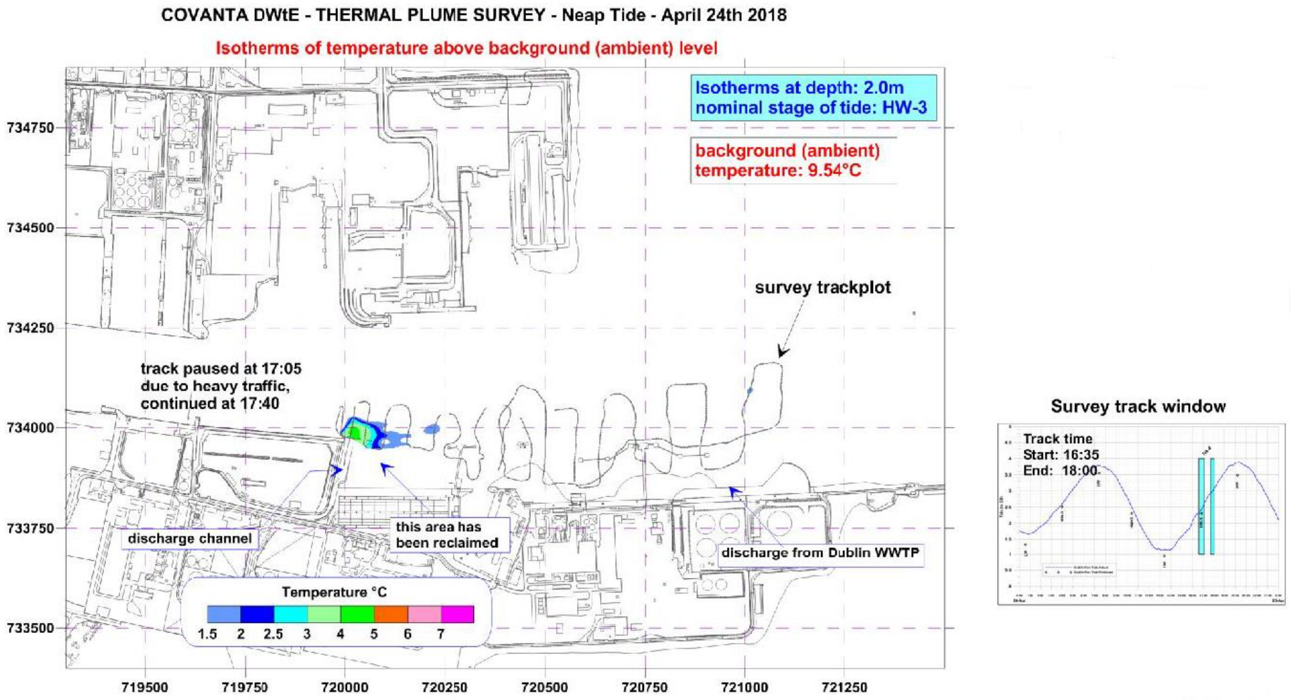


Figure 1.37: Survey contour 24th April 2018 – excess temperature at mid-flood 2m depth.

The numerical model for the same period also demonstrates the stratified flow. The following figures illustrate the thermal plumes with the flow vectors superimposed. Figure 1.38 and Figure 1.39 show the surface and near surface model output respectively. These are characterised by with flow vectors to the east with a larger plume extent below the surface. Whilst Figure 1.40 shows the lower layer with tidal flow entering from the east advecting the plume.

Figure 1.38: Thermal plume 24th April 2018 – excess temperature at mid-flood circa 0.3m depth.

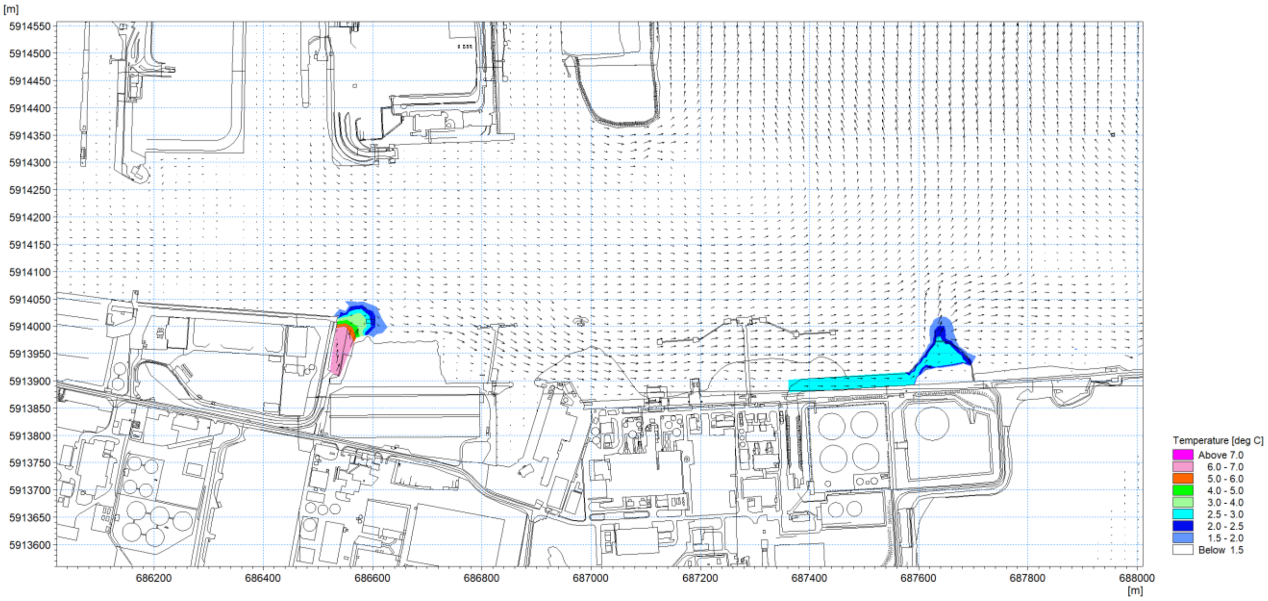


Figure 1.39: Thermal plume 24th April 2018 – excess temperature at mid-flood circa 1m depth.

Figure 1.40: Thermal plume 20th April 2018 – excess temperature at low water circa 2m depth.

In addition to the thermal plume plan surveys, which were undertaken at fixed depths to determine the thermal contours during the 2018 Dublin Waste to Energy surveys, a series of dip surveys were undertaken to prepare vertical profiles. These extended from within the outfall discharge canal and across the river channel as illustrated in Figure 1.41. This exercise was carried out during both spring and neap surveys. The comparison between the surveyed and modelled profiles during the neap survey are presented here.

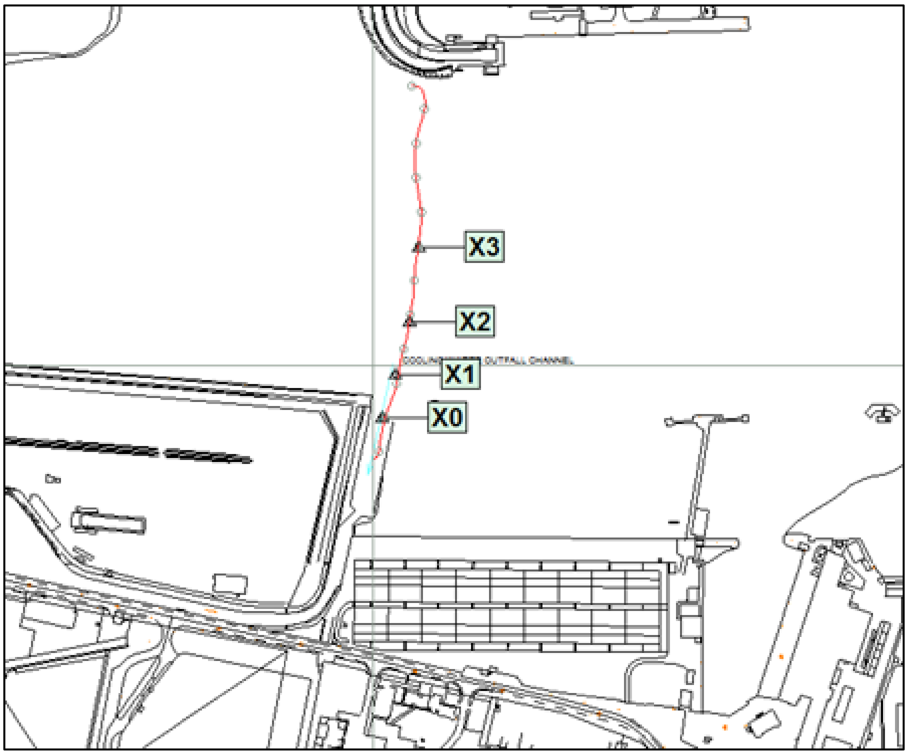


Figure 1.41: Approximate Locations of Vertical Dips

During the neap survey in April 2018 a series of four vertical profiles were taken. These occurred shortly following high water, during ebb tide, shortly following low water and during the flood tide. It was noted that the extraction of the dip profiles is sensitive both in terms of alignment and timing when undertaken near slack water and only an approximate overarching location was provided. The following figures present the surveyed profile followed by the equivalent profile from the modelled data. i.e. at the same approximate location, time and using the same contour palette, for each of the four tidal states.

Figure 1.42 and Figure 1.43 show the measured and modelled profiles shortly following high water. The form of the modelled data correlates with the measured data however it is apparent that a greater amount of mixing may have occurred within the discharge canal as the model bed levels differ from those in the survey plot in this area. This can be attributed to a lack of detailed bathymetric data in this localised area.

During the ebb tide approaching low water the plume is somewhat truncated in the model data indicating that the alignment of the plume may be differ between the modelled and surveyed locations. The two remaining modelled profiles correlate well with the surveyed data. They demonstrate the more buoyant river flows at the surface within the river channel, with the thermal saline plume residing just below this. The modelled plume is not quite as well defined as the surveyed values which extend further into the river channel. This may be due to the limitations of the mesh resolution (i.e. the layers becoming deeper with increasing water depth) and the lack of detailed bathymetry within the discharge canal. However, in general terms, the nature and form of the plume are well represented within the model.

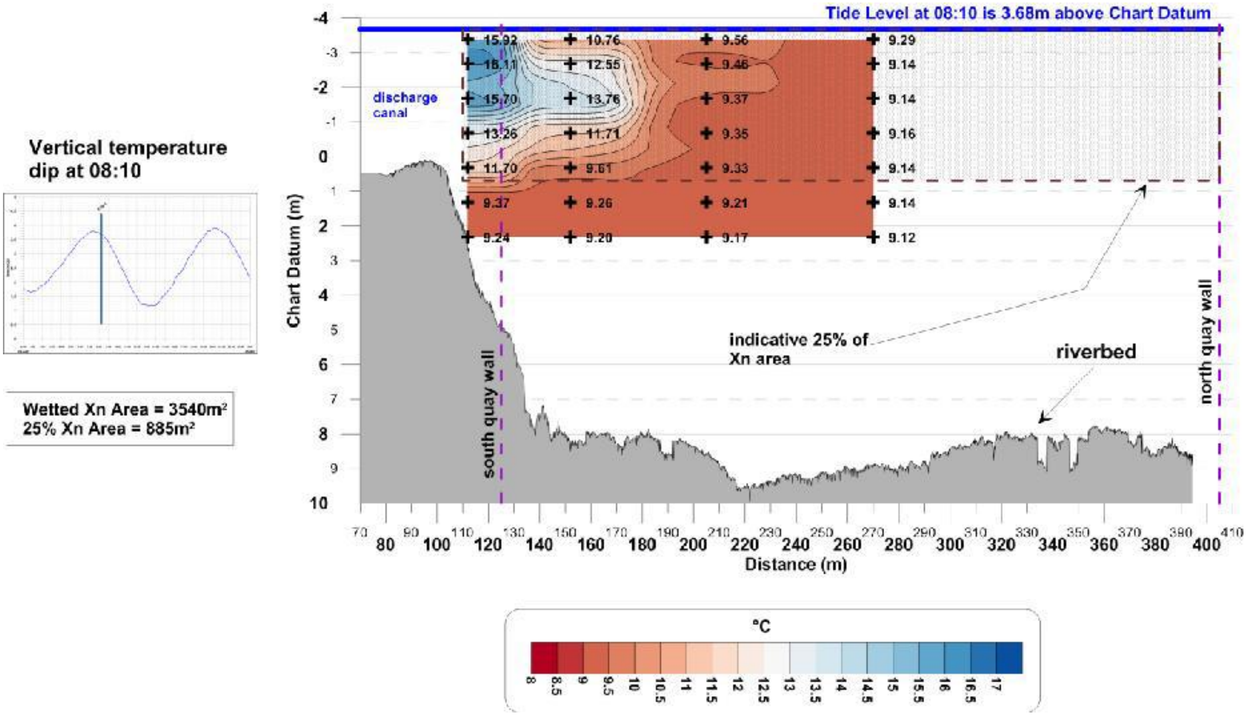


Figure 1.42: Surveyed vertical profile – 24th April 2018 high water plus 47mins

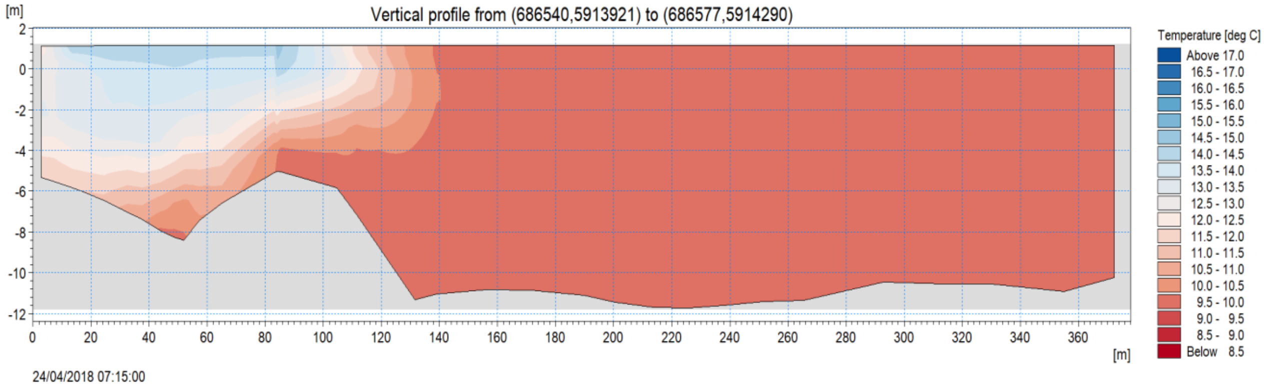


Figure 1.43: Modelled vertical profile – 24th April 2018 high water plus 47mins

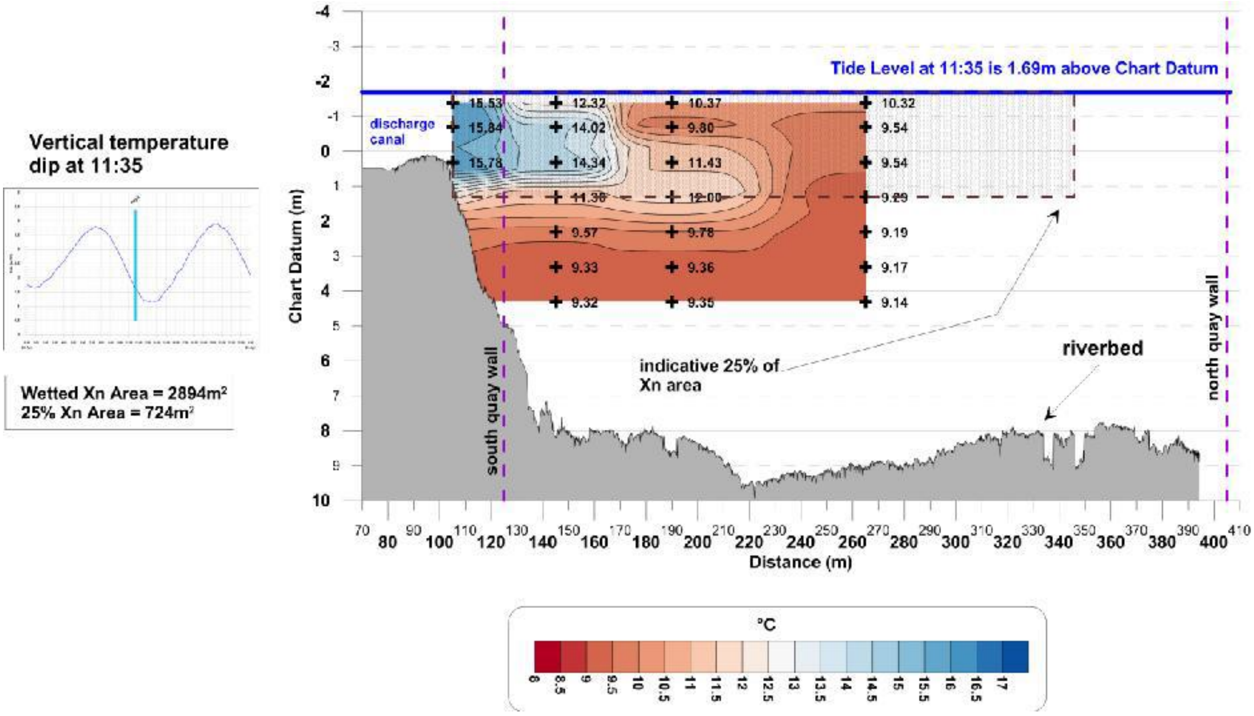


Figure 1.44: Surveyed vertical profile – 24th April 2018 high water plus 4hrs

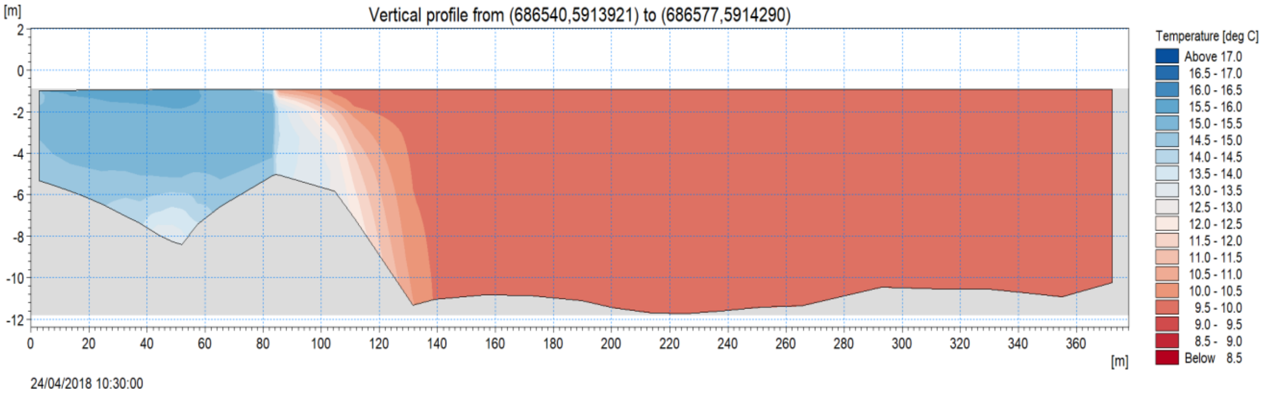


Figure 1.45: Modelled vertical profile – 24th April 2018 high water plus 4hrs

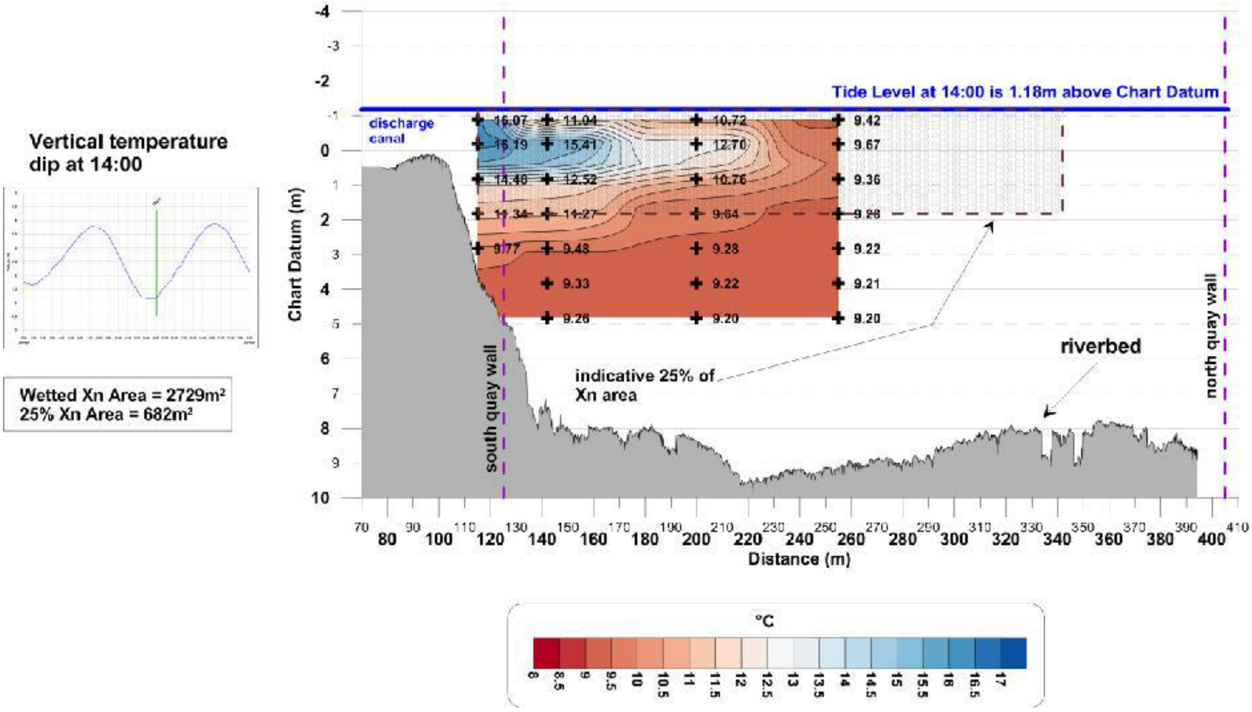


Figure 1.46: Surveyed vertical profile – 24th April 2018 low water plus 36mins

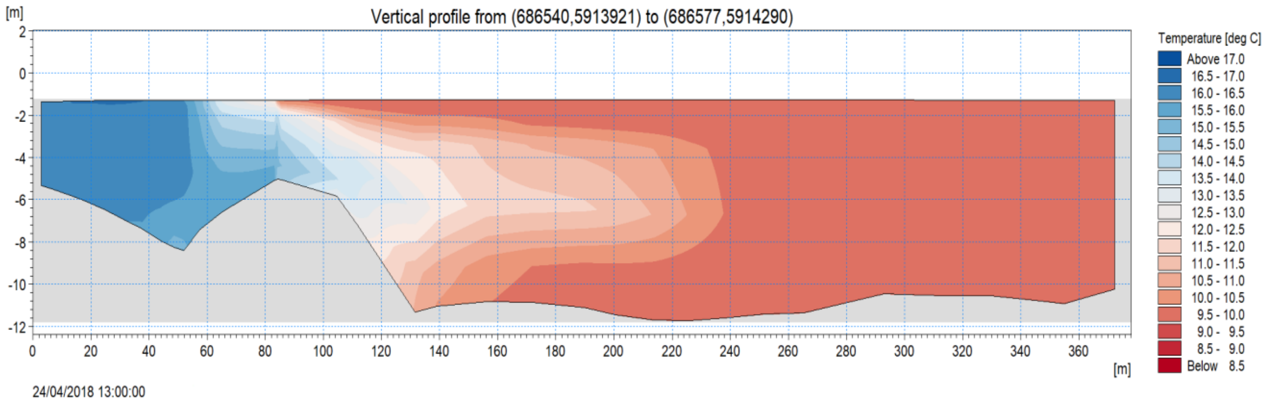


Figure 1.47: Modelled vertical profile – 24th April 2018 low water plus 36mins

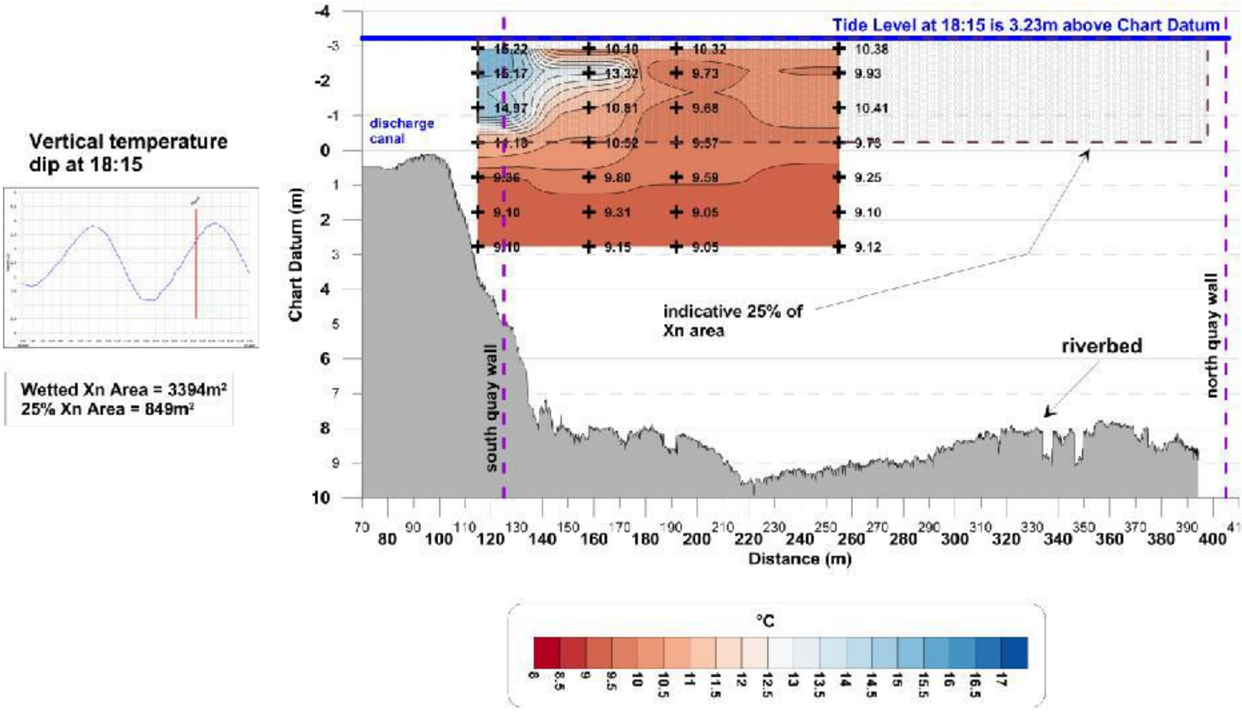


Figure 1.48: Surveyed vertical profile – 24th April 2018 high water minus 2hrs

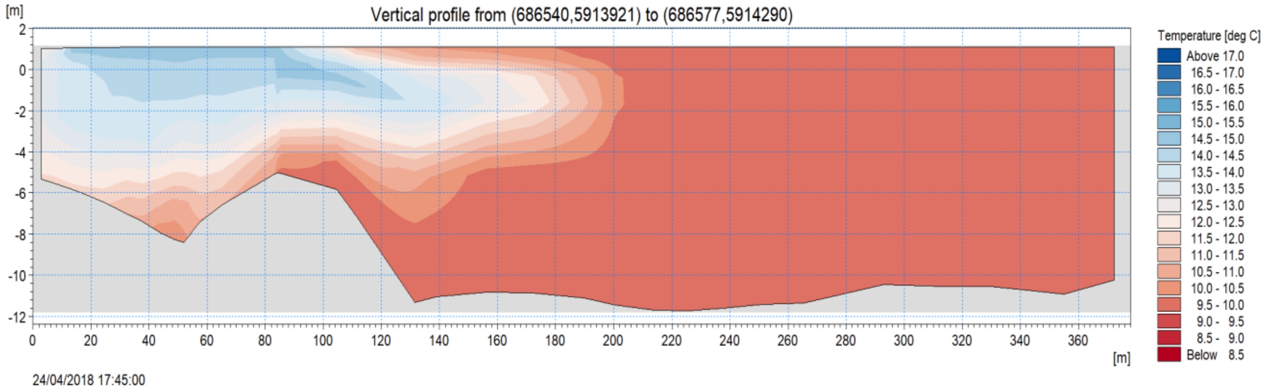


Figure 1.49: Modelled vertical profile – 24th April 2018 high water minus 2hrs

1.4.4 Additional Modelling

Having issued a report which described the findings of the Further Modelling described in Sections 1.4.2 and 1.4.3 in March 2024, RPS received additional comments from ESB which generally related to the simulated extent of thermal plumes generated at particular phases of different tides over the 2016, 2018 and 2019 periods. Recognising these comments and the importance of developing a suitable model to address potential concerns within this area, RPS undertook additional model developments and simulations to improve the overall accuracy and performance of the model.

The modelling results presented in the previous section indicates that the model developed was capable of simulating the stratified flow associated with the thermal discharges at Dublin Port. External feedback on the modelling study noted that model predictions from the Dublin Bay Power Station and Waste to Energy Plant are over-predicted along the south wall and do not extend sufficiently into the main channel.

In this respect it is important to note that the intended use of the model is to undertake a comparative study in relation to the Dublin Port 3FM development, which is proposed at this location, therefore use of this model to quantify potential impacts would provide a conservative prediction. It was also noted that the Poolbeg thermal discharge plume differed from that anticipated. It was therefore considered prudent to revisit the modelling and identify areas which may provide potential improvements.

It was noted that the thermal stratification and plume dispersion within Dublin Port is a result of numerous inter-rated factors some of which may be clearly prescribed within the models, such as discharge rates and temperatures, whilst others, such as ambient conditions are influenced by longer terms flow patterns and marine traffic. Two areas were considered for further investigation; namely river discharge and the mechanisms by which discharges are released. In the first instance models were re-run using the varying river flows provided by ESB for the duration of the simulations for which they were available and average flow for the periods when this data was not available. The resulting model output showed some variation from the previous scenario, however the plume extent along the south wall remained largely unaffected.

The second area identified for further consideration related to the discharge mechanisms. These concentrated on the canal which acts as a spillway for the Dublin Bay Power and Dublin Waste to Energy discharges and the discharge weir associated with the Ringsend WWTP and Poolbeg CCGT. The latter discharge being most apparent in the 2019 monitoring program where both discharges are operating and the threshold for excess temperature is lowest in the survey data presented.

1.4.4.1 Dublin Bay Power and Dublin Waste to Energy spillway

Examination of satellite data relating to discharge from the spillway indicates that the mechanism by which the discharge is released into the channel may influence how the subsequent plume is formed. This is illustrated in Figure 1.50 which shows images from Google Earth for a variety of tidal states and discharge volumes.

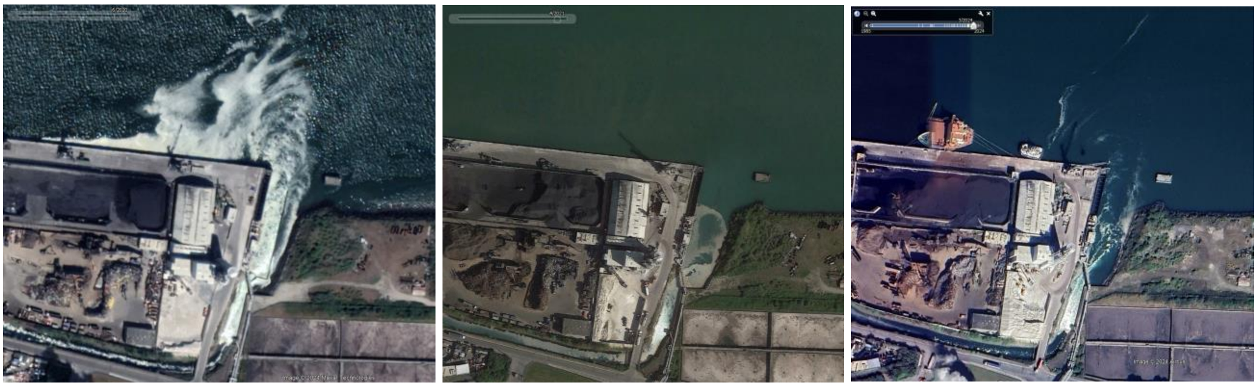


Figure 1.50: Spillway discharges 2020, 2021 & 2024 (Source: Google Earth)

The way in which the plume develops within the channel may be influenced by the discharge volume and also the spillway geometry. For the development of the preliminary model there was no recently surveyed bathymetric data for the spillway available. To update the model and test this sensitivity the original spillway extension construction drawing from the ESB archive was used to approximate the bathymetry within the spillway, a section of which is presented in Figure 1.51.

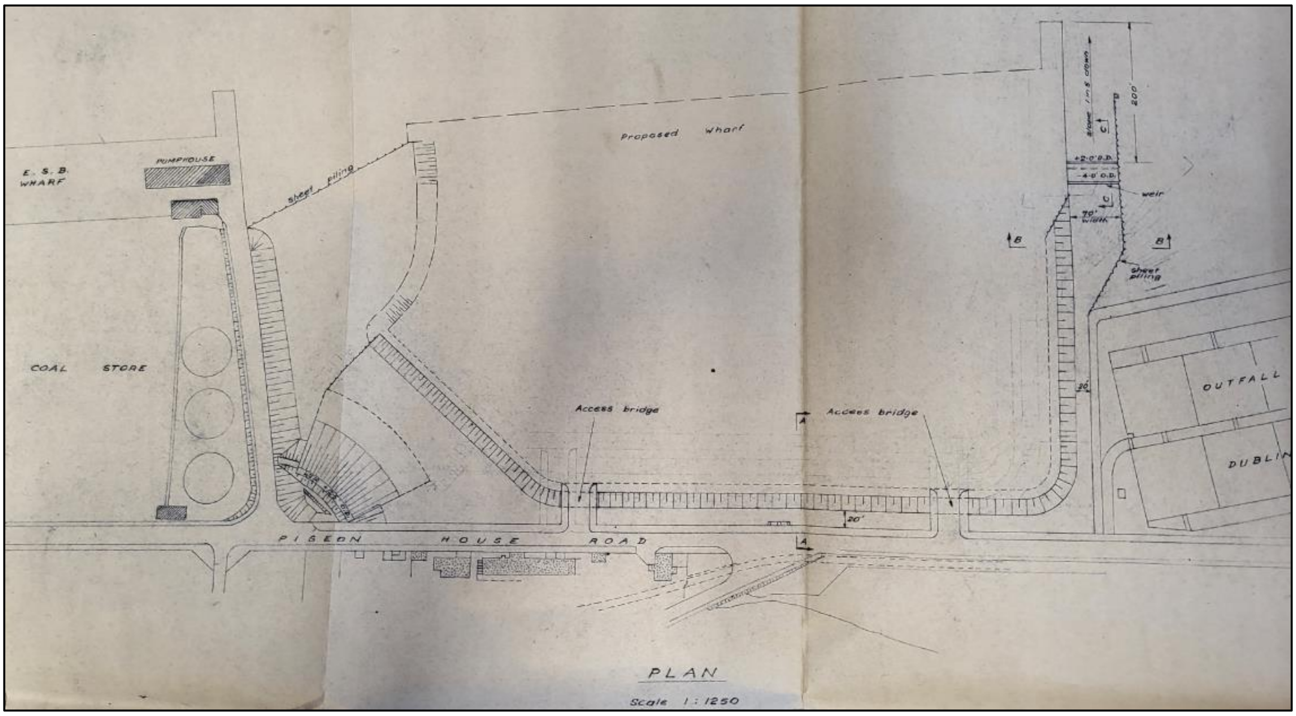


Figure 1.51: Ringsend Generating Station – C.W. Culvert Outfall Preliminary Drawing 25-05-1965

The model bathymetry was accordingly updated and then re-calibrated for the 2018 simulation period, which covered both spring and neap monitoring periods. Calibration involved introducing the discharge in all model layers at the head of the spillway and adjusting vertical dispersion parameters.

It was further noted that the spillway flow was also influenced by the tidal phase and the weir at the head of the spillway which is outside the model domain. The use of the modified spillway and revised calibration parameters gave rise to a general improvement in that the plume was moved into the channel and away from the south wall as is illustrated in Figure 1.52 and Figure 1.53 for the measured and modelled plume for mid-flood neap tide.

It was noted that the revised spillway bathymetry and parameters showed varying degrees of improvement across the range of tidal states and survey periods further indicating the sensitivity of both the discharge parameters and the receiving environment.

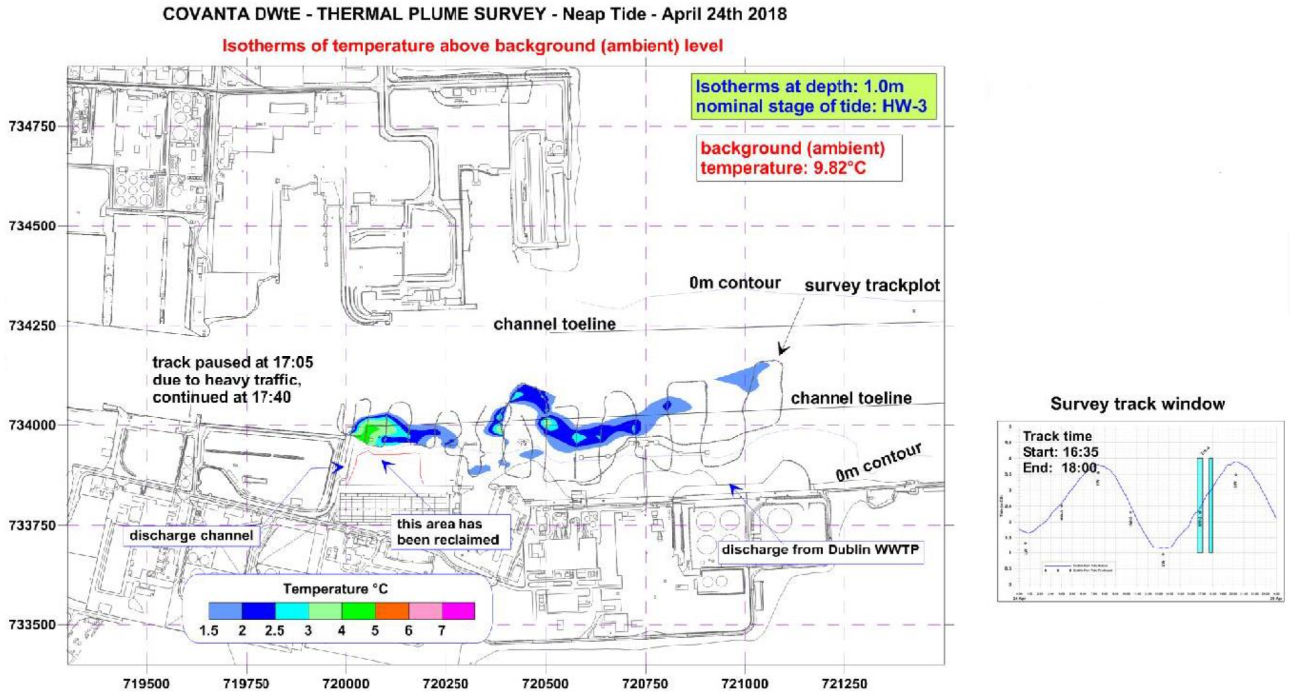


Figure 1.52: Survey contour 24th April 2018 – excess temperature at mid-flood 1m depth.

Figure 1.53: Thermal plume 24th April 2018 – excess temperature at mid-flood circa 1m depth (layer 5).

To demonstrate the improvements to the model, the dip profiles presented in the previous section (Figure 1.42 to Figure 1.49) are recreated here from the revised model. In each case the plume extends further into the channel comparing more closely with the monitored data –a distinct improvement for high water plus four hours. The revised model plume is more concentrated towards the surface at the exit of the spillway channel than in the previous simulations however the river flows are seen to still overlay the plume further into the channel. This is particularly evident in Figure 1.61 during the flood tide where counter flow occurs. Noting that the revised scenarios include time varying river flow from the ESB dataset.

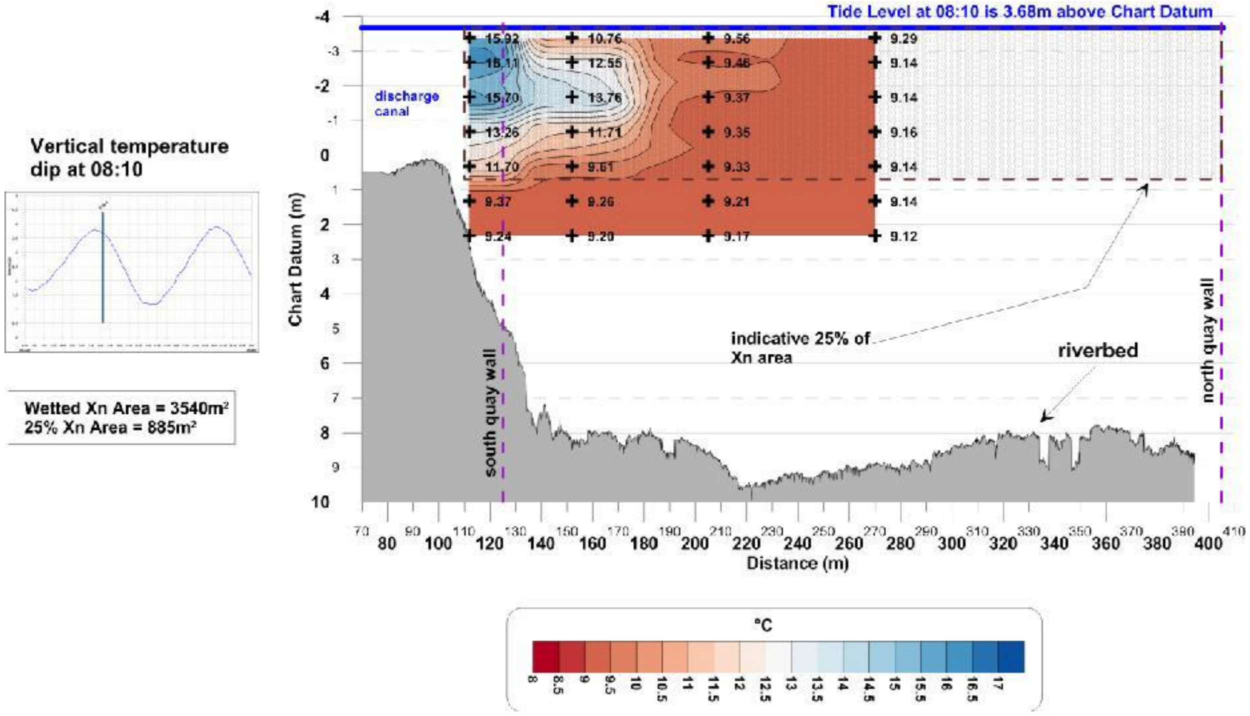


Figure 1.54: Surveyed vertical profile – 24th April 2018 high water plus 47mins

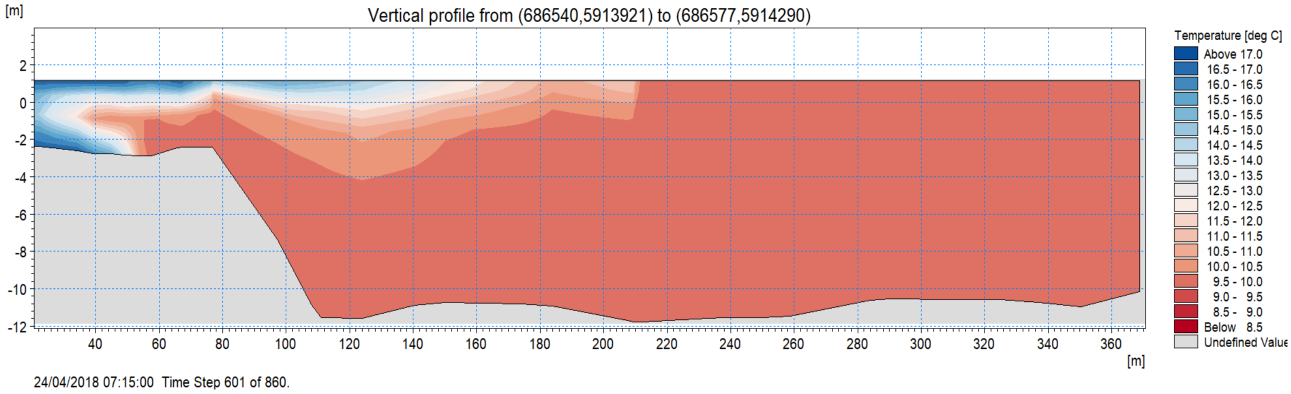


Figure 1.55: Modelled vertical profile – 24th April 2018 high water plus 47mins

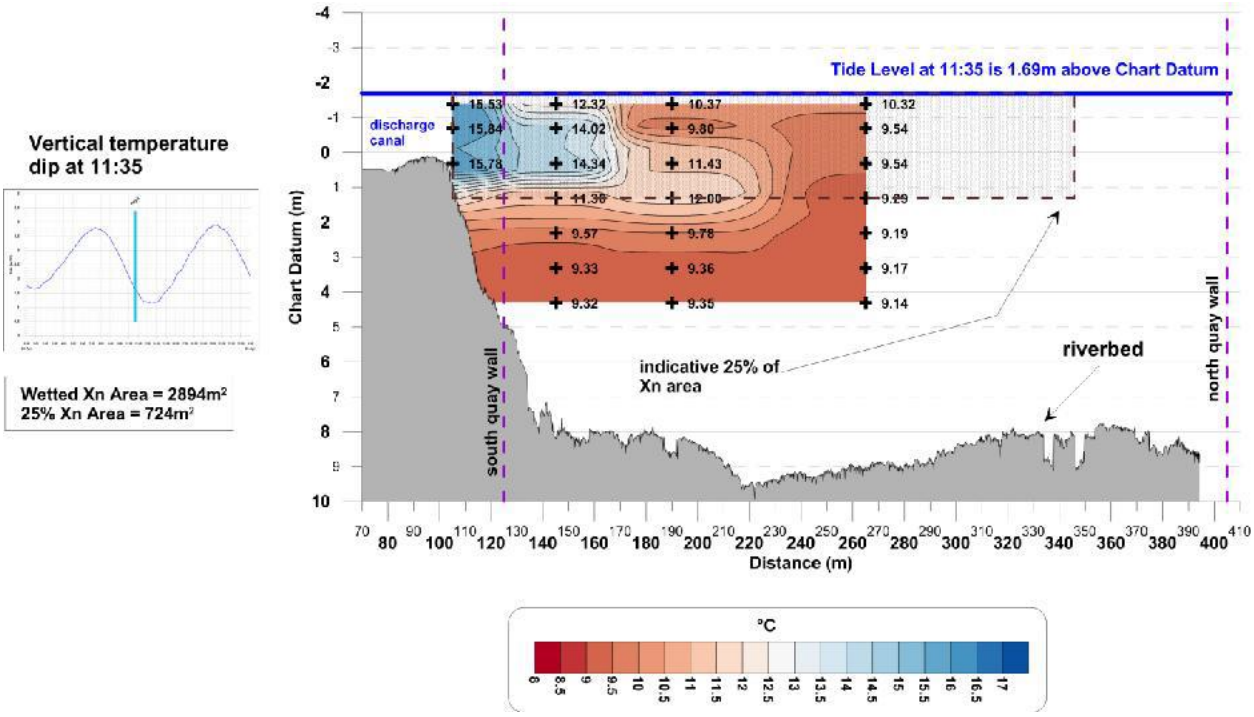


Figure 1.56: Surveyed vertical profile – 24th April 2018 high water plus 4hrs

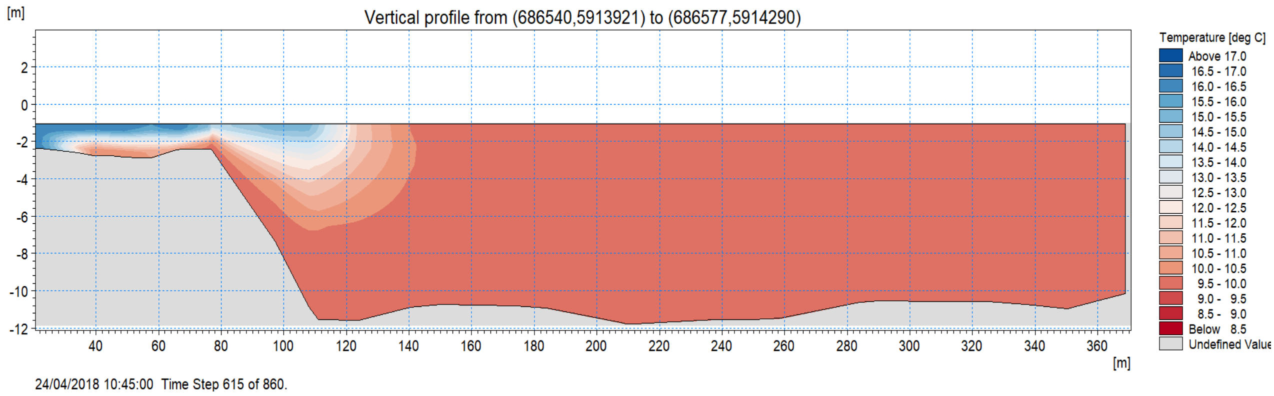


Figure 1.57: Modelled vertical profile – 24th April 2018 high water plus 4hrs

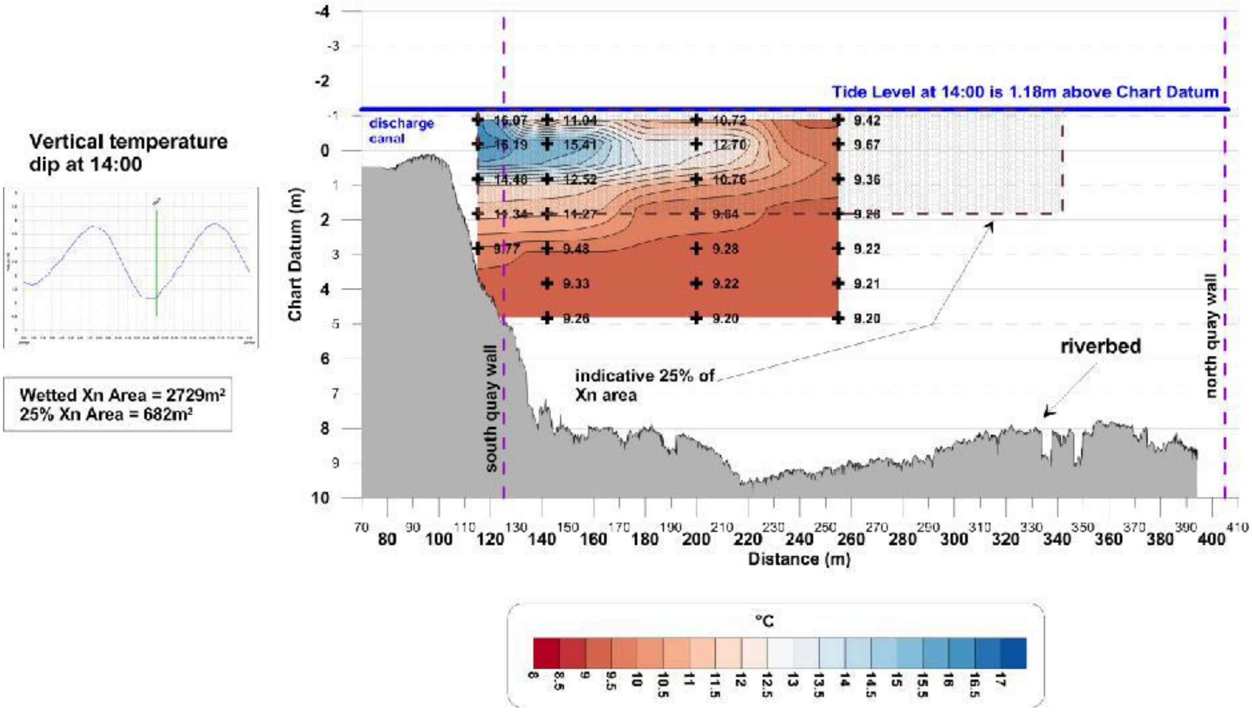


Figure 1.58: Surveyed vertical profile – 24th April 2018 low water plus 36mins

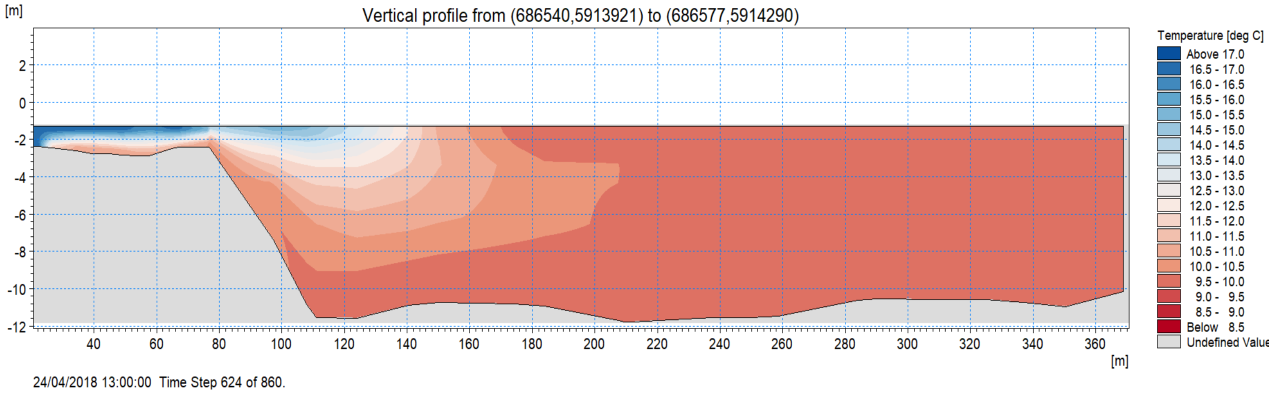


Figure 1.59: Modelled vertical profile – 24th April 2018 low water plus 36mins

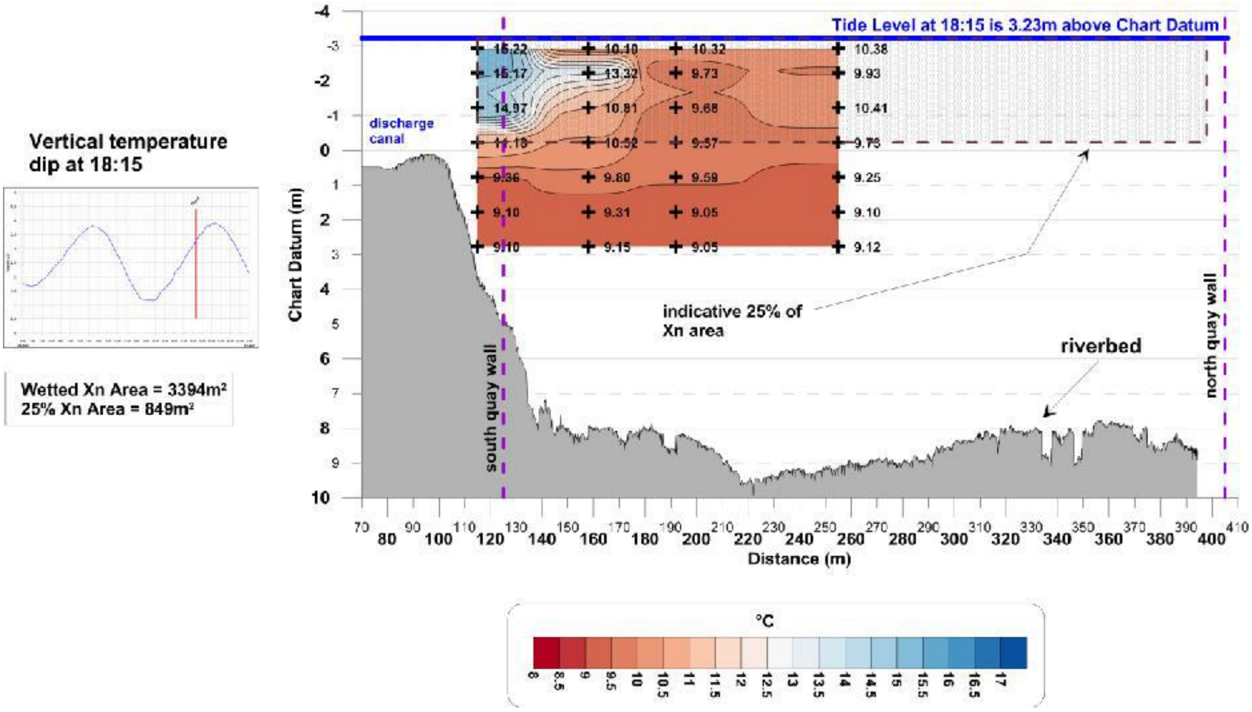


Figure 1.60: Surveyed vertical profile – 24th April 2018 high water minus 2hrs

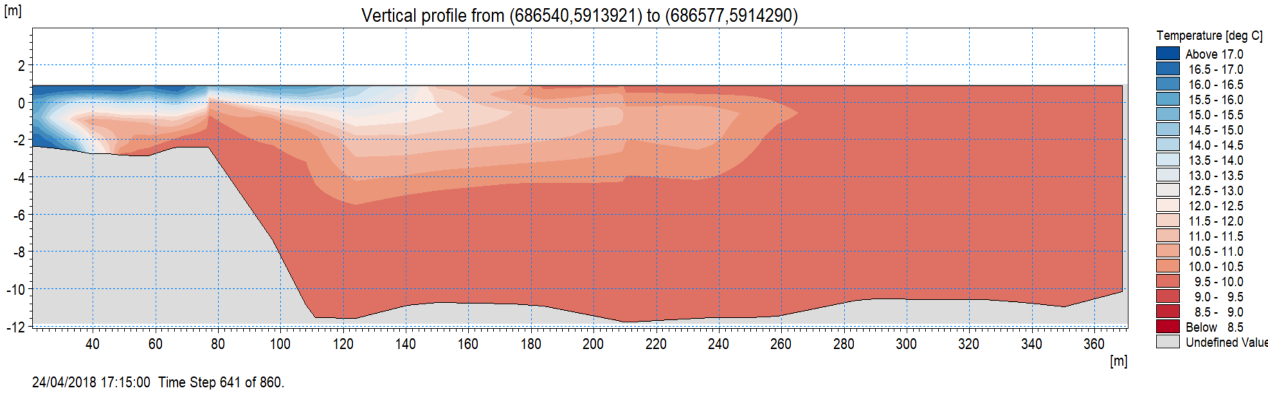


Figure 1.61: Modelled vertical profile – 24th April 2018 high water minus 2hrs

1.4.4.2 Vertical profile extent near Dublin Bay Power

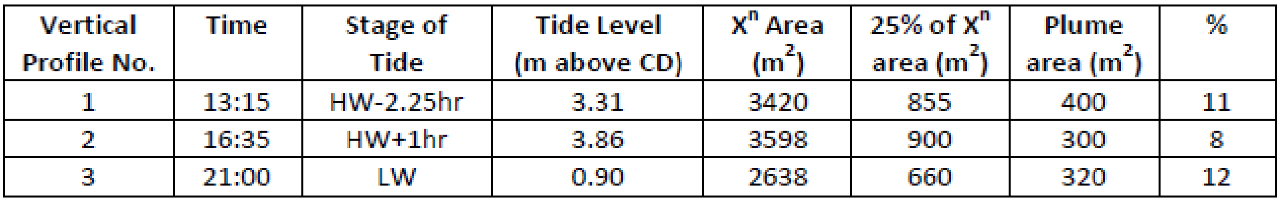
It is recognised that the maximum cross-sectional area of any thermal plume envelope produced by the assets which discharge into Dublin Port are of partiuclar interest to a range of stakeholders for the purposes of licensing consents. Given the importance of ensuring model accuracy in this context, RPS compared the relevant modelled vertical profiles described in the previous Section with measurements as reported by the 2018 thermal plume survey report across the section illustrated in Figure 1.41.

Using a geographic information system, the wetted cross-sectional area of the navigation channel was calculated which in-turn was used to derive the 25% area relative to the water level at that time. Similarly, the cross-sectional area of the channel occupied by a thermal plume which exceeded 1.5ºC above background levels was calculated (*with background levels between c. 9.5 – 10ºC*). This process was undertaken for both the spring and neap thermistor surveys described in the 2018 thermal plume survey report.

It will be seen by comparing Table 1.6 and Table 1.7 that the area occupied by a thermal plume which exceeded 1.5ºC ranged between 7 - 12% and 8 – 12% for measured and modelled results respectively. For spring conditions, the equivalent ranges were 8 to 12% and 8 to 13% for measured and modelled respectively.

These results demonstrate that the numerical model successfully represents the dispersion of thermal plume envelopes within Dublin Port. The slight discrepancies maybe accounted for by localised model performance or minor spatial and temporal differences between modelled and surveyed data.

Table 1.4: Recorded thermal plume data for the Spring tides as reported by 2018 survey

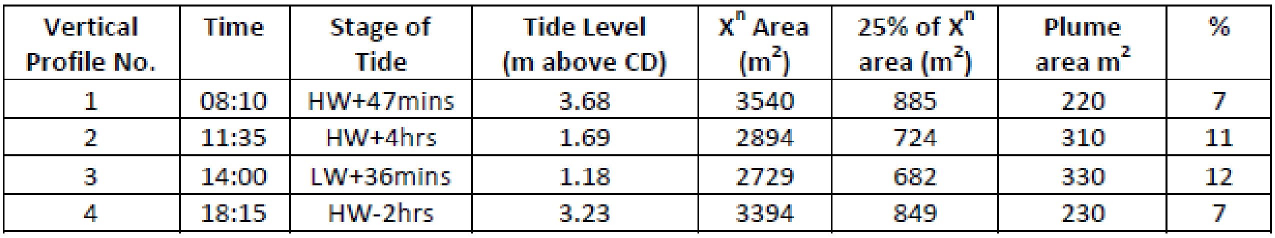


Vertical Profile No.	Time	Stage of Tide	Tide Level (m above CD)	X^n Area (m^2)	25% of X^n area (m^2)	Plume area (m^2)	%
1	13:15	HW-2.25hr	3.31	3420	855	400	11
2	16:35	HW+1hr	3.86	3598	900	300	8
3	21:00	LW	0.90	2638	660	320	12

Table 1.5: Modelled thermal plume data for the Spring tides *(note difference in daylight savings)*

Time relative to 20/04/2018	Channel Area [m^2]	25% of Channel Area [m^2]	Plume Area [m^2]	%
12:15	3890	959	510	13%
15:30	3948	987	320	8%
20:00	2760	708	263	10%

Table 1.6: Recorded thermal plume data for the Neap tides as reported by 2018 survey



Vertical Profile No.	Time	Stage of Tide	Tide Level (m above CD)	X^n Area (m^2)	25% of X^n area (m^2)	Plume area m^2	%
1	08:10	HW+47mins	3.68	3540	885	220	7
2	11:35	HW+4hrs	1.69	2894	724	310	11
3	14:00	LW+36mins	1.18	2729	682	330	12
4	18:15	HW-2hrs	3.23	3394	849	230	7

Table 1.7: Modelled thermal plume data for the Neap tides *(note difference in daylight savings)*

Time relative to 24/04/2018	Channel Area [m^2]	25% of Channel Area [m^2]	Plume Area [m^2]	%
07:15	4691	1173	413	9%
10:45	3075	769	239	8%
13:00	2992	748	330	11%
17:15	3847	962	476	12%

1.4.4.3 Ringsend WWTP and Poolbeg CCGT discharge pier

On review of the model setup it was noted that during the previous 2019 simulations the Poolbeg CCGT discharge had been incorrectly specified. This was therefore corrected and the model was re-run using the parameters defined during the calibration process defined in the previous section.

For the comparison of survey data and modelled data the process described in section 1.4.1 was applied to the model output to derive excess temperature. However, it is noted that within the survey a different parameter was used, whereby selection of the minimum temperature close to the edge of the surveyed extents was applied. This may result in a variation in the background temperature applied although the contour palette applied, in both survey and modelling output, is reduced from the previous surveys to 0.5°C minimum excess temperature which aids in comparisons. Figure 1.62 and Figure 1.63 illustrate the surface plume at low water during the 2019 survey for measured and modelled data respectively. For reference, it should be noted that the natural variation in background temperatures during this period was reported as varying between 8.6°C to 9.6°C. This is important even very minor changes in the background temperature used to create the plume envelopes could change considerably depending on what reference value is used.

The model layers will vary in depth from the surface depending on the bathymetry (still water depth) and tidal state (instantaneous water depth) this is particularly relevant to plumes along the south wall where the bed levels vary significantly as illustrated in Figure 1.64, where for example in the vicinity of the wall the 1m survey may be located in layer 2 whereas further offshore the same survey level is present in layer 5.

This is illustrated by comparison of the mid-ebb survey undertaken in 2019 shown in Figure 1.65 and the modelled data for the surface layer 6 in Figure 1.66 and the mid-depth layer 4 in Figure 1.67. As the profile approaches the drying areas the lower model layers link with the survey data.

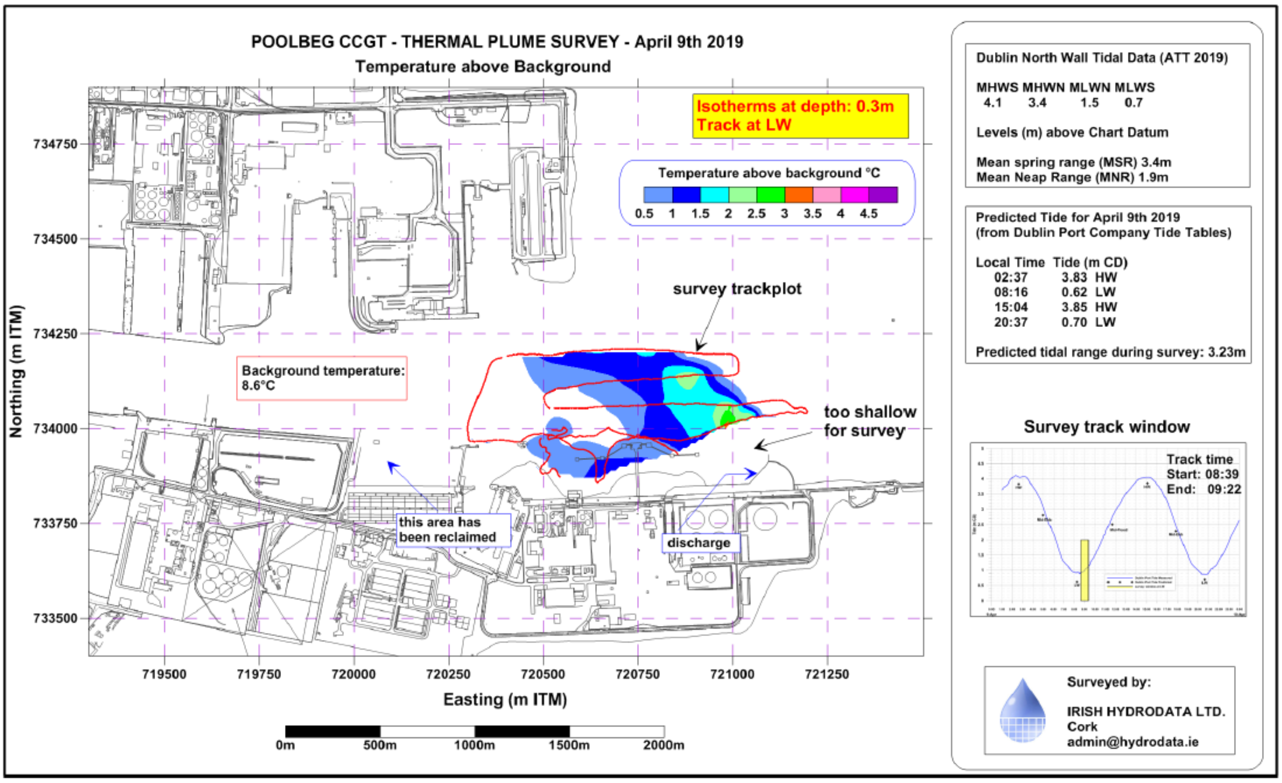


Figure 1.62: Survey contour 9th April 2019 – excess temperature at low water 0.3m depth.

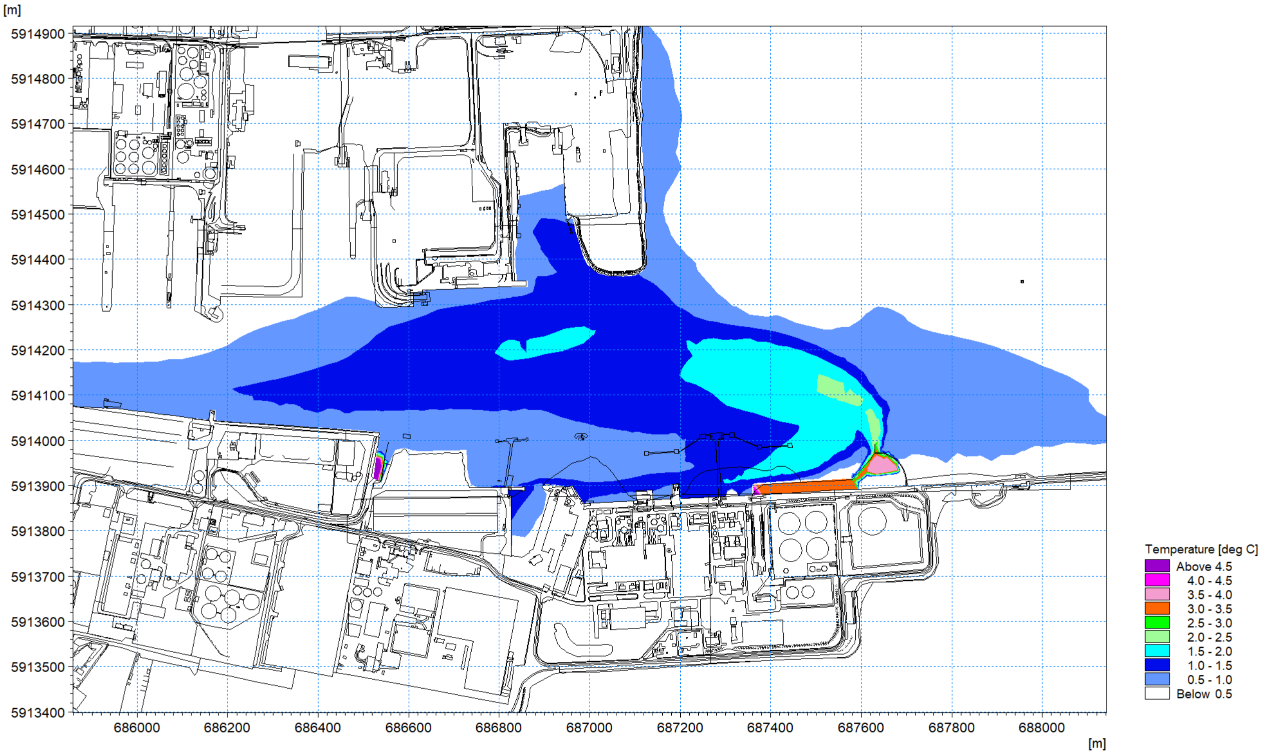


Figure 1.63: Thermal plume 9th April 2019 – excess temperature at low water circa 0.3m depth (layer 6).

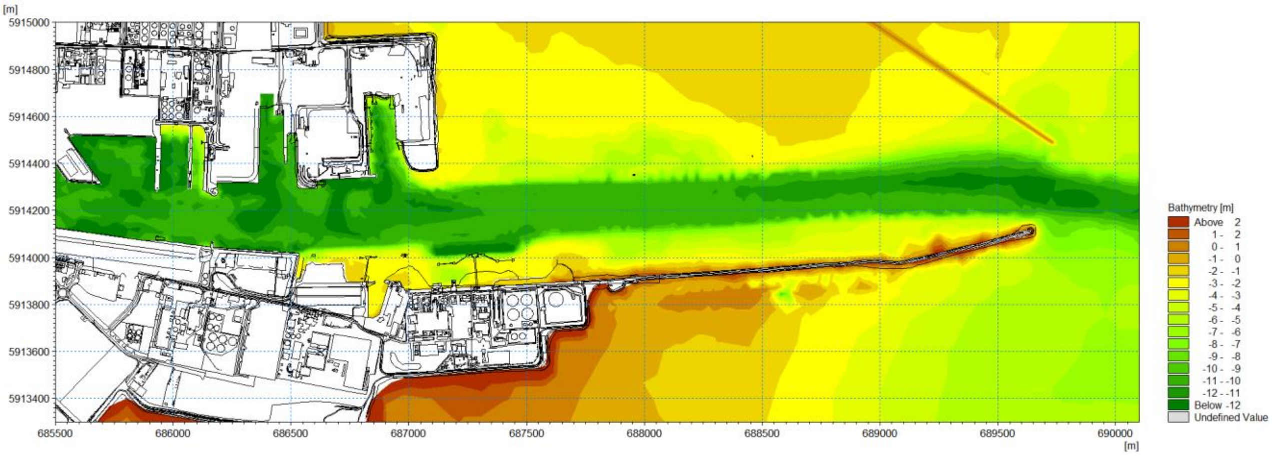


Figure 1.64: Bathymetry to mean sea level Dublin Port

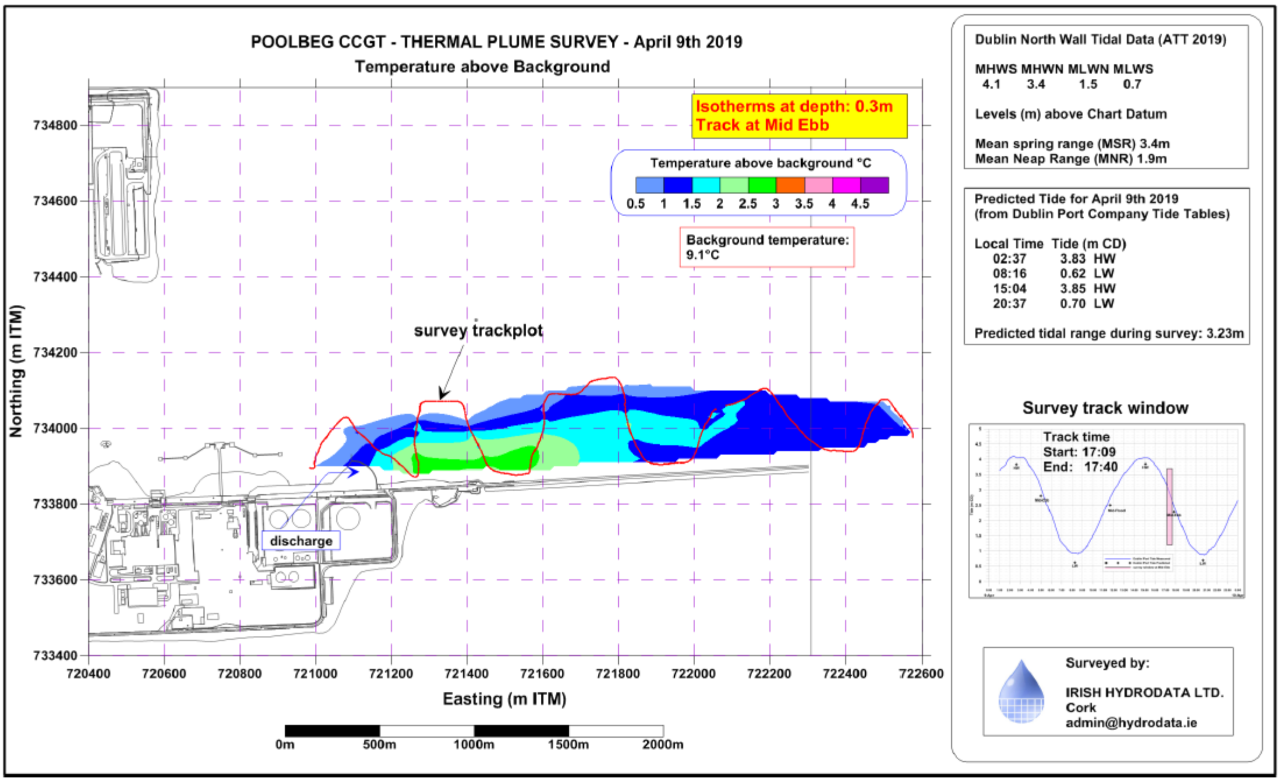


Figure 1.65: Survey contour 9th April 2019 – excess temperature at mid-ebb 0.3m depth.

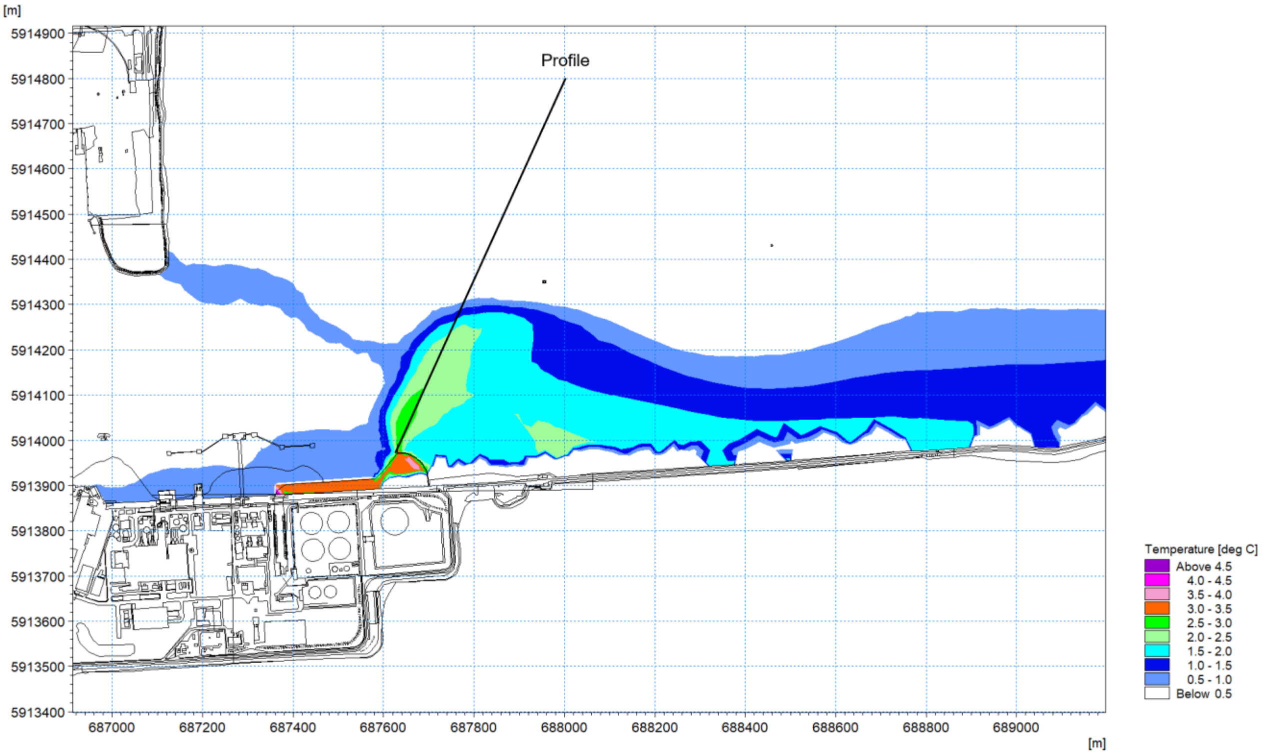


Figure 1.66: Thermal plume 9th April 2019 – excess temperature at mid-ebb layer 6.

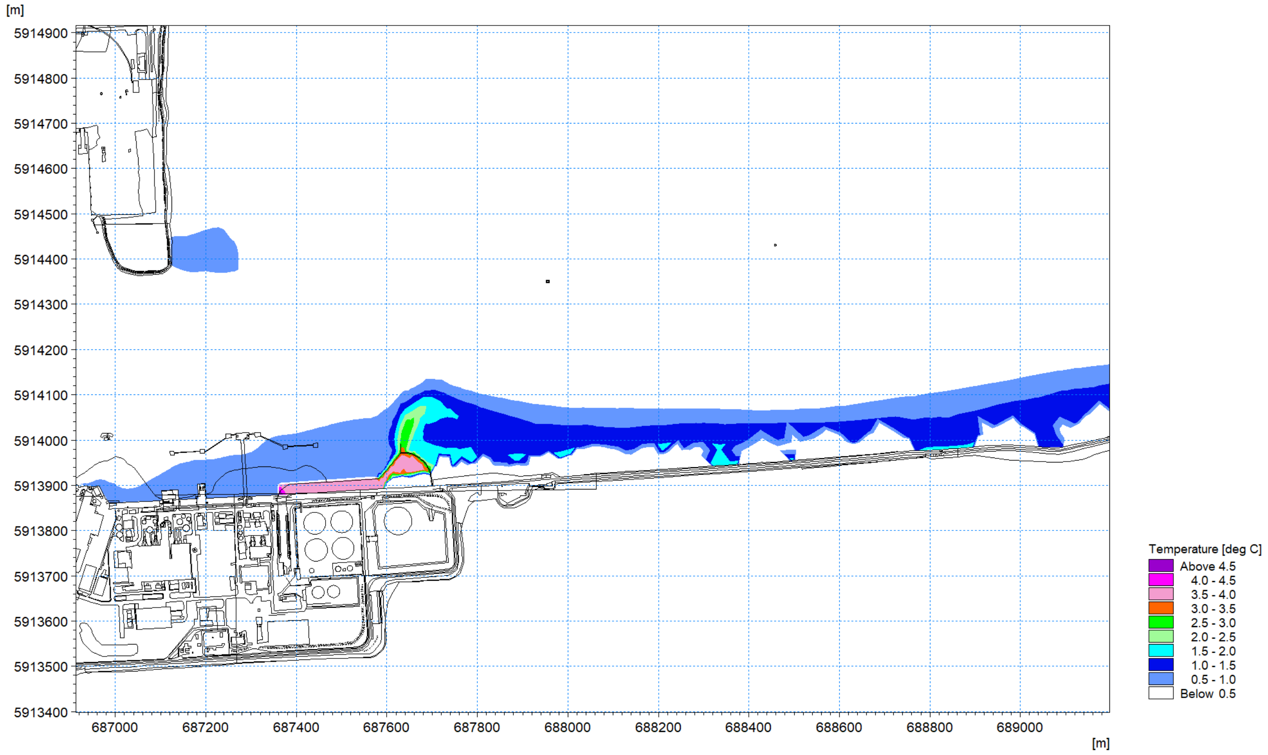


Figure 1.67: Thermal plume 9th April 2019 – excess temperature at mid-ebb circa layer 3.

There is a clear disparity between the surveyed and modelled data where the discharge is released at the eastern end of the impoundment. Within the model this is represented by a series of weirs, the curved section with a level set to mean sea level, whilst the adjacent section is set 1m lower which effectively forms the discharge plume. This arrangement was used to represent the structures in place, as shown in Figure 1.68 on the right, however in reality due to the condition of the structures the discharge is more diffuse, as illustrated on the left of this figure. This would be difficult to recreate in the existing model without either detailed survey information to describe the condition of the structure at the time of thermal plume survey or decreased resolution to diffuse the influx numerically.

Figure 1.68: Poolbeg CCGT discharge pier

However, once the discharge is released from the immediate vicinity of the impoundment the plume spreads out and forms a surface layer circa 1m in depth with an excess temperature of 1.5°C. This is illustrated in Figure 1.69 which is a profile taken at mid-ebb during the 2019 survey at the location shown in Figure 1.66. This is in accordance with the observed behaviour of the plume from the Ringsend WWTP and Poolbeg CCGT discharges.

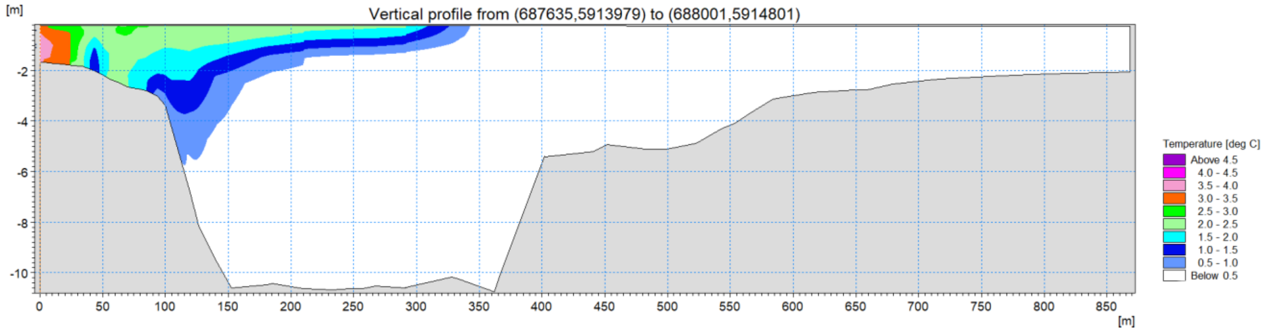


Figure 1.69: Thermal plume 9th April 2019 – excess temperature at mid-ebb profile.

1.4.5 Assessing Model Performance

This document has discussed the model performance relating to thermal plumes surveys presented in the following three reports:

- Survey reports:
  - ESB International (2017) Dublin Bay Power Plant: Thermal Plume Survey.
  - Irish Hydrodata (2018) Covanta Dublin Wate to Energy Facility: Thermal Plume Surveys of April 20th and 24th 2018.
  - Irish Hydrodata (2019) Poolbeg CCGT: Thermal Plume Survey of April 9th, 2019.
- The full set of the final model output corresponding to each survey is provided in the Appendices of this document as flows:
  - 2016 survey: Discharge from ESB's Dublin Bay Power facility and Irish Water's Waste Water Treatment Plant (WWTP) in Appendix A.
  - 2018 survey: Discharge from ESB's Dublin Bay Power facility, Irish Water's WWTP and the Dublin Waste to Energy facility in Appendix B. This includes both thermal contour plots and dip profiles collected during spring and neap surveys.
  - 2019 survey: Discharge from Poolbeg CCGT, Irish Water's WWTP and the Dublin Waste to Energy facility in Appendix C.

The stratified flow and thermal plume dispersion within Dublin Port is a complex process which is influenced by various factors which act on a range of temporal scales, Such factors include longer term hydrological conditions which develop background conditions and short term direct influences such as outfall discharges, current meteorological conditions and vessel activity within the Port. The purpose of this study was to characterise the primary hydraulic processes that govern the dispersive behaviour of the thermal discharges in order that the parameters derived may be applied in a comparative thermal plume study undertaken to inform the environmental assessment.

The numerical model provides instantaneous output based on the model discretisation described in sections 1.2 and 1.4.4, with thermal plumes presented from specific model layers. The use of layers relative to water depth is the most effective way to accurately simulate the behaviour of stratified flow. As previously noted, the use of sigma layers means that the information presented is relative to the location within the water column, as opposed to a fixed location relative to the water surface (as is the case with the surveyed data). The relative depth and thickness of the layers will vary spatially (i.e. are shallower in shallow water) and also temporally (i.e. with the changing water level associated with tidal flows). This is because the sigma layers used represent a fix percentage of the water column, the depth of which changes with tides and location.

It was therefore important when comparing modelled output with surveyed data to apply a holistic approach. In the case of comparing model layers it is noted that for a specific surveyed depth more than one model layer may be relevant to those measured values. For example, a depth of 1m below the surface would be in layer 5 (one below the surface layer) within the main channel but within layer 2 (one above the bed) in intertidal areas. Similarly, the surveys were undertaken over a period of time which in many cases exhibited a wide range of conditions such as turning tides and marine traffic therefore a single model step could not be expected to recreate the data presented within a single survey plot.

The conditions across the four surveys, covered by the three monitoring campaigns, varied in terms of background conditions, tidal flows and thermal discharges however a single set of parameters were required to best simulate the behaviour of the thermal plumes across all three survey periods.

> The thermal plume model development and calibration process was independently audited by DHI and determined to be fit for the purpose of undertaking a comparative study to evaluate the impacts of the proposed development of 3FM on existing thermal discharges and intakes in Dublin Port.

Therefore, when undertaking the comparison, rather than comparing each individual survey plot with a single model output, it is often necessary to assess the behaviour of the thermal plumes through the water column and across the survey period and compare with the simulated behaviour. That is to say, the reader may have to review modelled outputs in more than one layer when comparing with an equivalent survey reading.

1.5 Summary

Numerical models were developed to simulate the hydrodynamic conditions in Dublin Port. The models included freshwater input from river sources and saline tidal flow from the Irish Sea through Dublin Bay. The modelled tidal levels were shown to correlate well with those recoded at Dublin Port under the same meteorological conditions. A three dimensional modelling scheme was used to simulate thermal plumes from both saline sources from the Dublin Waste to Energy, Dublin Power Station and Poolbeg CCGT cooling water outfalls and buoyant freshwater discharge from Ringsend WWTP.

Based on constructive feedback from ESB, models were developed to include a series of improvement. Based upon these improvements, the model was ultimately found to recreate the mechanisms of stratified flow; with a profile of increasing salinity with depth persisting throughout the ebb tide upstream of Dublin Port. Additionally, on occasion, the modelled surface flow out of Dublin Port was observed when tidal flow entered below the stratified layer during flood tides.

The use of sigma layers with varied thicknesses within the model was able to distinguish between the saline thermal plume layers and freshwater surface plumes. The model was compared with survey reports presenting excess temperature during three survey campaigns. Whilst it can be challenging to directly compare this data with model outputs, due to the phased nature of the surveys and method of assessing background temperatures coupled with the modelled discretisation the model was found to generally perform well and represented key processes relating to thermal dispersion and stratification to degree considered suitable by RPS.

In conclusion, the model was found to recreate the plume behaviour across all three survey periods with sufficient accuracy. The models were considered fit for the purpose of undertaking a comparative study to examine the impact of the proposed 3FM development in an independent audit by DHI.

Appendix A

A.1 Thermal Survey August 2016

Figure 1.70: Thermal plume 12th August 2016 – excess temperature at high water circa 0.3m depth layer 6

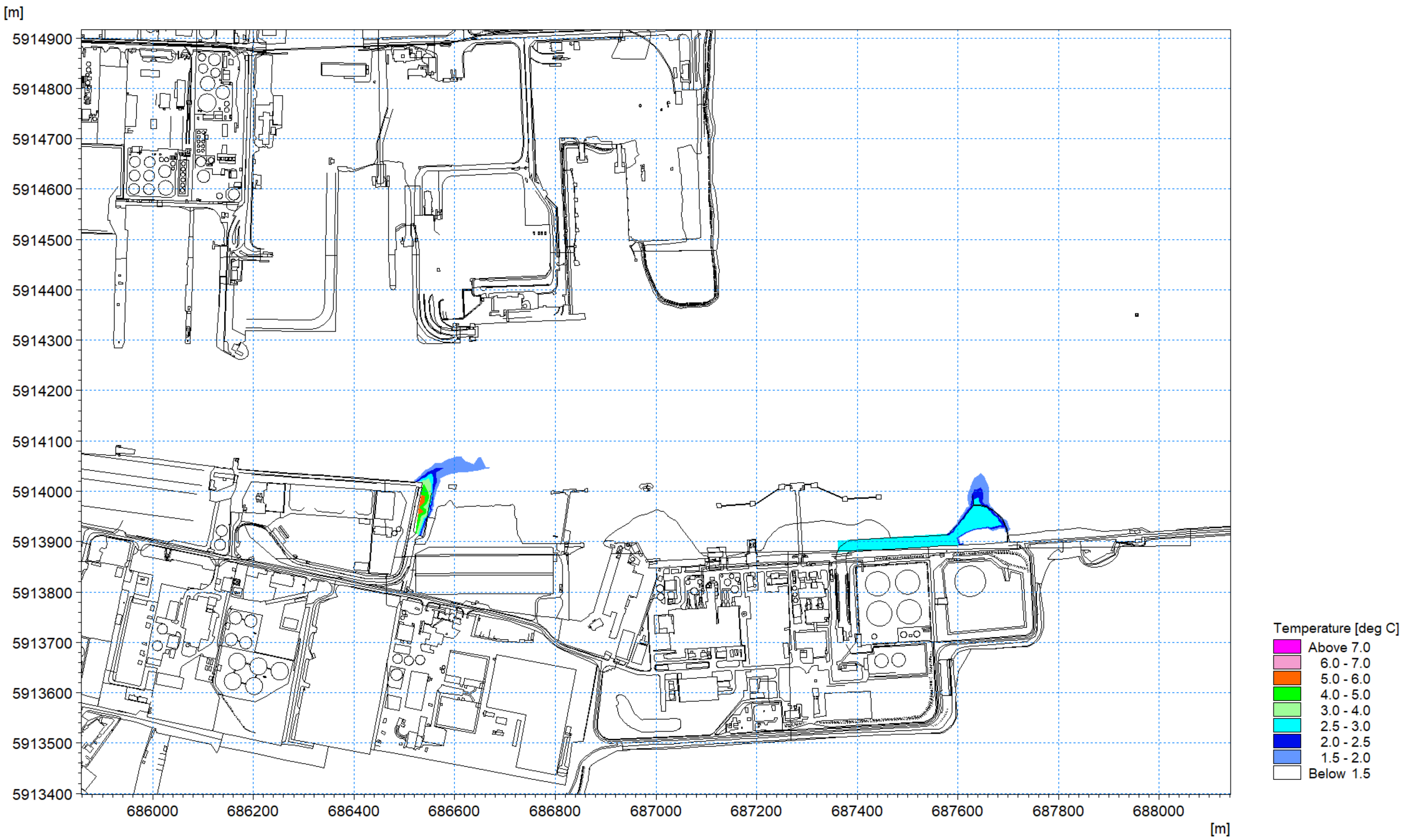


Figure 1.71: Thermal plume 12th August 2016 – excess temperature at high water circa 1m depth layer 5

Figure 1.72: Thermal plume 12th August 2016 – excess temperature at high water circa 2m depth layer 4

Figure 1.73: Thermal plume 12th August 2016 – excess temperature at mid-ebb circa 0.3m depth layer 6

Figure 1.74: Thermal plume 12th August 2016 – excess temperature at mid-ebb circa 1m depth layer 5

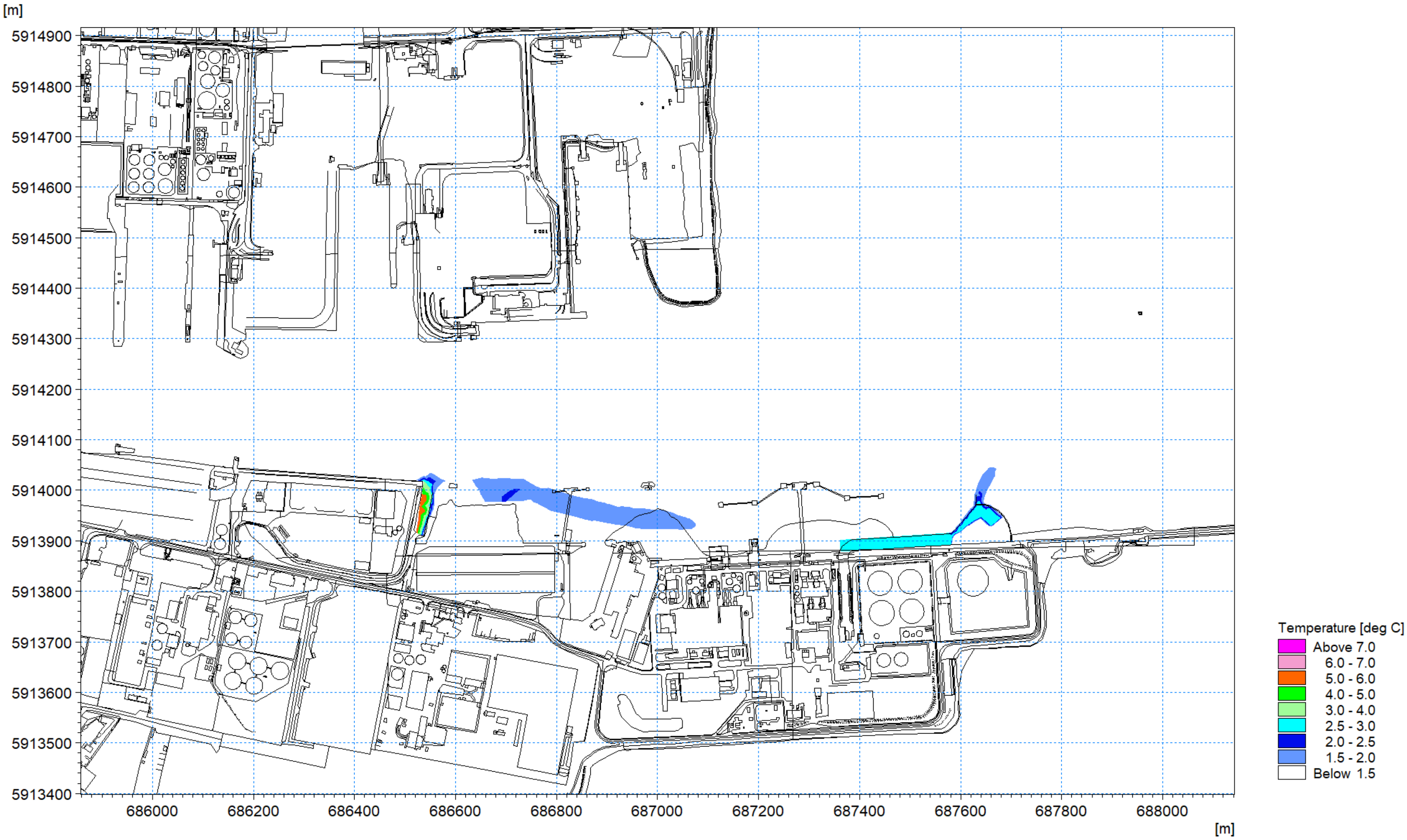


Figure 1.75: Thermal plume 12th August 2016 – excess temperature at mid-ebb circa 2m depth layer 4

Figure 1.76: Thermal plume 12th August 2016 – excess temperature at low water circa 0.3m depth layer 6

Figure 1.77: Thermal plume 12th August 2016 – excess temperature at low water circa 1m depth layer 5

Figure 1.78: Thermal plume 12th August 2016 – excess temperature at low water circa 2m depth layer 3

Figure 1.79: Thermal plume 12th August 2016 – excess temperature at mid-flood circa 0.3m depth layer 6

Figure 1.80: Thermal plume 12th August 2016 – excess temperature at mid-flood circa 1m depth layer 5

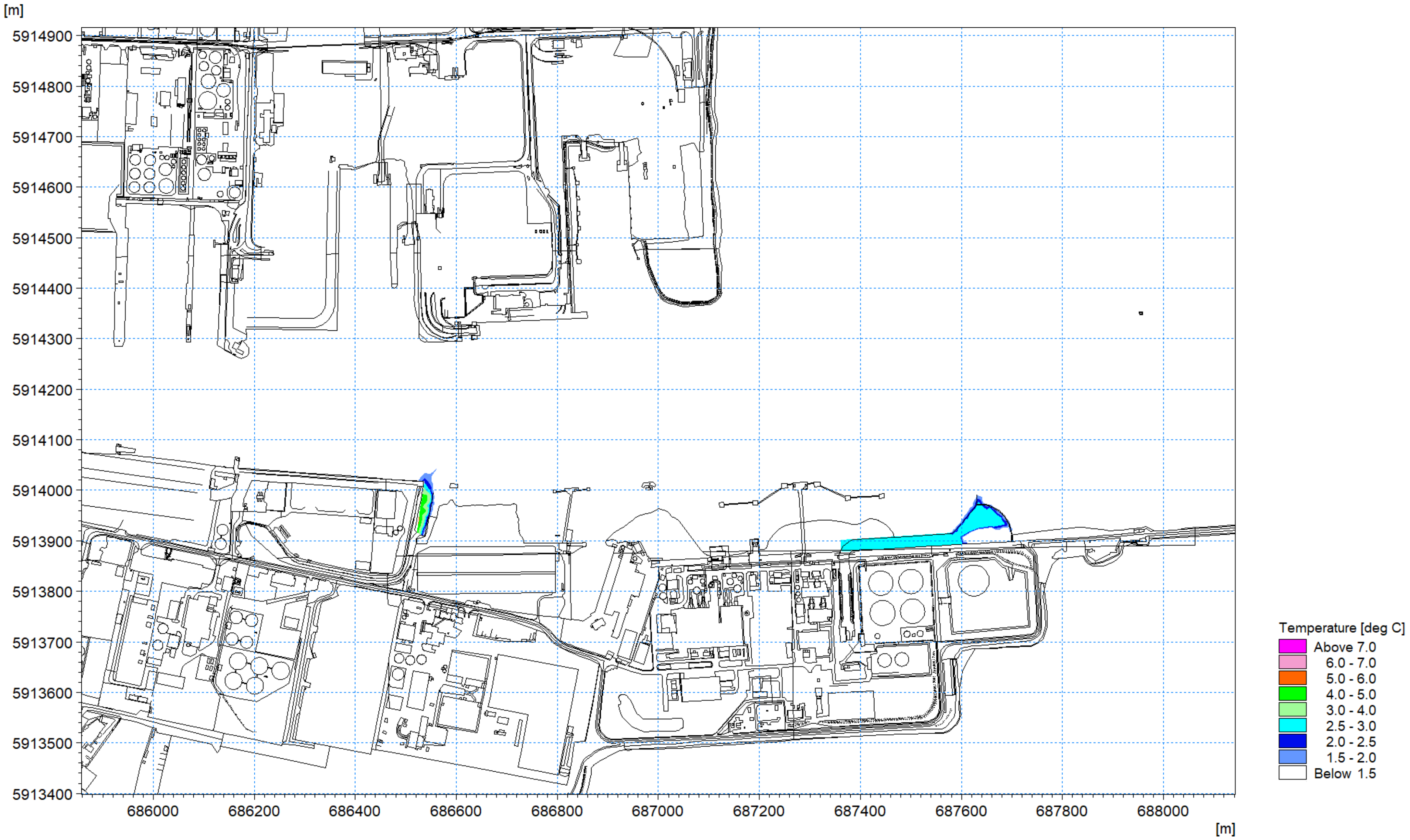


Figure 1.81: Thermal plume 12th August 2016 – excess temperature at mid-flood circa 2m depth layer 4

Appendix B

B.1 Thermal Survey Spring Tide 20th April 2018

B.1.1 Thermal Survey – Contours of Excess Temperature

Figure 1.82: Thermal plume 20th April 2018 – excess temperature at mid-flood circa 0.3m depth layer 6

Figure 1.83: Thermal plume 20th April 2018 – excess temperature at mid-flood circa 1m depth layer 5

Figure 1.84: Thermal plume 20th April 2018 – excess temperature at mid-flood circa 2m depth layer 4

Figure 1.85: Thermal plume 20th April 2018 – excess temperature at high water circa 0.3m depth layer 6

Figure 1.86: Thermal plume 20th April 2018 – excess temperature at high water circa 1m depth layer 5

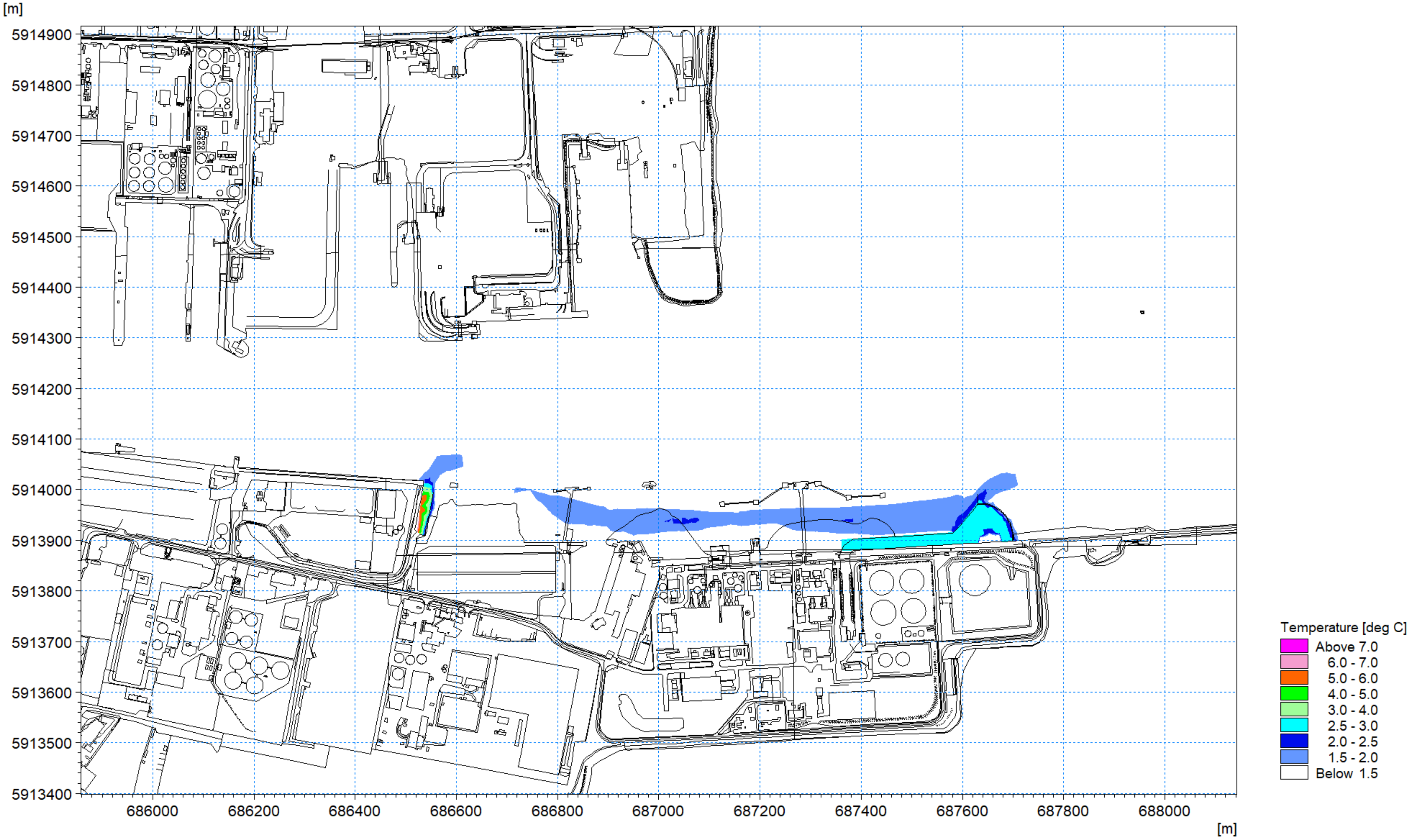


Figure 1.87: Thermal plume 20th April 2018 – excess temperature at high water circa 2m depth layer 4

Figure 1.88: Thermal plume 20th April 2018 – excess temperature at mid-ebb circa 0.3m depth layer 6

Figure 1.89: Thermal plume 20th April 2018 – excess temperature at mid-ebb circa 1m depth layer 5

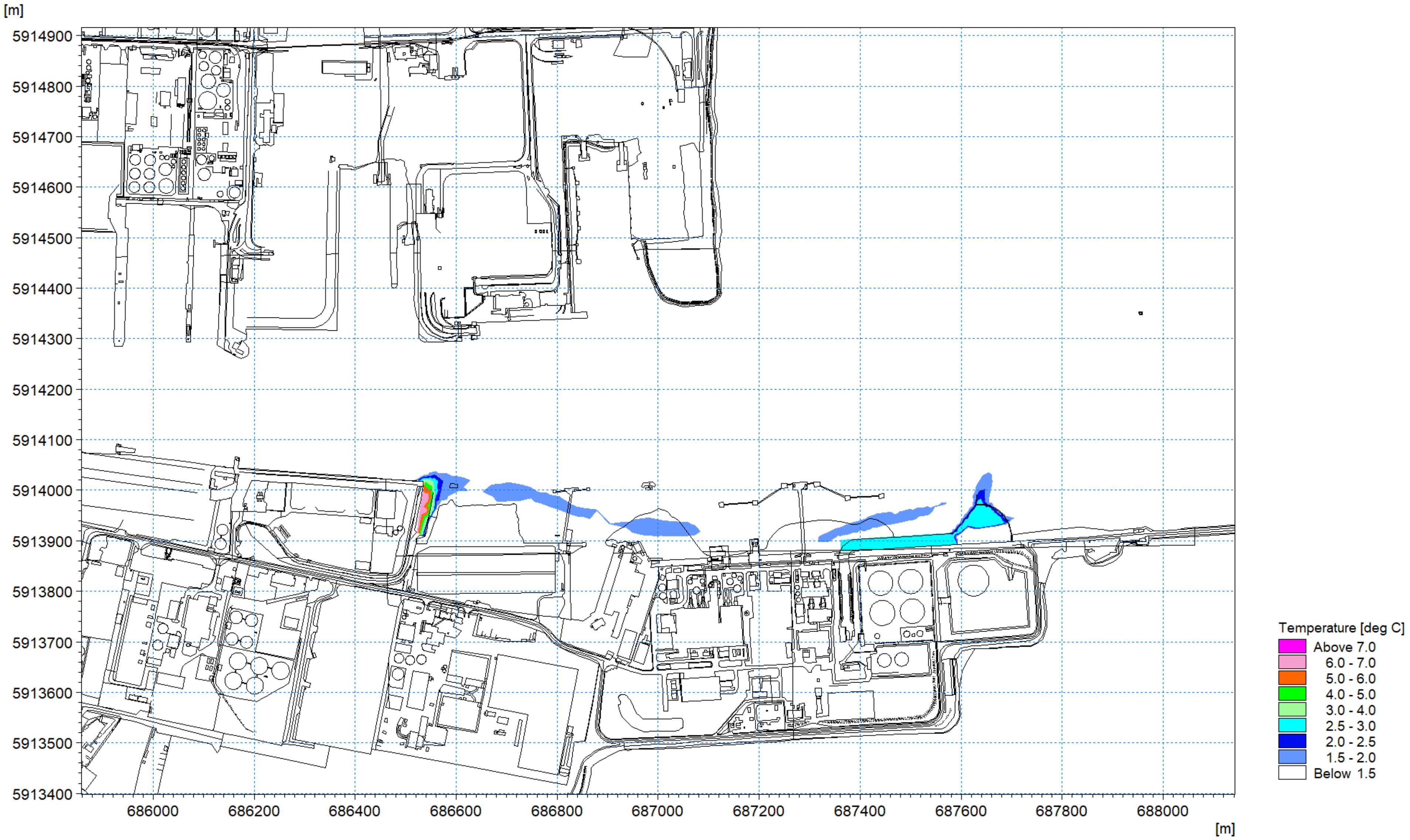


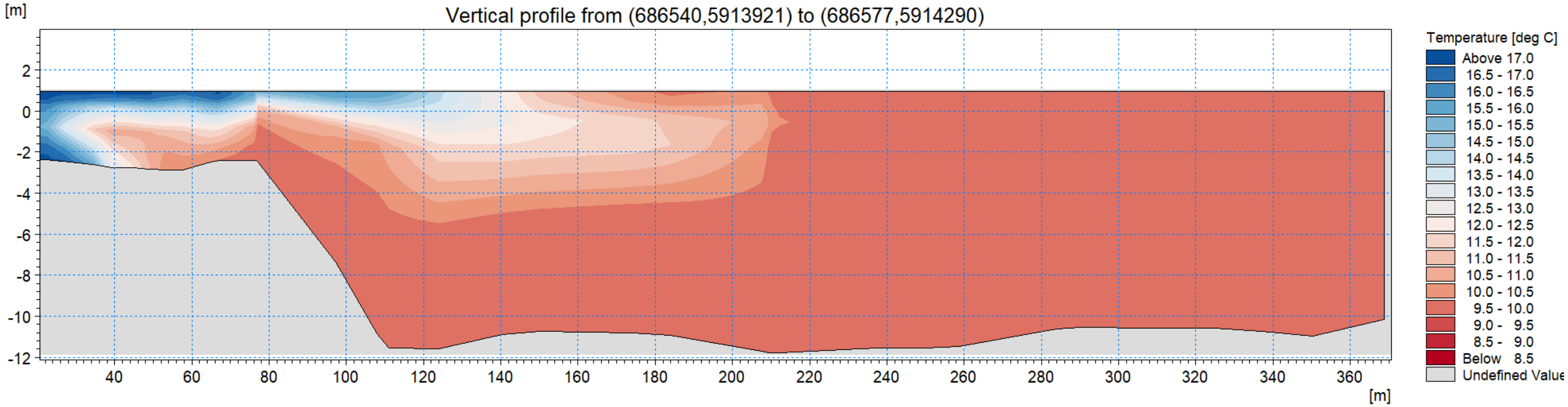
Figure 1.90: Thermal plume 20th April 2018 – excess temperature at mid-ebb circa 2m depth layer 4

Figure 1.91: Thermal plume 20th April 2018 – excess temperature at low water circa 0.3m depth layer 6

Figure 1.92: Thermal plume 20th April 2018 – excess temperature at low water circa 1m depth layer 5

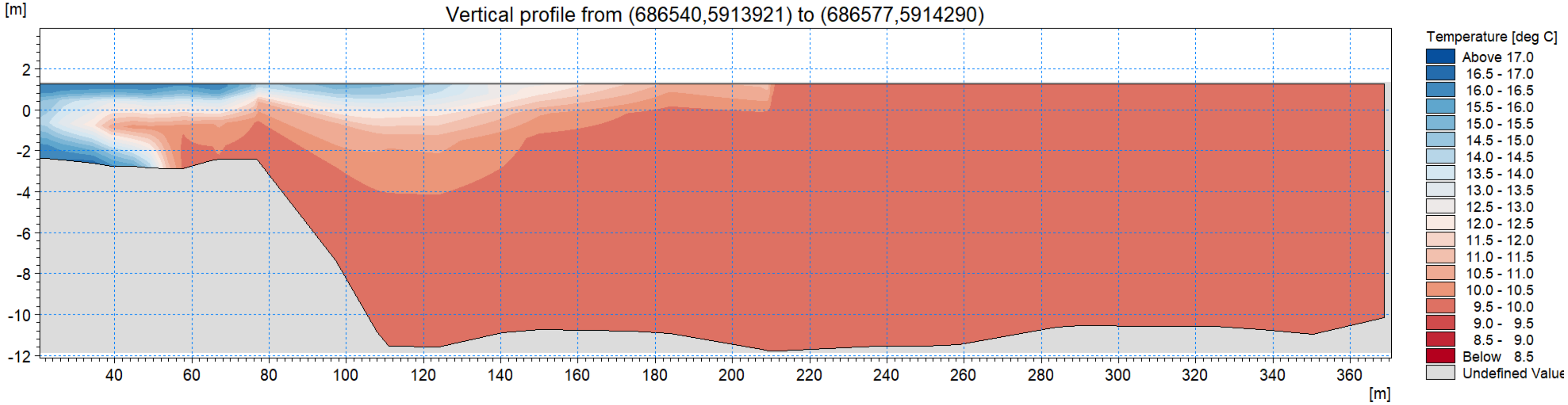
Figure 1.93: Thermal plume 20th April 2018 – excess temperature at low water circa 2m depth layer 4

B.1.2 Thermal Survey – Vertical profiles



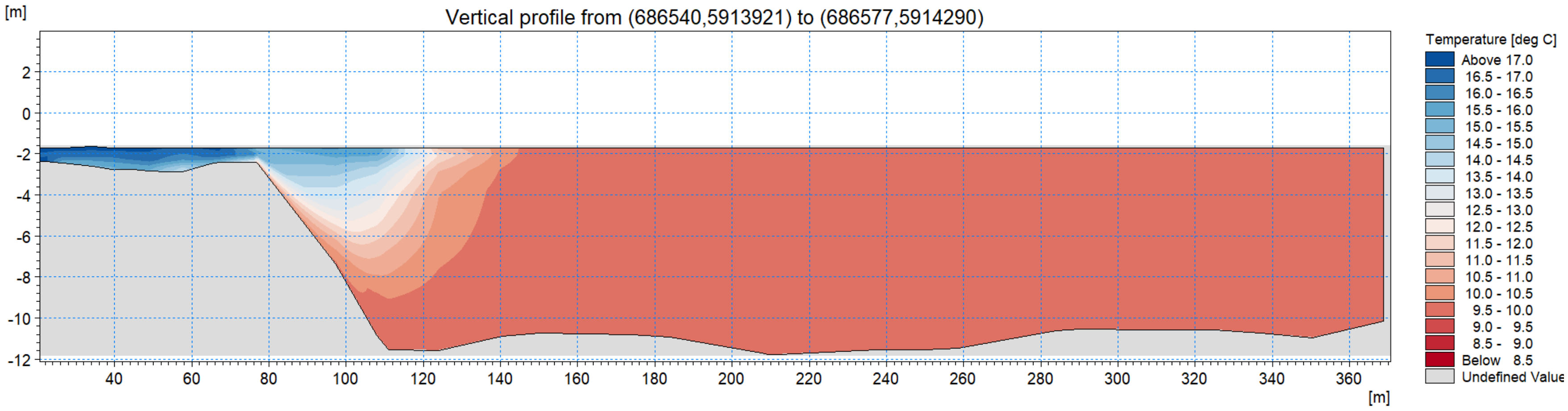
20/04/2018 12:15:00 Time Step 237 of 860.

Figure 1.94: Thermal profile 1 - 20th April 2018 – high water minus 2.25 hours



20/04/2018 15:30:00 Time Step 250 of 860.

Figure 1.95: Thermal profile 2 - 20th April 2018 – high water plus 1 hour



20/04/2018 20:00:00 Time Step 268 of 860.

Figure 1.96: Thermal profile 3 - 20th April 2018 – low water

B.2 Thermal Survey Neap Tide 24th April 2018

B.2.1 Thermal Survey – Contours of Excess Temperature

Figure 1.97: Thermal plume 24th April 2018 – excess temperature at high water circa 0.3m depth layer 6

Figure 1.98: Thermal plume 24th April 2018 – excess temperature at high water circa 1m depth layer 5

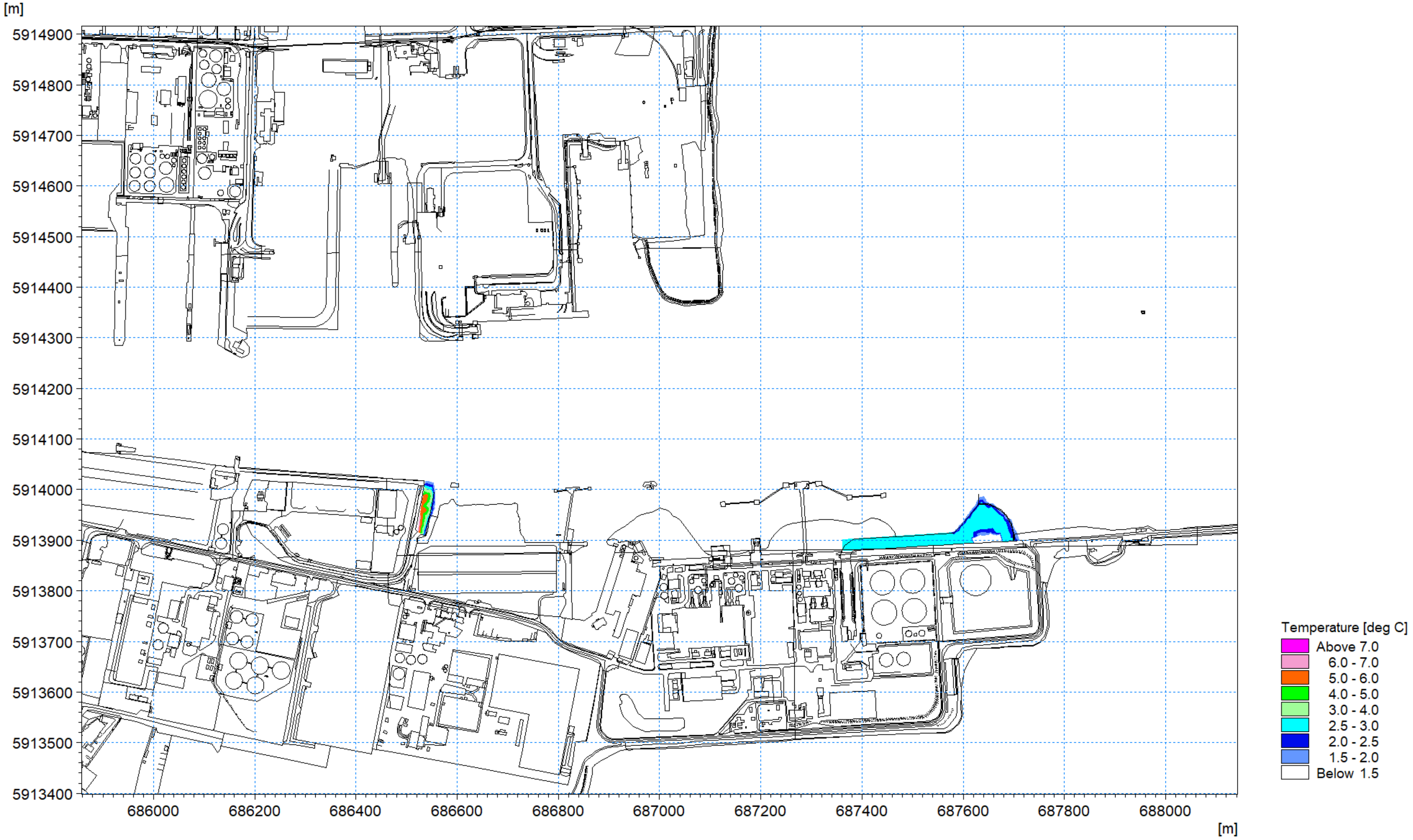


Figure 1.99: Thermal plume 24th April 2018 – excess temperature at high water circa 2m depth layer 4

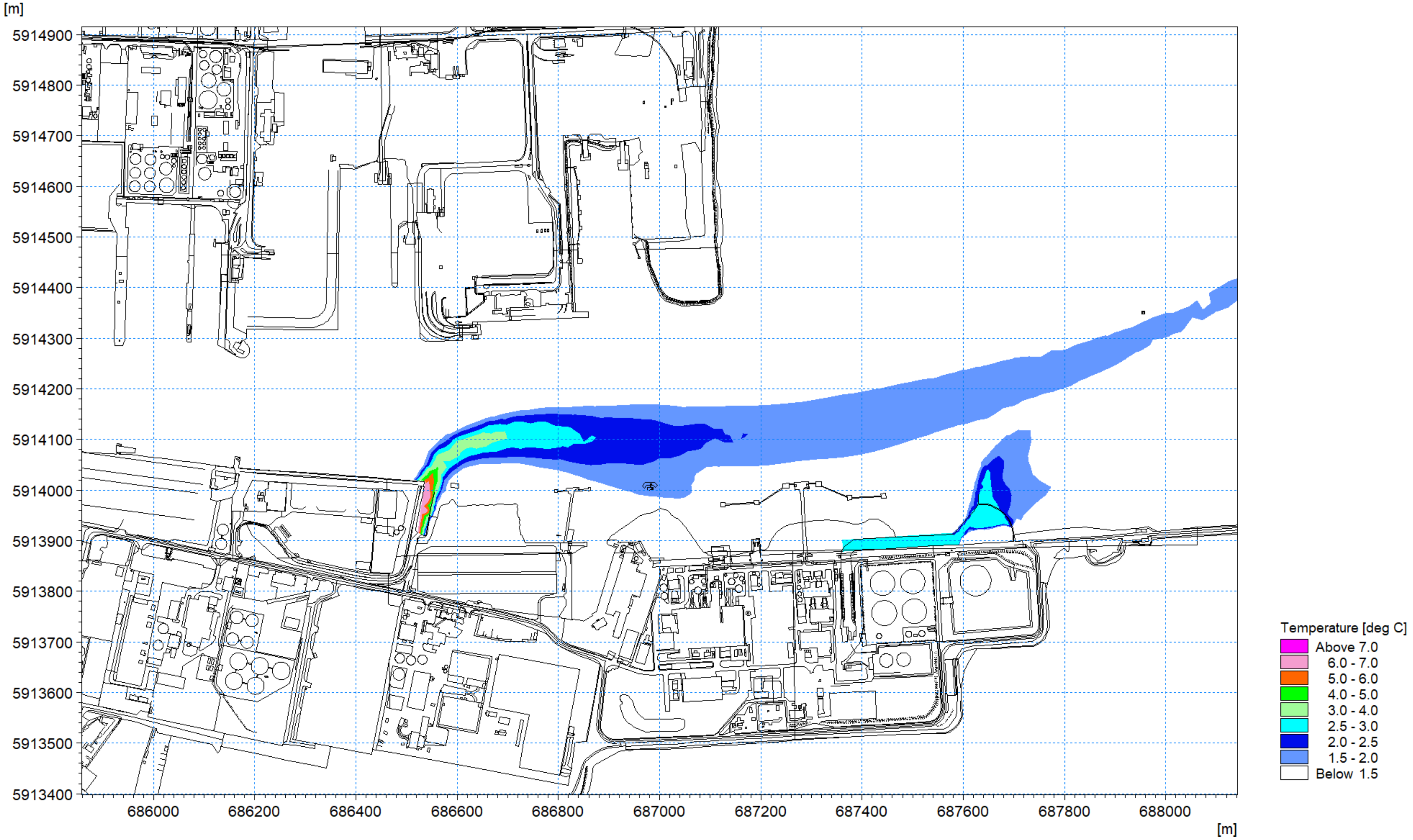


Figure 1.100: Thermal plume 24th April 2018 – excess temperature at mid-ebb circa 0.3m depth layer 6

Figure 1.101: Thermal plume 24th April 2018 – excess temperature at mid-ebb circa 1m depth layer 5

Figure 1.102: Thermal plume 24th April 2018 – excess temperature at mid-ebb circa 2m depth layer 4

Figure 1.103: Thermal plume 24th April 2018 – excess temperature at low water circa 0.3m depth layer 6

Figure 1.104: Thermal plume 24th April 2018 – excess temperature at low water circa 1m depth layer 5

Figure 1.105: Thermal plume 24th April 2018 – excess temperature at low water circa 2m depth layer 4

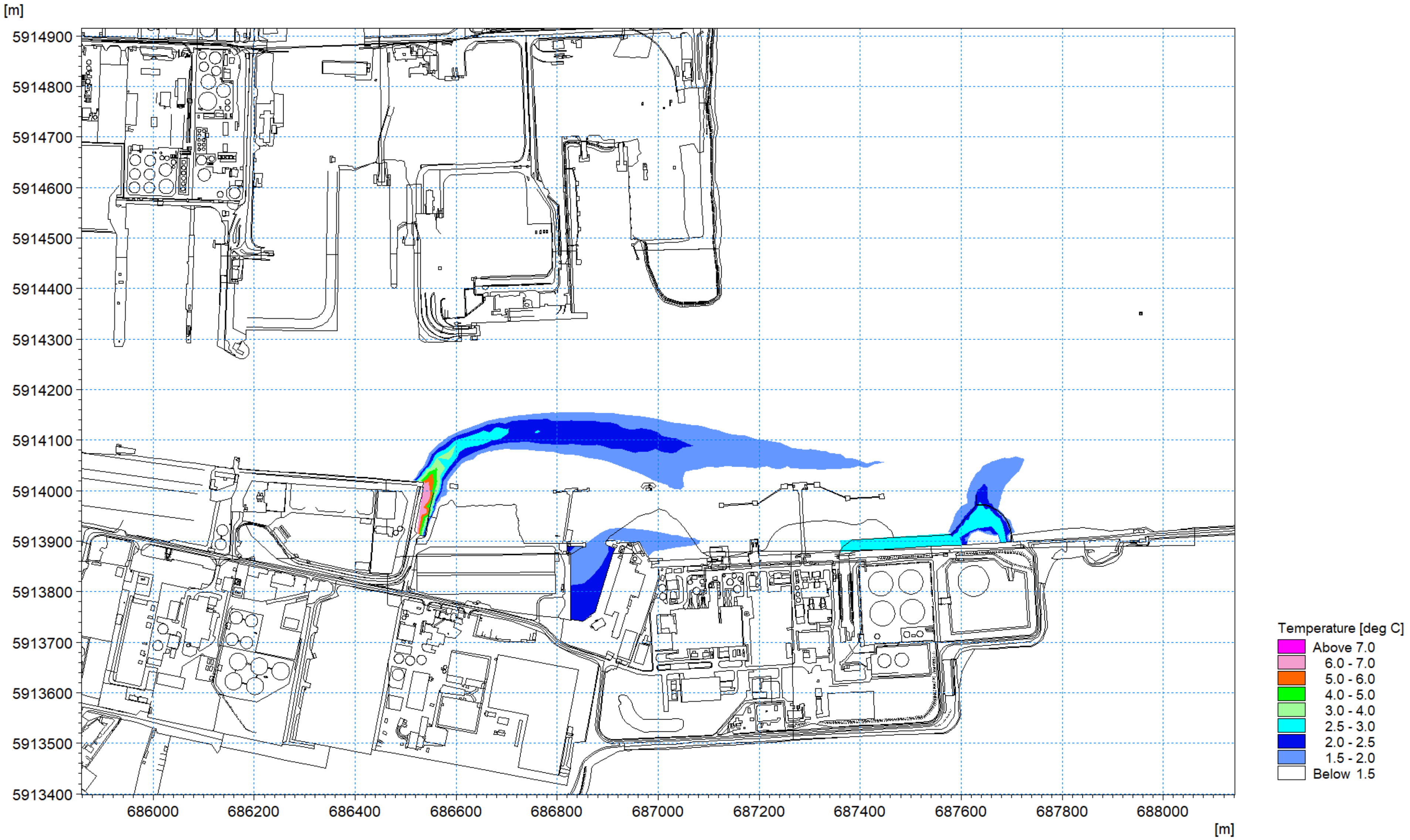


Figure 1.106: Thermal plume 24th April 2018 – excess temperature at mid-flood circa 0.3m depth layer 6

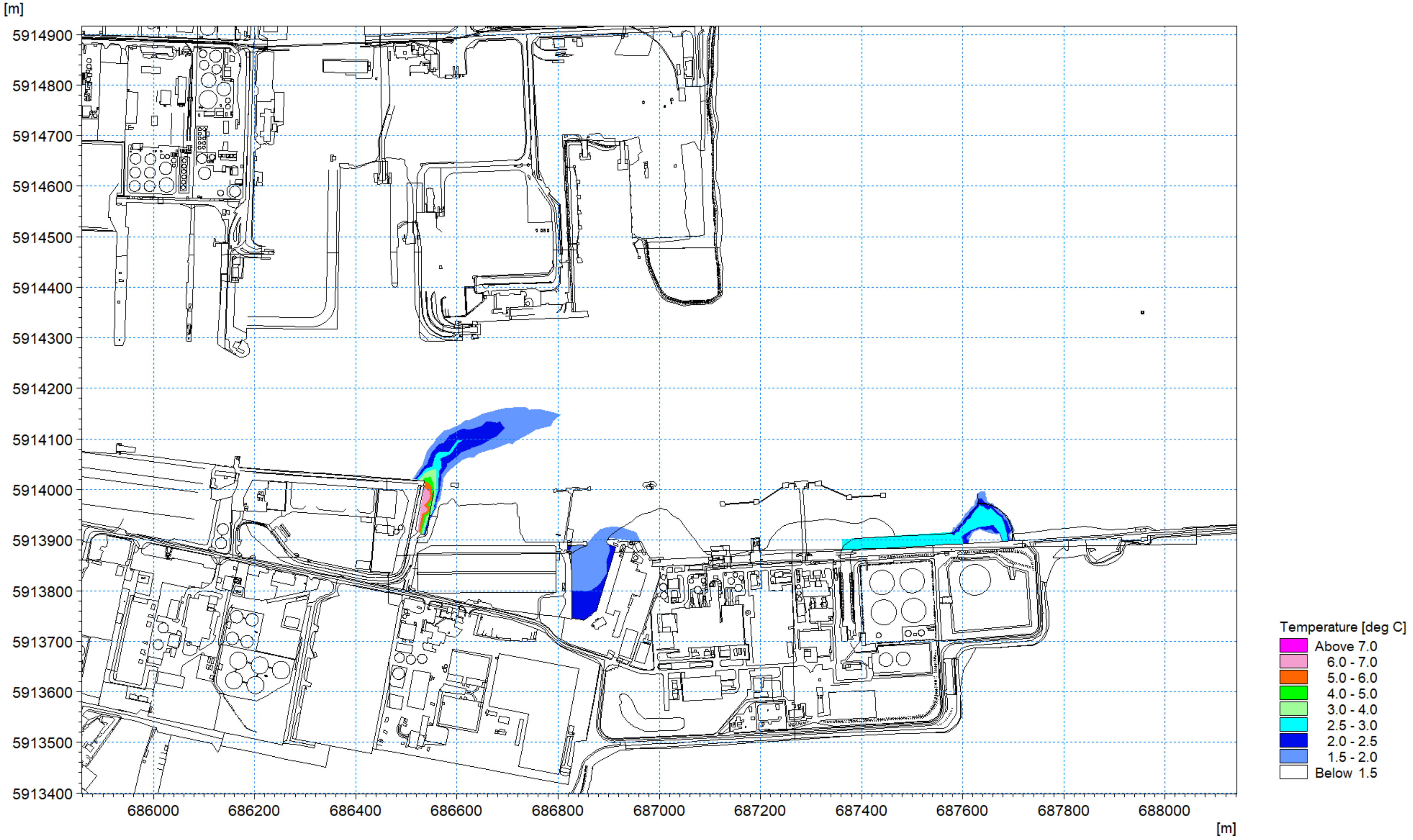


Figure 1.107: Thermal plume 24th April 2018 – excess temperature at mid-flood circa 1m depth layer 5

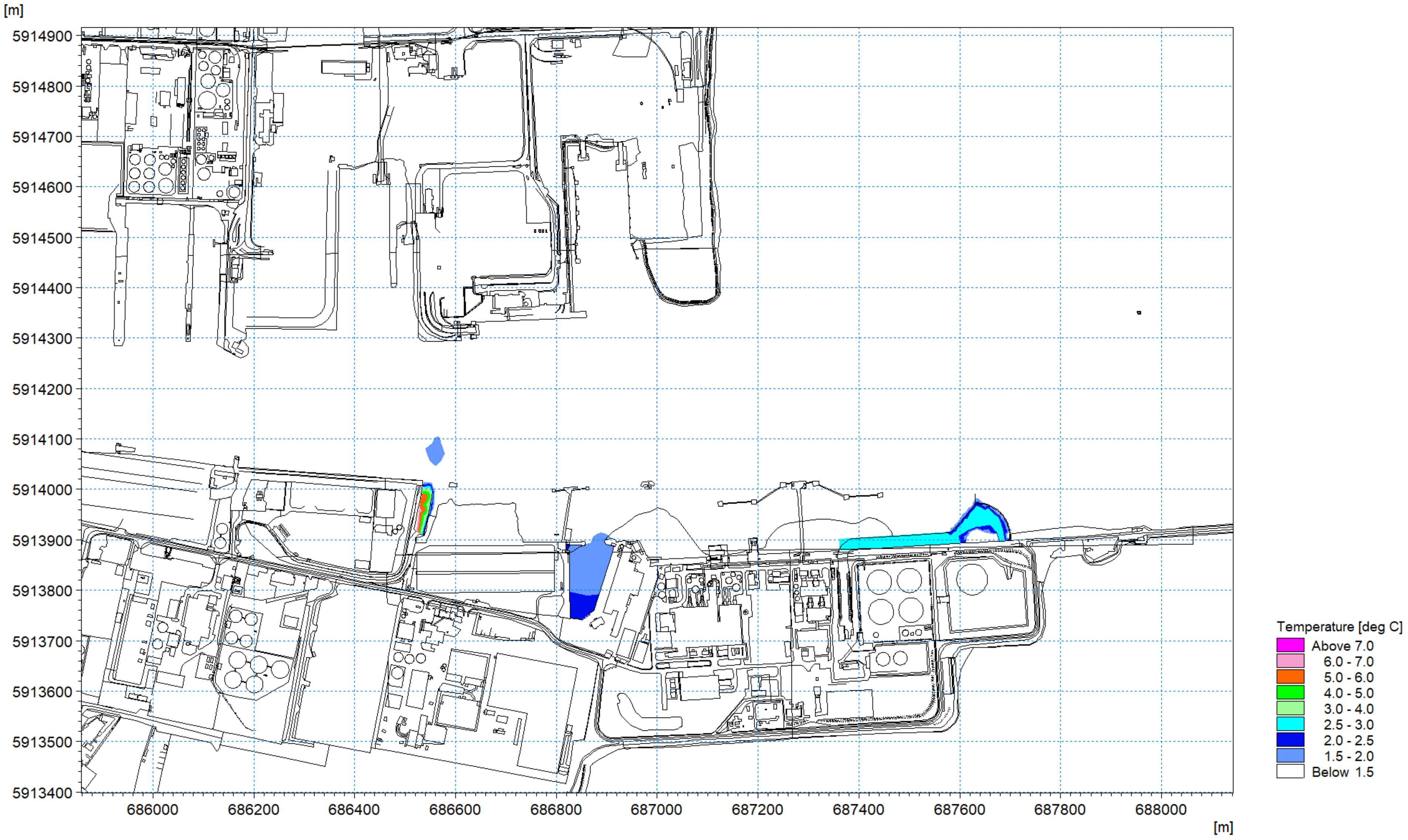


Figure 1.108: Thermal plume 24th April 2018 – excess temperature at mid-flood circa 2m depth layer 4

B.2.2 Thermal Survey – Vertical Profiles

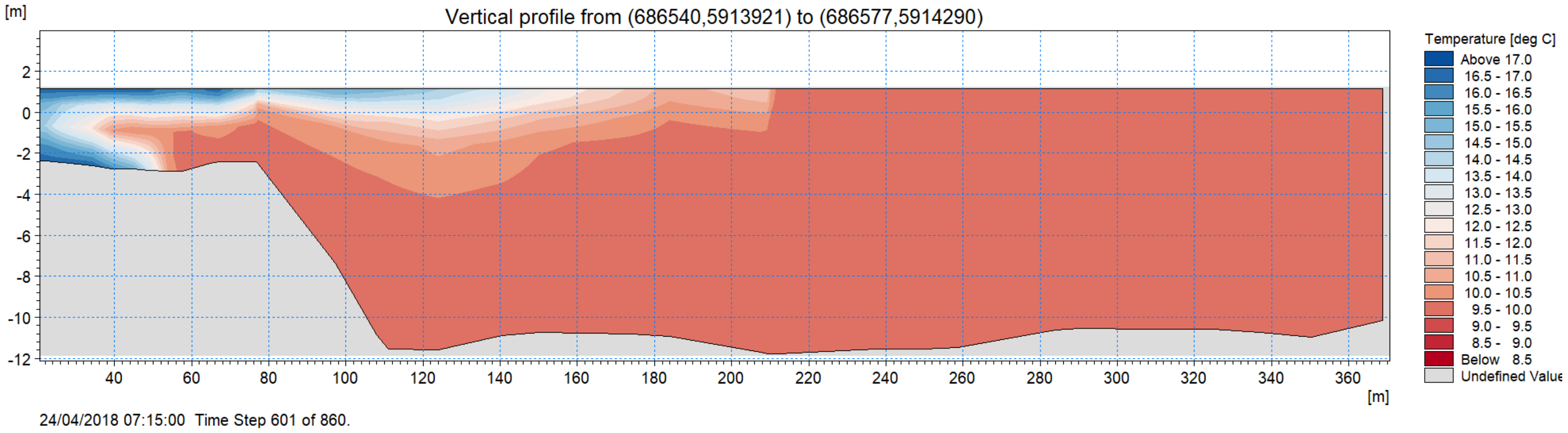


Figure 1.109: Thermal profile 1 - 24th April 2018 – high water plus 47 minutes

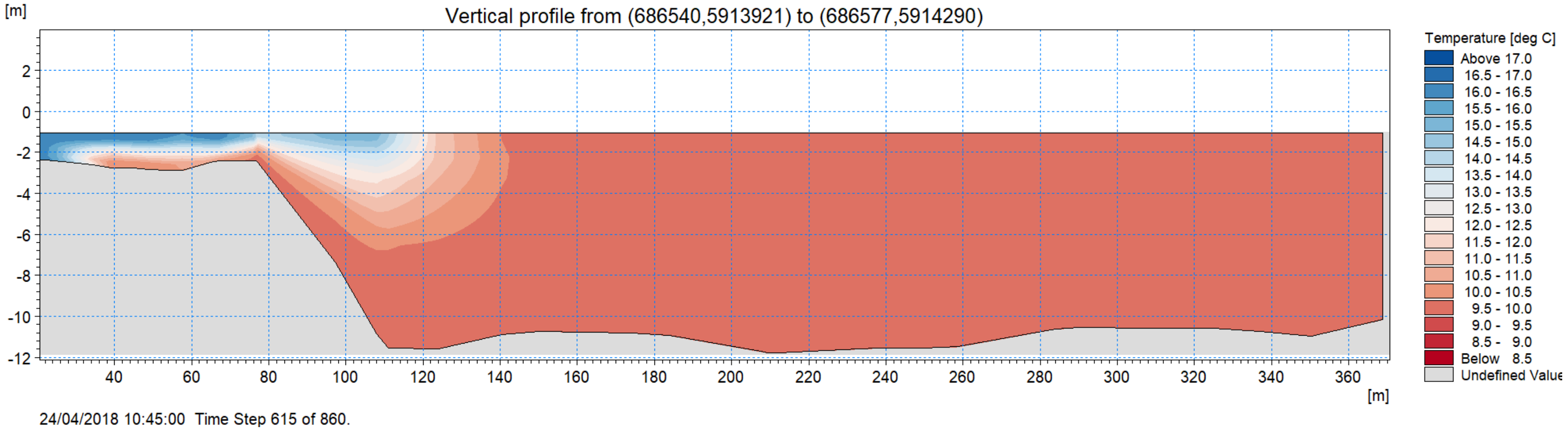


Figure 1.110: Thermal profile 2 - 24th April 2018 – high water plus 4 hours

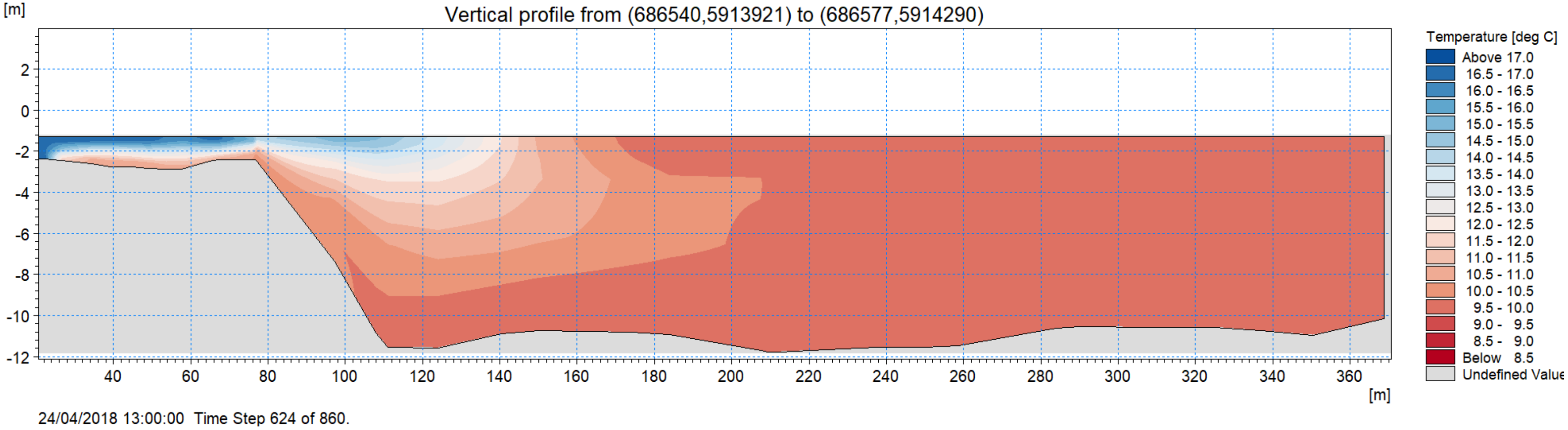


Figure 1.111: Thermal profile 3 - 24th April 2018 – low water plus 36 minutes

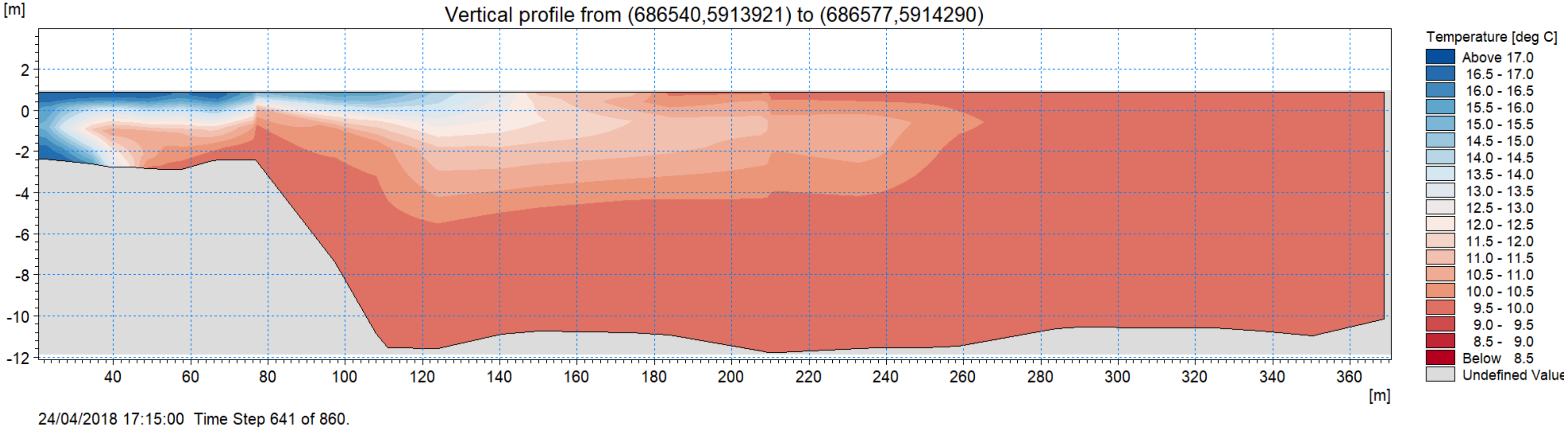


Figure 1.112: Thermal profile 4 - 24th April 2018 – high water minus 2 hours

Appendix C

C.1 Thermal Survey 9th April 2019

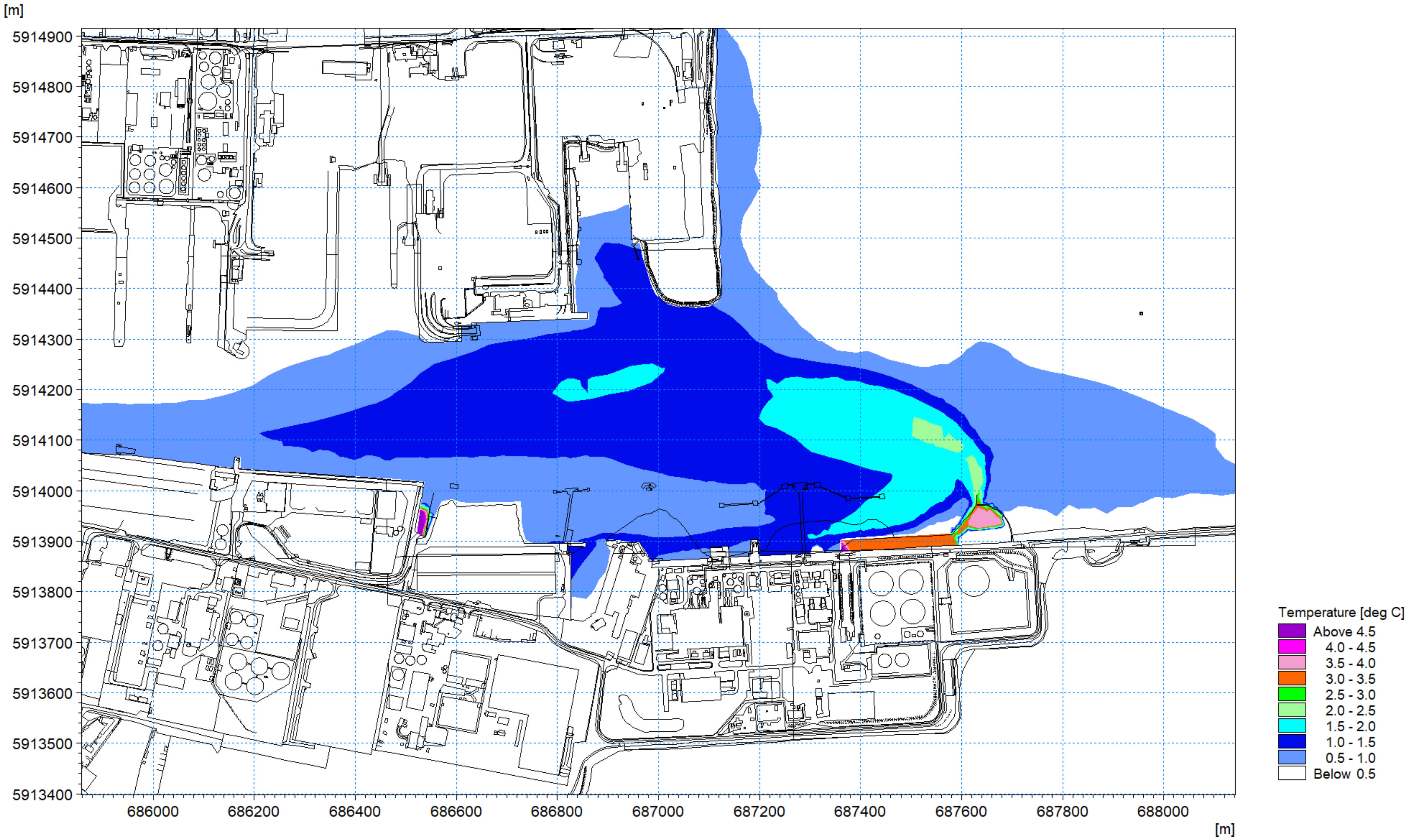


Figure 1.113: Thermal plume 9th April 2019 – excess temperature at low water circa 0.3m depth layer 6

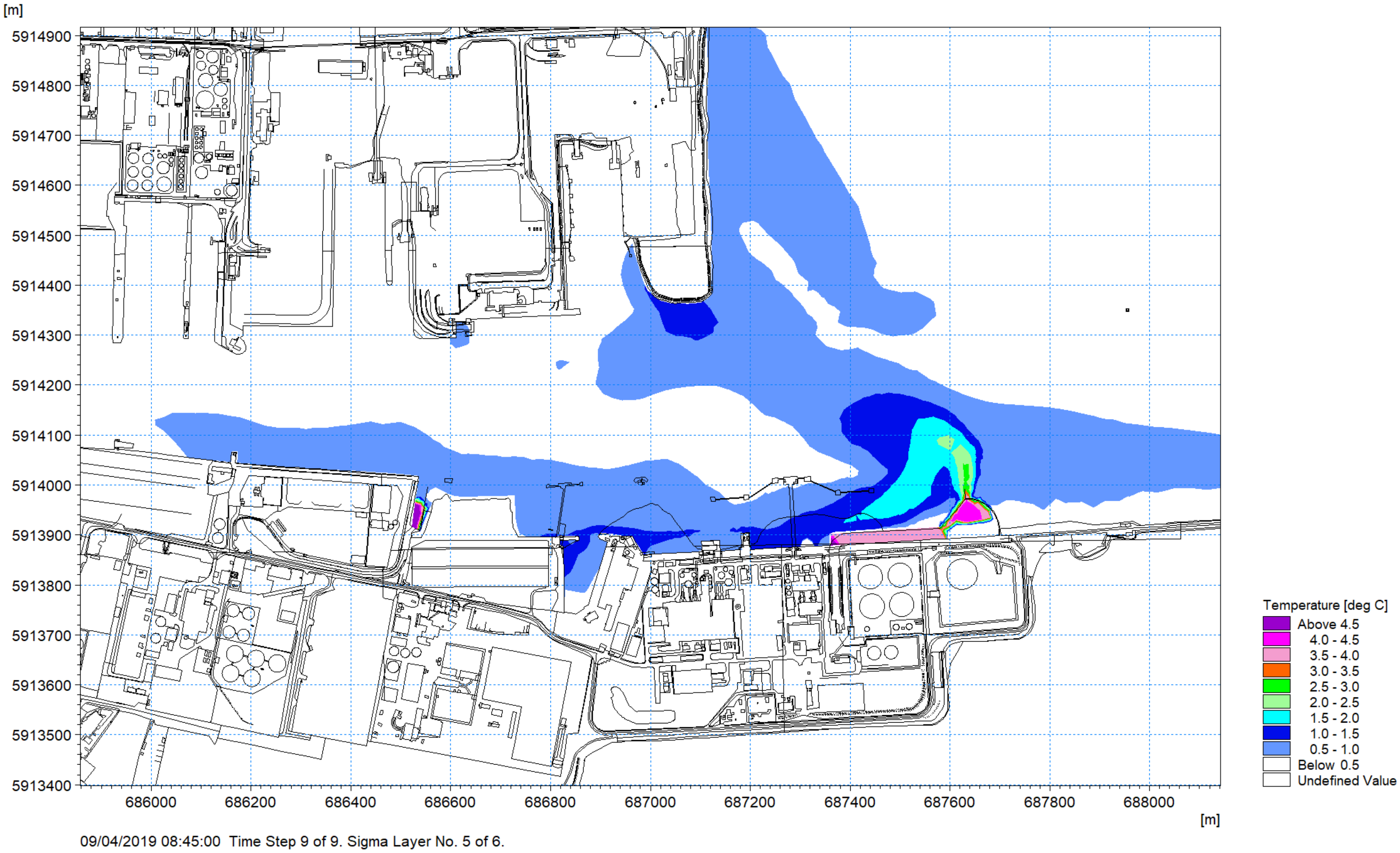


Figure 1.114: Thermal plume 9th April 2019 – excess temperature at low water circa 0.9m depth layer 5

Figure 1.115: Thermal plume 9th April 2019 – excess temperature at low water circa 1.8m depth

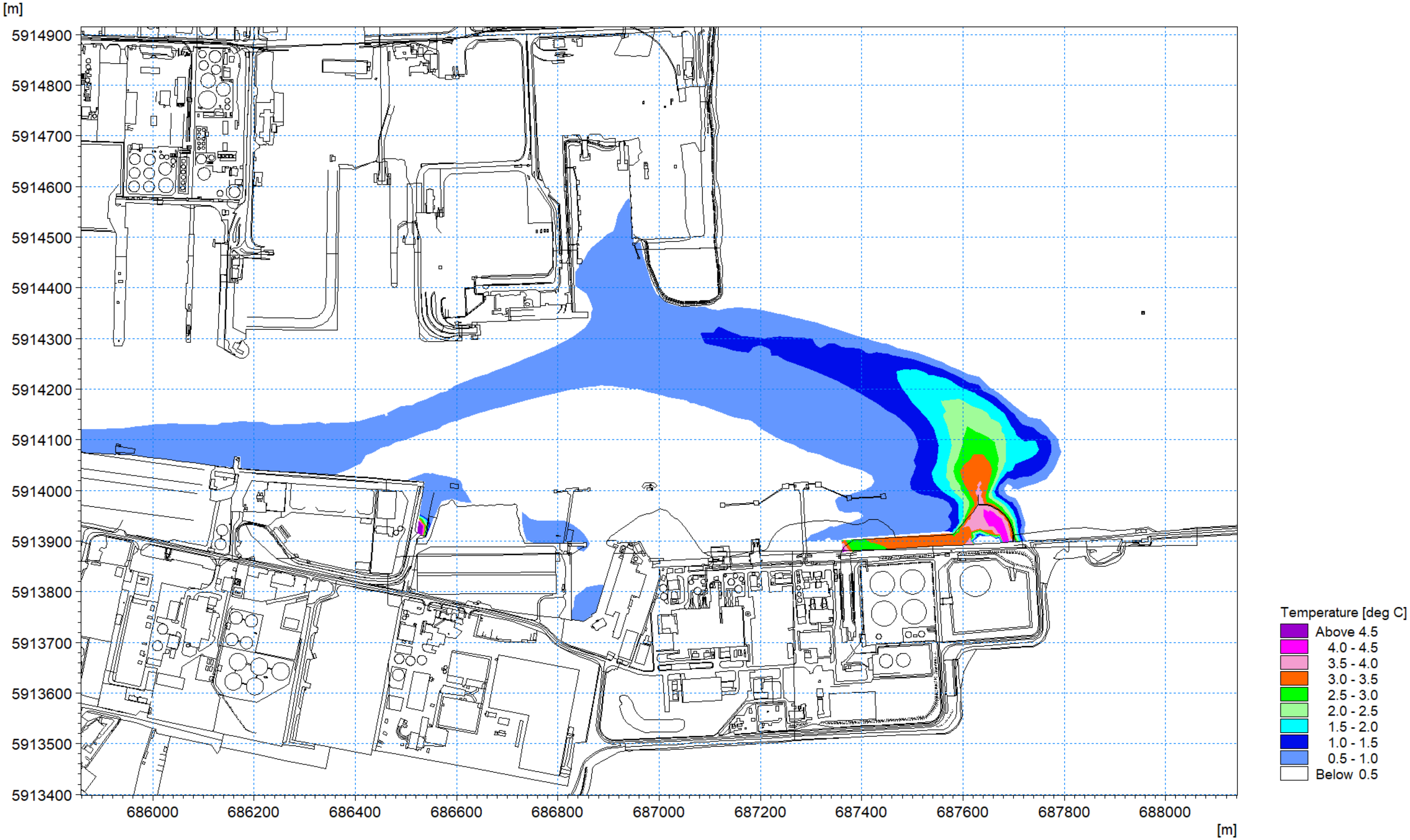


Figure 1.116: Thermal plume 9th April 2019 – excess temperature at mid-flood circa 0.3m depth layer 6

Figure 1.117: Thermal plume 9th April 2019 – excess temperature at mid-flood circa 0.9m depth layer 5

Figure 1.118: Thermal plume 9th April 2019 – excess temperature at mid-flood circa 1.8m depth layer 4

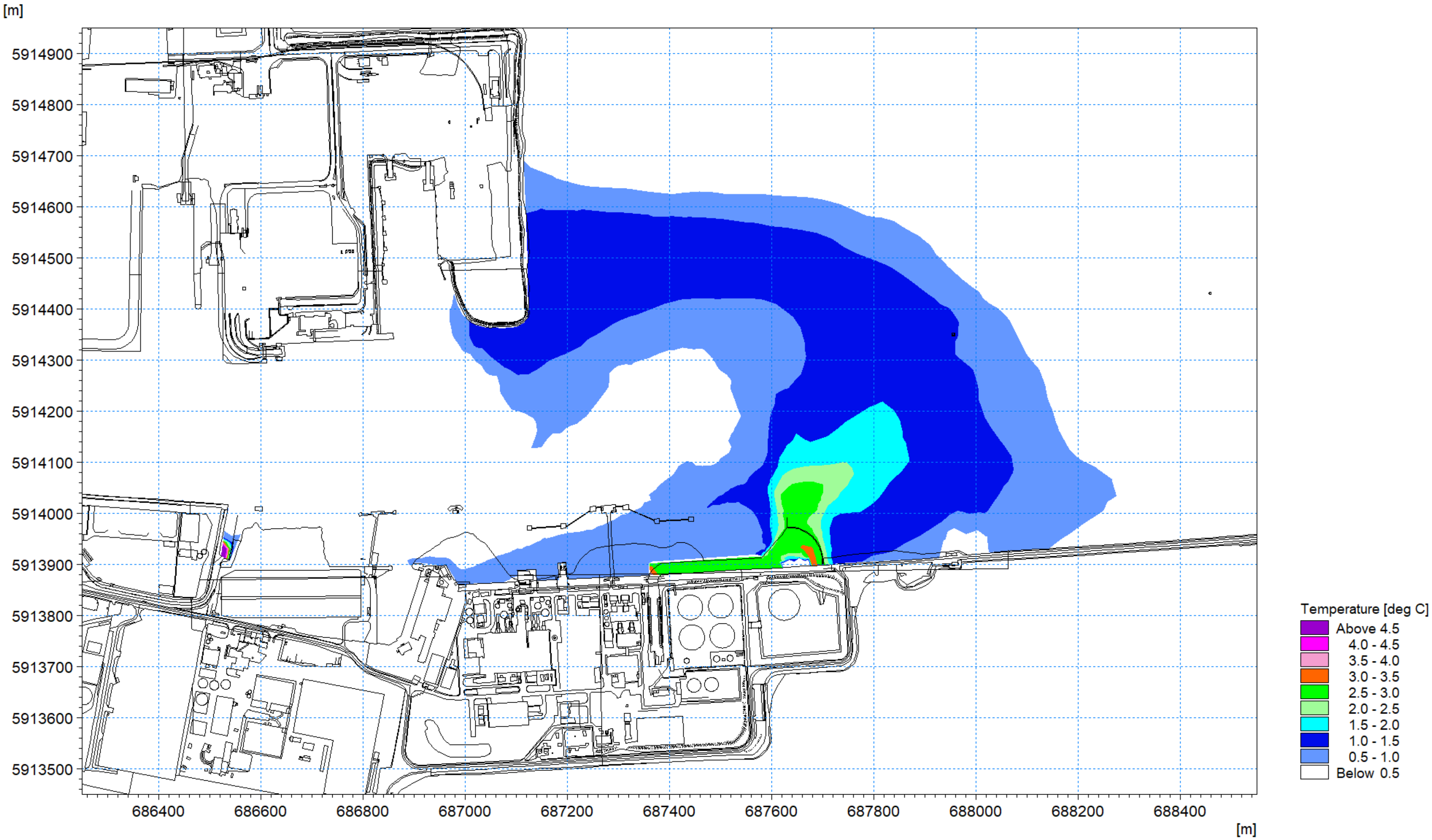


Figure 1.119: Thermal plume 9th April 2019 – excess temperature at high water circa 0.3m depth layer 6

Figure 1.120: Thermal plume 9th April 2019 – excess temperature at high water circa 0.9m depth layer 5

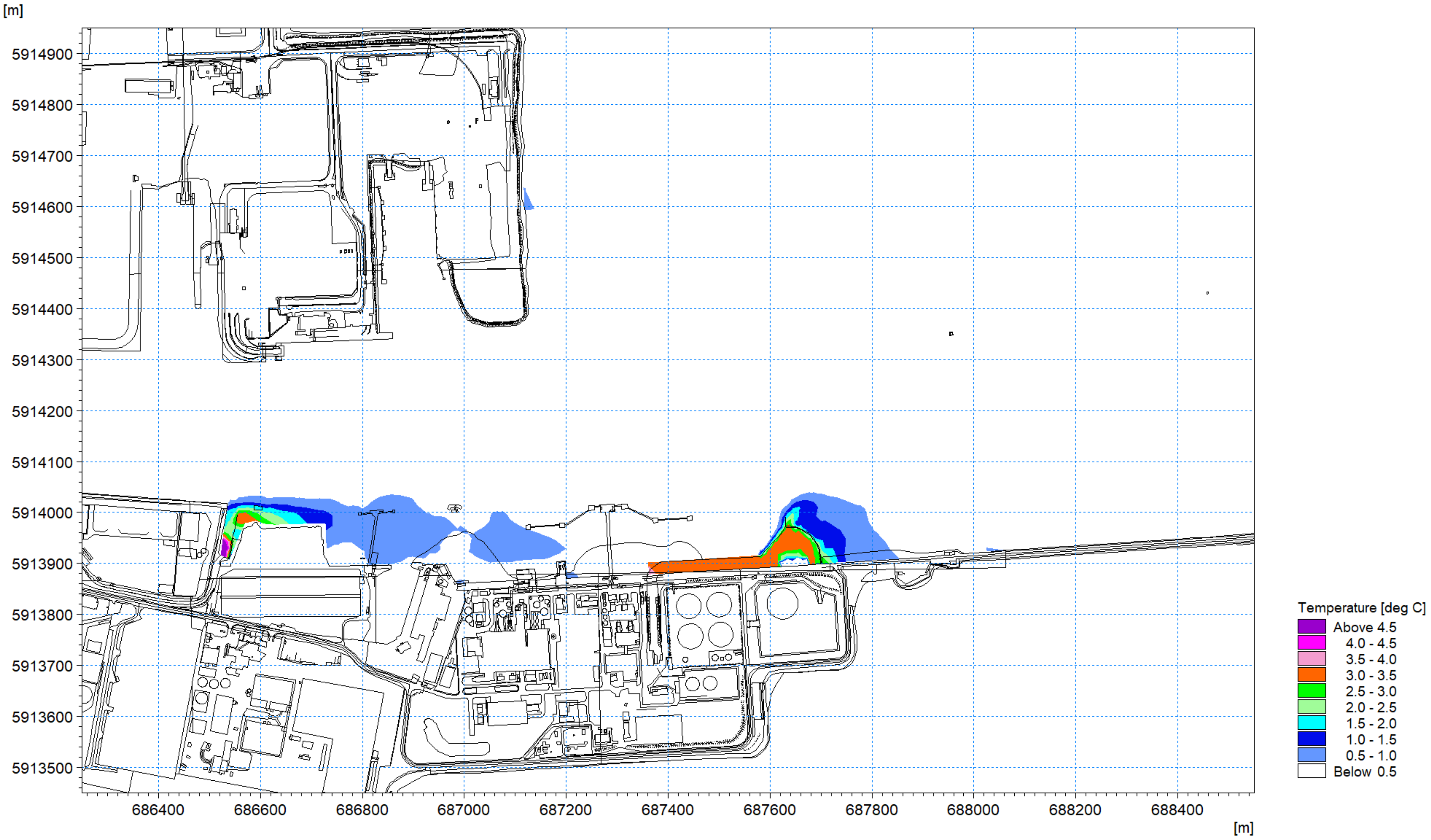


Figure 1.121: Thermal plume 9th April 2019 – excess temperature at high water circa 1.8m depth layer 3

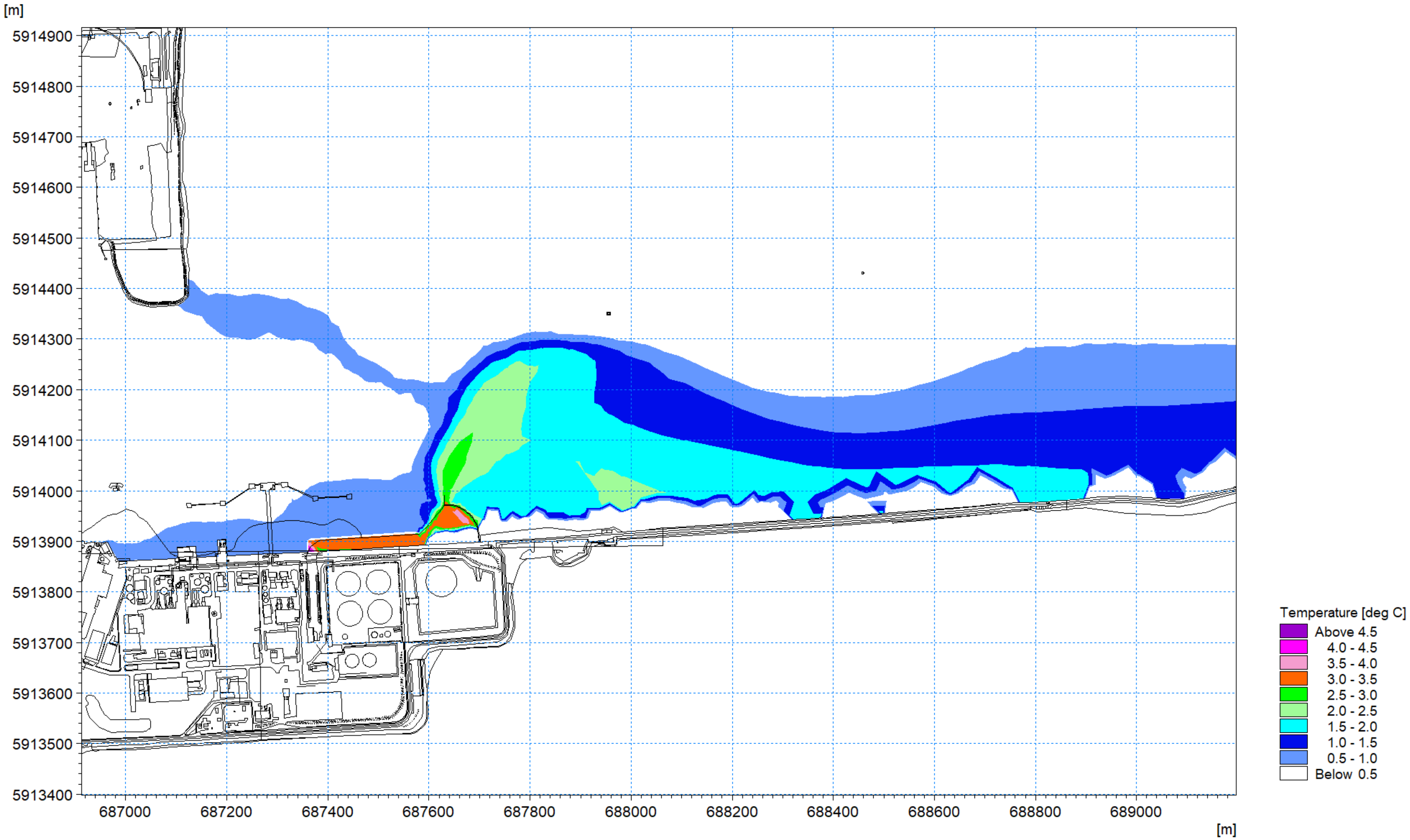


Figure 1.122: Thermal plume 9th April 2019 – excess temperature at mid-ebb circa 0.3m depth layer 6

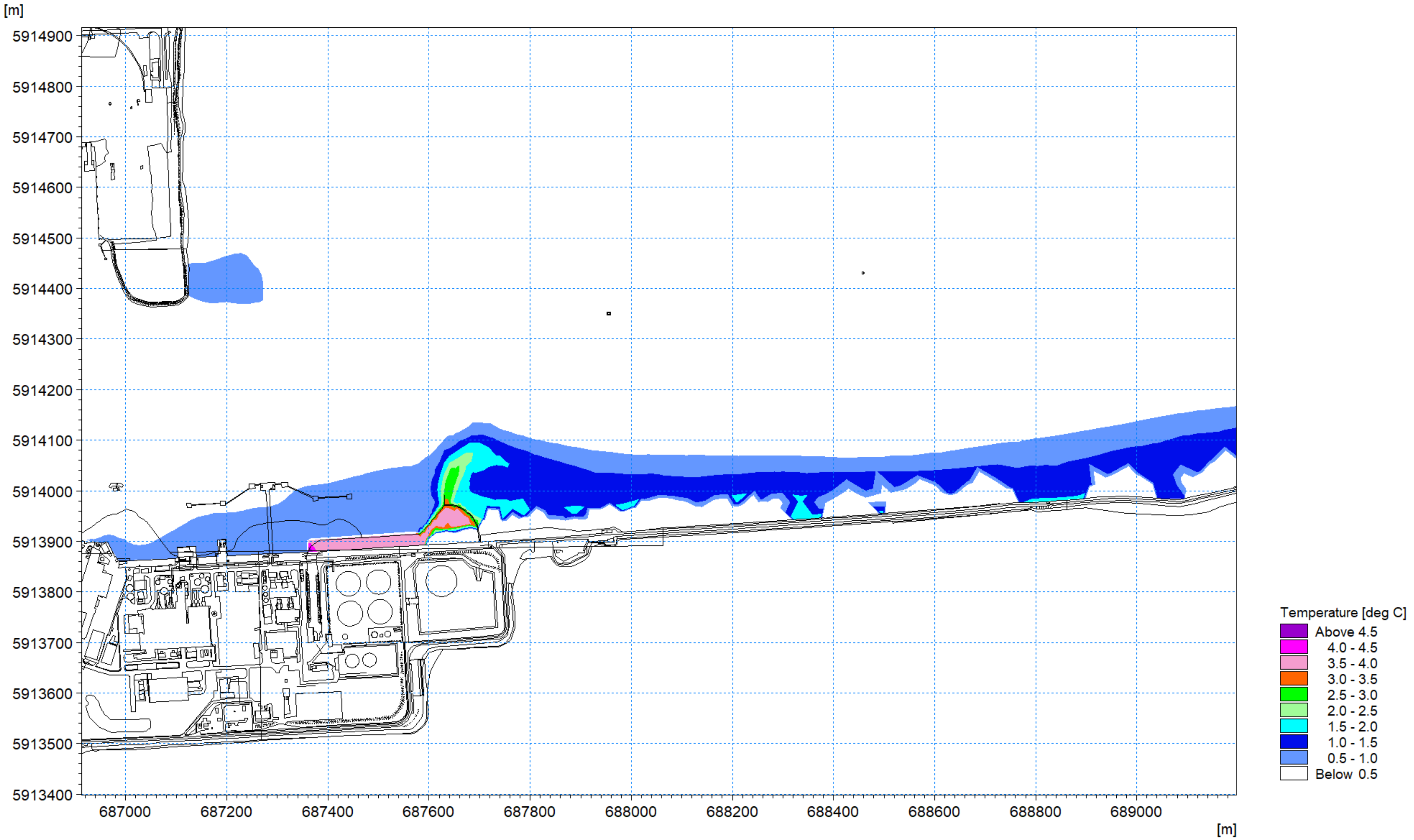


Figure 1.123: Thermal plume 9th April 2019 – excess temperature at mid-ebb circa 0.9m depth layer 4

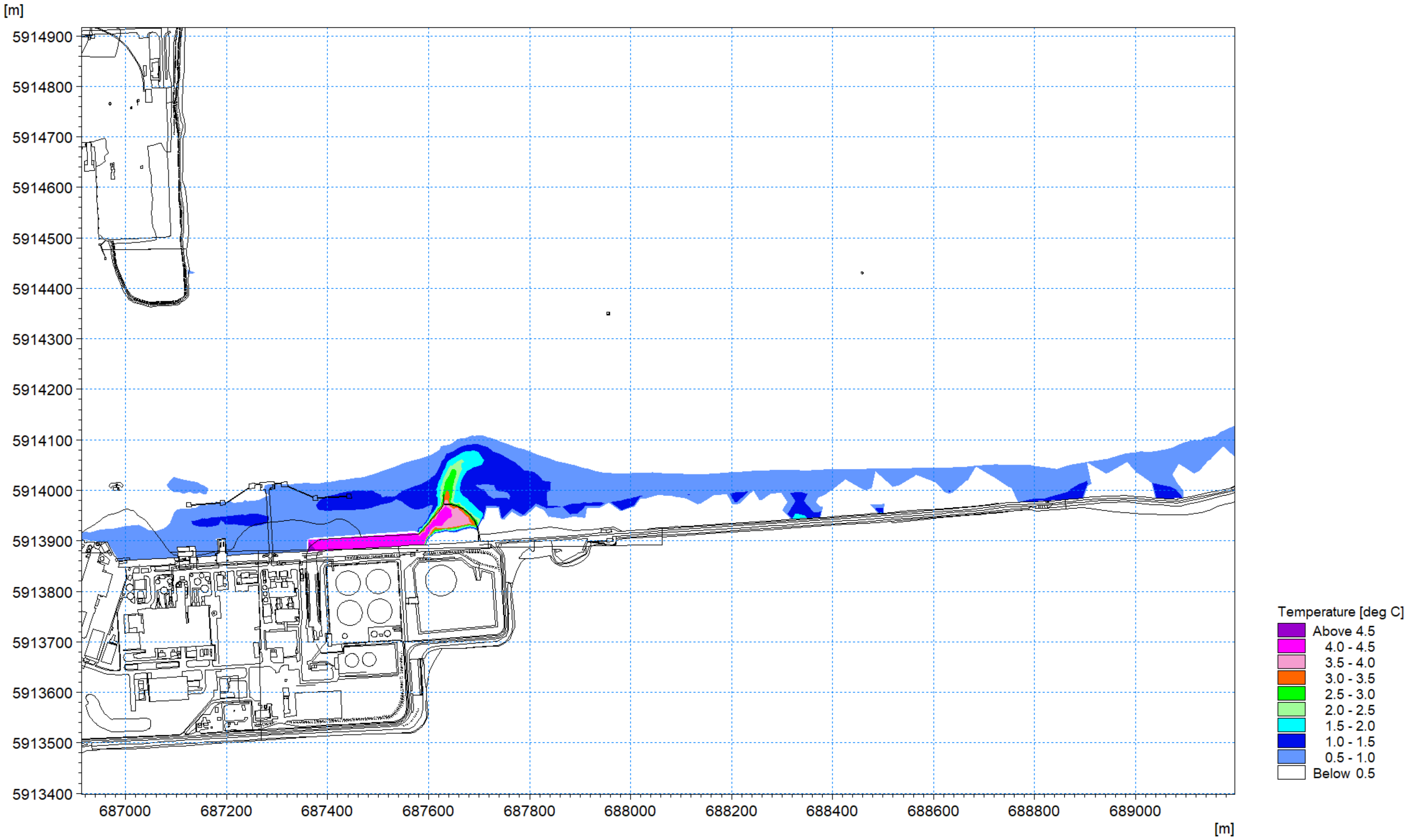


Figure 1.124: Thermal plume 9th April 2019 – excess temperature at mid-ebb circa 1.8m depth layer 3

APPENDIX 13-4

CUMULATIVE IMPACT OF SEDIMENT DEPOSITION AND DISPERSION WITH ACTIVITIES PERMITTED UNDER (S0004-03 AND S0024-02)

DUBLIN PORT COMPANY

DUBLIN HARBOUR CAPITAL DREDGING PROJECT DUMPING AT SEA PERMIT (S0033-01)

Response to Section 5(2) Notice

Capital Dredging Programme
Dumping at Sea Permit
S0033-01

Response to Section 5(2)
Notice

D01
4 January 2024

rpsgroup.com

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
Draft	Internal Review	KC	AKB	AGB	15/12/2023
Final	Issue to EPA	KC	AKB	AGB	04/01/2024

Approval for issue

Dr A G Barr	Alan Barr	4 January 2024

Prepared by:

RPS

Kristopher Calder BSc (Hons) MSc C.Sci MCIWEM C.WEM AMICE
Technical Director - Water Environment and Flood Risk Management
Elmwood House
74 Boucher Road, Belfast
Co. Antrim BT12 6RZ

T +44 2890 667 914
E kristopher.calder@rpsgroup.com

Prepared for:

Dublin Port Company

Eamon McElroy
Port Engineer

Dublin Port Centre
Alexandra Road, Dublin 1

T 01 8876000
E emcelroy@dublinport.ie

Declaration

I certify that the information given in this Section 5(2) response is truthful, accurate and complete.

I give consent to the EPA to copy this Section 5(2) response for its own use and to make it available for inspection and copying by the public, both in the form of paper files available for inspection at EPA and local authority offices, and via the EPA's website.

This consent relates to this Section 5(2) response itself and to any further information or submission, whether provided by me as Applicant, any person acting on the Applicant's behalf, or any other person.

E. McElroy

Signed by: ***Date:*** *4th January 2024*

(on behalf of the organisation)

Print signature name: Eamon McElroy

Position in organisation: Port Engineer

Contents

1 INTRODUCTION

Dublin Port Company (DPC) submitted a Dumping at Sea Permit Application to the EPA for the Dublin Harbour Capital Dredging Project on 26th August 2021 (DAS Permit Ref S0033- 01). The application was supported by an EIAR, AA Screening Report and NIS.

A public consultation was undertaken between 8th September 2021 to 8th October 2021.

A Section 5(2) Notice was issued to DPC from the EPA on 7th November 2023 requesting additional information so that the Agency may complete a comprehensive assessment of the application.

This technical document provides a response to Issue No.3 of the Section 5(2) notice which requires DPC to:

> "Provide details on the predicted sediment deposition and sediment dispersion from loading and dumping activities, cumulatively from the proposed activities and those permitted under (S0004-03 and S0024-02) and any subsequent impacts on the wider environment. As a minimum a modelling assessment is required to describe the fate of sediments and the impact on the receiving environment, and address how the activities will be managed to ensure that they will comply with, or will not result in the contravention of the following Directives:
>
> - The Habitats Directive 82/43/EEC and Birds Directive 2009/147/EEC,
> - The Water Framework Directive 2000/60/EC,
> - The Marine Strategy Framework Directive 2008/56/EC.

The cumulative assessment includes the following permitted loading and dumping activities:

- Dumping at Sea Permit S0004-03 - Dublin Port 2022-2029 Maintenance Dredging Programme
- Dumping at Sea Permit S0024-02 - MP2 Project Capital Dredging

For robustness, the cumulative assessment also includes for proposed capital dredging required by the 3FM Project, the third and final Strategic Infrastructure Development to be brought forward for planning consent from the Dublin Port Masterplan 2040, reviewed 2018. The planning application for the 3FM Project is anticipated to be issued to An Bord Pleanála (ABP) in Q2/Q3 2024. The Dumping at Sea Permit application is anticipated to be issued to the EPA in Q3/Q4 2024. The assessment of this element of loading and dumping is contingent on the granting of consents from ABP and the EPA.

It should be noted that this response builds and expands upon an accepted response to a previous Section 5(2) Notice received as part of the D@S application for S0024-02 which requested "*details on the predicted sediment deposition from loading and dumping activities, cumulatively from all three projects (S0024-02, S0004-03 and S0033-01) and any subsequent impacts on the wider environment.*"

2 DREDGE VOLUMES, PROGRAMME AND KEY MITIGATION MEASURES

2.1 Dredge Volumes and Programme

The cumulative assessment has been based on the maximum dredge volumes presented in Table 2-1.

Table 2-1 Maximum Dredge Volumes

Project	Dumping at Sea Reference	Status	Maximum Dredge Volume (m^3)
Dublin Harbour Capital Dredging Project	S0033-01	Current Application	500,000 m^3
Dublin Port 2022-2029 Maintenance Dredging Programme	S0004-03	Permitted	2,400,000 m^3 (Annual Max 300,000 m^3)
MP2 Project Capital Dredging	S0024-01	Permitted	668,317 m^3
3FM Project Capital Dredging	N/A	Application expected Q3/Q4 2024	1,117,000 m^3

Notes

- MP2 Project (S0024-02) - Dredging Campaign No.1 was completed 15th Oct to 6th Dec 2022; the dredge volume was 339,683 m^3.
- Dublin Port 2022-2029 Maintenance Dredging Programme - Dredging Campaign No.1 was completed 19th July - 20th August 2023; the dredge volume was 298,152 m^3.
- 3FM Project Capital Dredging – A breakdown of the anticipated maximum dredge volumes are presented in Table 2-2.

Table 2-2 Breakdown of 3FM Project anticipated Maximum Dredge Volumes

Location	Dredged Depth (m, Chart Datum)	Volume (m^3)
Poolbeg Marina (Maritime Village)	-3.0 m CD	197,000 m^3
South Port Berths (Proposed Ro-Ro Terminal – Localised Scour Protection to 220 kV cables)	-12.5 m CD	13,000 m^3
Sludge Jetty (Proposed Turning Circle)	-10.0m CD	444,000 m^3
Poolbeg Oil Jetty (Proposed Lo-Lo Terminal Berthing Pocket)	-13.0 m CD	533,000 m^3
Total Dredge Volume		**1,187,000 m^3**
Volume not suitable for disposal at sea (top 1.0m at Poolbeg Marina)		70,000 m^3
Total Dredge Volume suitable for disposal at sea		**1,117,000 m^3**

Notes

- Sediment Chemistry Sampling and Analysis showed that the surface layer at Poolbeg Marina exhibited a wide range of Class 2 material. This material will be brought ashore for treatment and will not be disposed of at sea.

The proposed Overarching Dredge Programme (2022 – 2038) is presented in Appendix A. This programme was submitted to the EPA on 29th November 2023 in response to the Section 5(2) Notice, Issue No.2. The dredging programme takes on board the following common constraints:

- All capital dredging activity at Dublin Port takes place over the winter period (October – March).
- All Maintenance dredging activity at Dublin Port takes place over the summer period (April – September).

2.2 Key Mitigation Measures

The following two key mitigation measures apply to all loading activity within the Inner Liffey Channel (capital dredging and maintenance dredging):

- No overspill is permitted within the inner Liffey channel.
- The hopper volume is limited to 4,100m^3 per trip.

These mitigation measures are enforced to both minimise the source of sediment entering the receiving waters and to control the formation of sediment plumes.

3 PREDICTED SEDIMENT DEPOSITION FROM LOADING ACTIVITIES

The most sensitive receptor for sediment deposition is the Tolka Estuary which forms part of the South Dublin Bay and Tolka Estuary Special Protection Area (SPA). The qualifying interests of this Natura 2000 site are over-wintering water birds.

3.1 Natural Sediment Deposition

Prior to assessing the predicted sediment deposition from loading activities, it is important to first define natural deposition within the Port Area.

To this end, the natural sediment load from the upstream Liffey catchment is estimated at about 200,000 tonnes per annum (DPC Maintenance Dredge AER 2017, Dumping at Sea Permit S0004-01). If dispersed over the Port Area between Tom Clarke Bridge and Poolbeg Lighthouse and the Tolka Estuary; this is roughly equivalent to a natural sediment load of 30 kg/m^2 in any one year (30,000 g/m^2).

This is equivalent to an average siltation depth of 2cm per year (based on a silt material).

3.2 Sediment Deposition from Loading Activity

Considering dredging activities, computational modelling studies have been undertaken to predict sediment deposition within the Tolka Estuary as a result of loading activity associated with each of the following capital and maintenance dredging programmes:

- Dublin Harbour Capital Dredging Project (subject of current application).
- Dumping at Sea Permit S0004-03 - Dublin Port 2022-2029 Maintenance Dredging Programme.
- Dumping at Sea Permit S0024-02 - MP2 Project Capital Dredging.
- 3FM Project Capital Dredging (application expected Q3/Q4 2024).

The maximum dredge volumes. programme and key mitigation measures as outlined in Section 2 were used as input to the computational modelling studies.

The output of the computational studies is summarised in Table 3-1.

Table 3-1 Predicted Sediment Deposition within the Tolka Estuary for various capital and maintenance dredging activities

Dredging Campaign	Predicted Sediment Deposition	Maximum deposition depth	Reference Document
Dublin Harbour Capital Dredging Project (S0033-01)	<0.30g/m²	<0.2µm	Dublin Harbour Capital Dredging Project EIAR, Dumping at Sea Permit Application (August 2021)
MP2 Project (S0024-02)	<0.50g/m²	*c.*0.33µm	RPS Report on Additional Sediment Plume Modelling, Response to Section 5(2) Notice (November 2021)
Dublin Port 2022 - 2029 Maintenance Dredging Programme (S0004-03)	<0.30g/m²	<0.2µm	RPS Report on Coastal Processes Risk Assessment, Dumping at Sea Permit Application (December 2020)
3FM Project Capital Dredging (application expected Q3/Q4 2024)	<128g/m²	85 µm	See detailed results below
Comparison with Natural Sedimentation	**30,000g/m²**	***c.*2cm**	**Dublin Port Maintenance Dredging AER (March 2017)**

Whilst outputs from the numerical modelling studies used to inform the summary assessment presented in Table 3-1 can be found in the respective reference document, it is acknowledged that the 3FM Project EIAR is not yet publicly available for review. Therefore, in the interest of transparency, the predicted deposition of the silt fractions lost to the water column during proposed capital dredging are presented in Figure 3-1 to Figure 3-4 respectively.

It should be noted that with all planned dredging activities, dredging proceeds until the specified design depth is reached and any material deposited within the dredge area will be removed by the dredger until the specification is met. As such, the values presented in Figure 3-1 to Figure 3-4 and summarised in Table 3-1 are considered conservative.

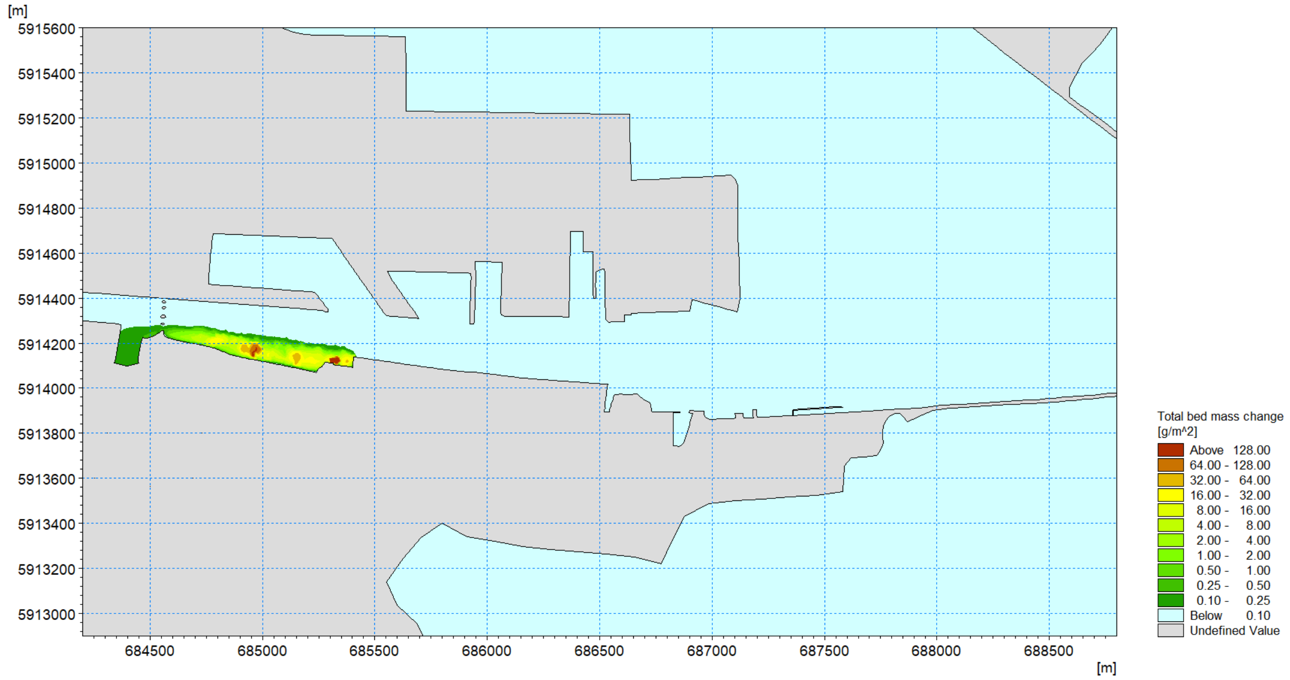


Figure 3-1 3FM Project - Deposition of sediment following dredging activities at Poolbeg Marina for a proposed Maritime Village

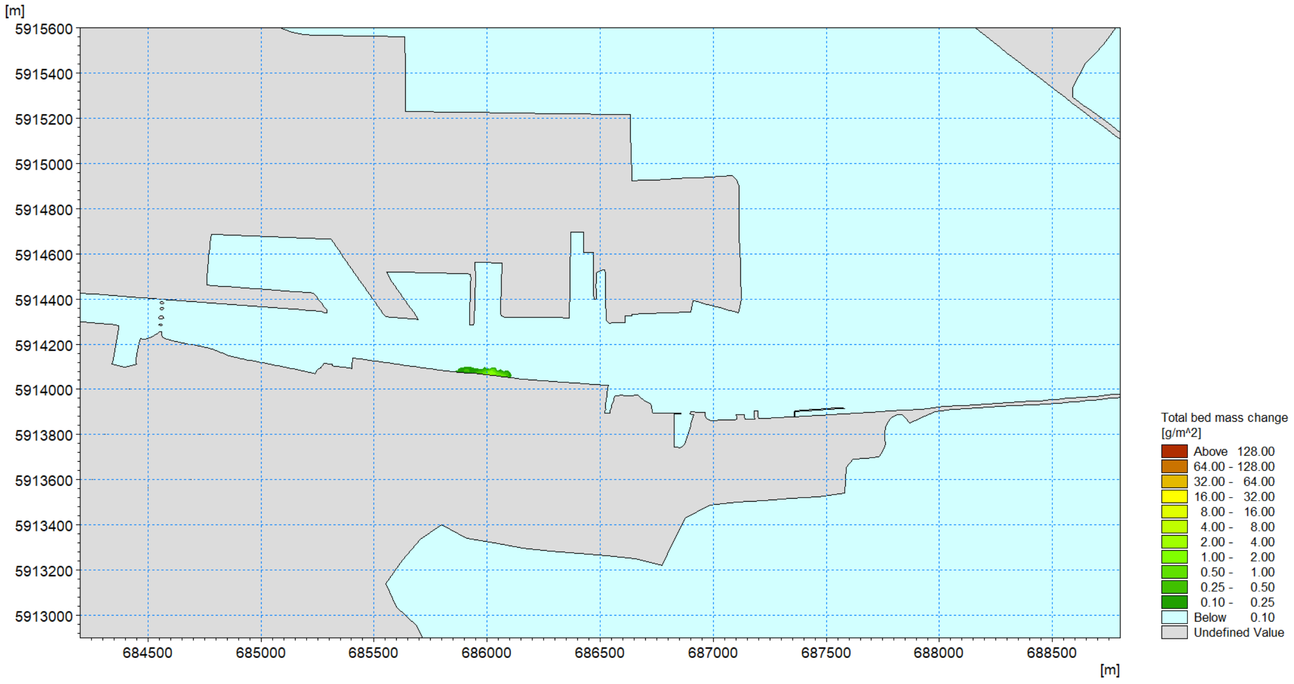


Figure 3-2 3FM Project - Deposition of sediment following dredging activity at South Port Berths for a proposed Ro-Ro Terminal (Localised Scour Protection to 220 kV cables)

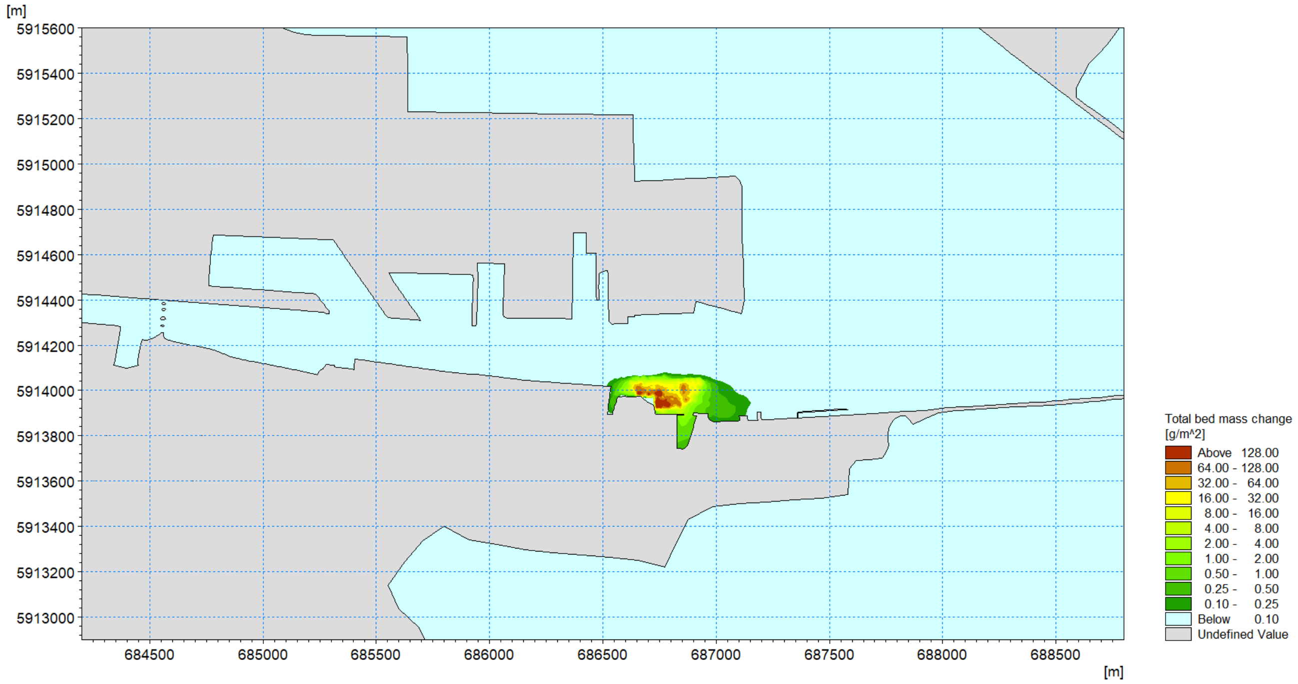


Figure 3-3 3FM Project - Deposition of sediment following capital dredging activity at the Sludge Jetty to create a proposed Turning Circle

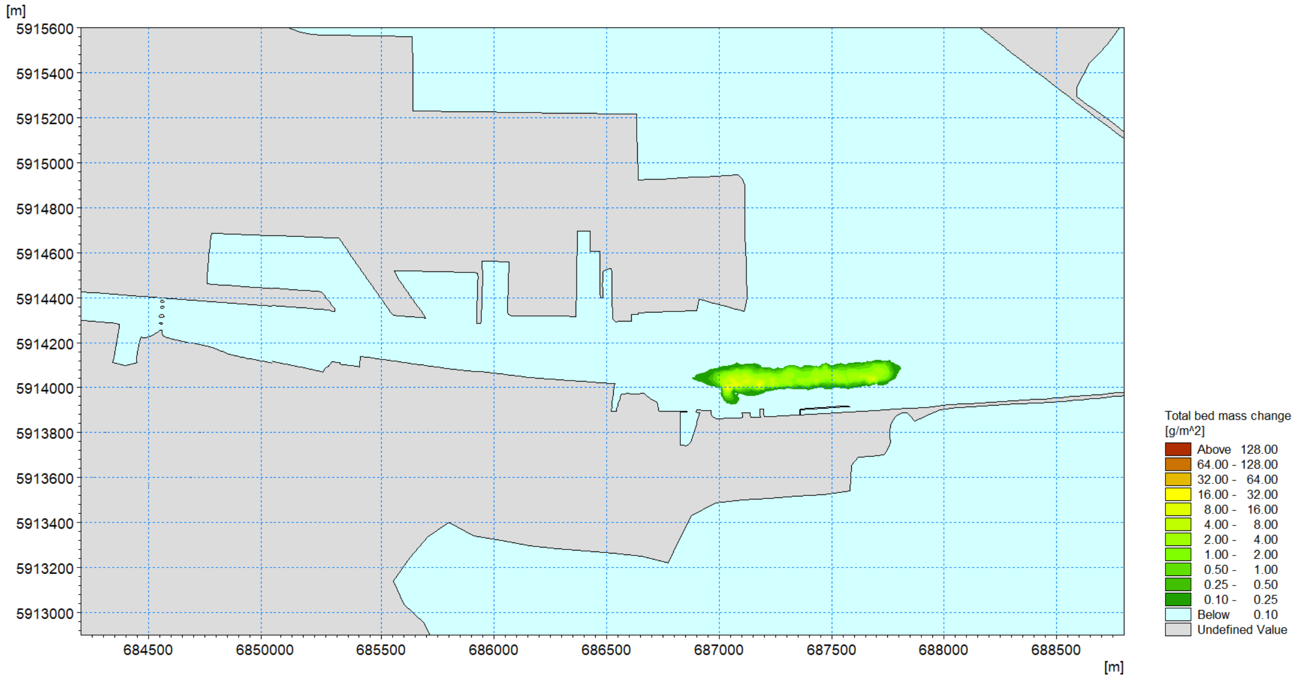


Figure 3-4 3FM Project - Deposition of sediment following capital dredging activity at Poolbeg Oil Jetty to create a proposed Lo-Lo Container Terminal Berthing Pocket

The results of the computational modelling studies demonstrate that only an imperceptible amount of silt will be deposited within the Tolka Estuary during loading activities within the inner Liffey.

In general, dredging activities associated with each project is expected to result in a maximum deposition depth of less than between 0.2µm and 0.33µm. The exception to this is the proposed dredging activity at Poolbeg Marina and the Turning Circle under the proposed 3FM Project whereby owing to local tide conditions, bathymetry and configuration of the channel, loading activities could result in a maximum deposition depth of c. 85µm.

When considered in context of natural sedimentation within the Port Area (i.e., 30,000 g/m^2/yr which is equivalent to a deposition rate of *c.*2cm/yr), it is clear that the impact of sediment deposition from all loading activities is several magnitudes lower than natural sedimentation rates. The impact of predicted sediment deposition from all capital and maintenance dredging loading activities can therefore be considered to be *de minimis*.

In conclusion, the computational modelling studies of the capital and maintenance dredging loading activities within the inner Liffey, in adherence with the key mitigation measures set out in Section 2, will ensure that cumulatively they will comply with, or will not result in the contravention of the following Directives:

- The Habitats Directive 82/43/EEC and Birds Directive 2009/147/EEC,
- The Water Framework Directive 2000/60/EC,
- The Marine Strategy Framework Directive 2008/56/EC.

4 PREDICTED SEDIMENT DEPOSITION FROM DUMPING ACTIVITIES

Numerical modelling work undertaken previously in support of the Alexandra Basin Redevelopment (ABR) Project (RPS, 2014) found that sediment material to be dredged throughout the Port Area could generally be characterised by three discrete fractions with mean diameters of 200μm, 20μm and 3μm with each fraction constituting 1/3 of the total volume of the dredge material. This specification was based on Particle Size Distributions (PSDs) of sediment samples collected from the Harbour area (RPS, 2014) (Dublin Port Company, 2020).

Based on this earlier work, the sand fraction of the dredge material was found to behave differently to silt material in that the sand fraction remained on the dump site whereas the silt material was dispersed by tidal currents.

Recognising the different dispersion and deposition characteristics of these different fractions, the sediment deposition as a result of disposing the silt and sand dredge material at the dump site is considered separately in Sections 4.1 and 4.2 respectively.

4.1 Silt deposition arising from each dredging project

4.1.1 Modelling Approach

For this study, RPS adopted a similar comprehensive modelling approach to that used to validate the Alexandra Basin Redevelopment (ABR) capital dredging programme (RPS, 2020) under Dumping at Sea Permit S0024-01. The analysis of the ABR Project using detailed recorded information from loading and dumping logs provided by the dredging contractor to create bespoke, site specific sediment source terms that were then applied to a calibrated and validated hydrodynamic model. The Sediment Plume Validation Study Report is presented in Appendix C (RPS, 2020).

This approach involved defining exact spill rates and quantities for 210 individual trips between 09/03/2020 – 28/03/2020 and simulating all 210 trips in a single model. In total, the dispersion and fate of 218,686T Total Dry Solids was represented in one single simulation, with the average quantity of material being disposed of per trip equating to 1,041T TDS (*n* =210, *SD* =126 TDS).

The output from the ABR Project simulation of recorded trips was then scaled to reflect the dredging and disposal requirements associated with S0024-02, S0004-03, S0033-01 and the 3FM project as summarised in Figure 4-1. These scaled results were then combined to provide details on the cumulative impacts from all four projects over the full period of the planned projects as set out in the overarching dredging programme presented in Appendix A.

As this approach utilised actual spill rates and quantities and varied locations of the dump releases within the boundary of the dump site, the model simulations were considered to be reflective of the proposed future dumping at sea activities. The location of the dredge hopper during the disposal of sediment during 3 of the 210 dumping activities is illustrated in Figure 4-2.

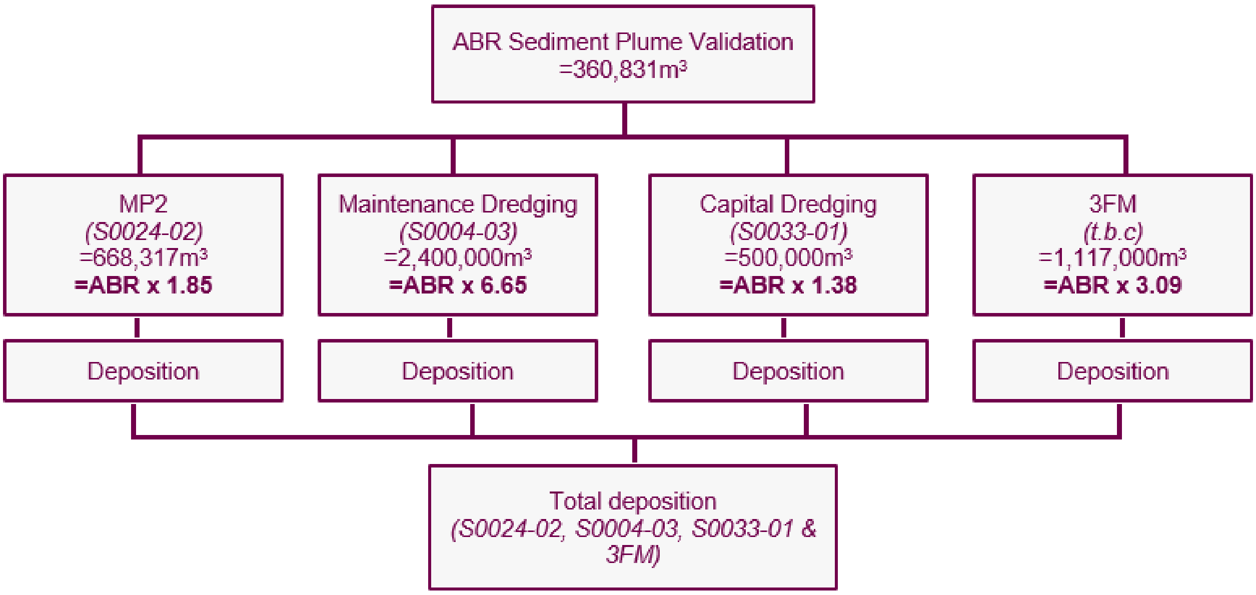


Figure 4-1 Summary of the modelling approach used to assess the cumulative impact of all four projects.

The coupled MIKE 21 sediment transport model was used to simulate the fate of the silt released from the Trailing Suction Hopper Dredger (TSHD) / bottom opening barge over the dump site by moving a sediment source along the track that the barge would take as it traversed the dump site area during the disposal operation. The model then simulated the dispersion, deposition of silt material in response to the tidal currents throughout the model area.

The location of the licenced offshore dump site at the approaches to Dublin Bay, west of the Burford Bank is presented in Figure 4-3.

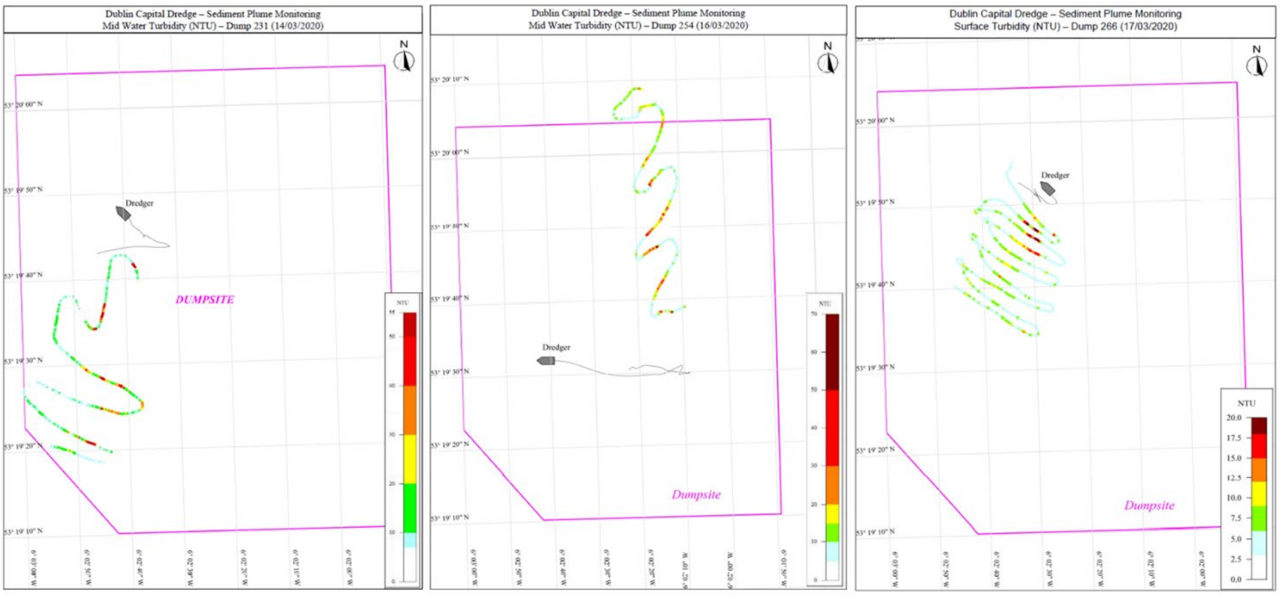


Figure 4-2 TSHD track during the disposal of sediment across three individual dumping activities (trips) with the corresponding measured suspended sediment concentration

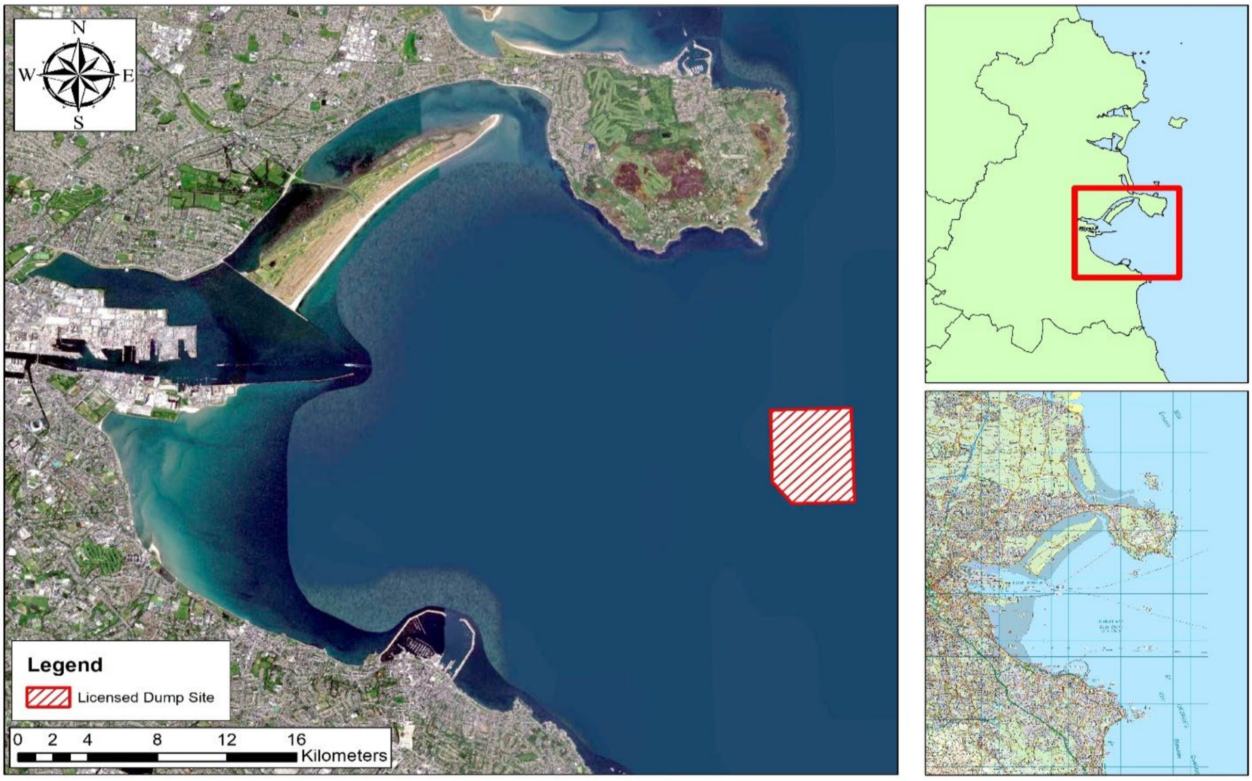


Figure 4-3 Location of the licenced offshore dump site at the approaches to Dublin Bay, west of the Burford Bank

4.1.2 Modelling Overview

RPS used the MIKE 21 hydrodynamic numerical modelling software package developed by DHI, to undertake the sediment plume simulations presented in Section 4.1.1 of this report.

The MIKE system is a state of the art, industry standard, modelling system, based on a flexible mesh approach. This software was developed for applications within oceanographic, coastal and estuarine environments.

A brief synopsis of the MIKE system and modules used for this assessment is outlined below:

- **MIKE 21 FM system** - Using this flexible mesh modelling system, it was possible to simulate the mutual interaction between currents, waves and sediment transport by dynamically coupling the relevant modules in two dimensions.
    - **The Hydrodynamic (HD) module** - This module is capable of simulating water level variations and flows in response to a variety of forcing functions in lakes, estuaries and coastal regions. The HD Module is the basic computational component of the MIKE 21 Model system providing the hydrodynamic basis for the Sediment Transport and Spectral Wave modules. The Hydrodynamic module solves the two-dimensional incompressible Reynolds averaged Navier-Stokes equations subject to the assumptions of Boussinesq and of hydrostatic pressure. Thus the module consists

of continuity, momentum, temperature, salinity and density equations. In the horizontal domain both Cartesian and spherical coordinates can be used.

- **The Sediment Transport module** - The Sediment Transport Module simulates the erosion, transport, settling and deposition of cohesive sediment in marine and estuarine environments and includes key physical processes such as forcing by waves, flocculation and sliding. The module can be used to assess the impact of marine developments on erosion and sedimentation patterns by including common structures such as jetties, piles or dikes. Point sources can also be introduced to represent localised increases in current flows as a result of outfalls or ship movements etc.

4.1.3 Computational Models and Data Sources

RPS' model of Dublin Bay was created using flexible mesh technology to provide detailed information on the coastal processes around the licenced dump site and Dublin Port as well as the wider Dublin Bay area. The model uses mesh sizes varying from 250,000m^2 (equivalent to 500m x 500m squares) at the outer boundary of the model down to a very fine 225 m^2 (equivalent to 15m x 15m squares) in Dublin Port and around the licenced dump site. The extent, mesh structure and bathymetry of this model is presented in Figure 4-4.

The bathymetry of this model was developed using data gathered from hydrographic surveys of Dublin Port, the Tolka estuary and the dump site since 2017 to present. This resource was supplemented by data from the Irish National Seabed Survey, INFOMAR and other local surveys collated by RPS for the Irish Coastal Protection Strategy Study (RPS, 2003).

Tidal boundaries for the Dublin Bay model shown in Figure 5 were taken from the Irish Coastal Protection Strategy Study (ICPSS) tidal surge mode. This model was developed using flexible mesh technology with the mesh size varying from *c.* 24km along the offshore Atlantic boundary to *c.* 200m around the Irish coastline. This validated model is run three times daily on behalf of the Office of Public Works (OPW) to provide detailed tidal information around the coast of Ireland. The extent and bathymetry of this model is illustrated in Figure 4-5.

Boundary conditions used to represent the mean annual river flows for the Liffey, Dodder and Tolka were set at 15.6, 2.3 and 1.4m^3/s respectively.

It should be noted that the same computational models used to support the environmental assessment of the ABR Project (RPS, 2014) were used for this technical assessment. A previous calibration and validation exercise that utilised recorded data from throughout Dublin Bay concluded that the Dublin Bay model performed very well and provided a very good representation of the coastal processes in Dublin Port and Dublin Bay (see Appendix B).

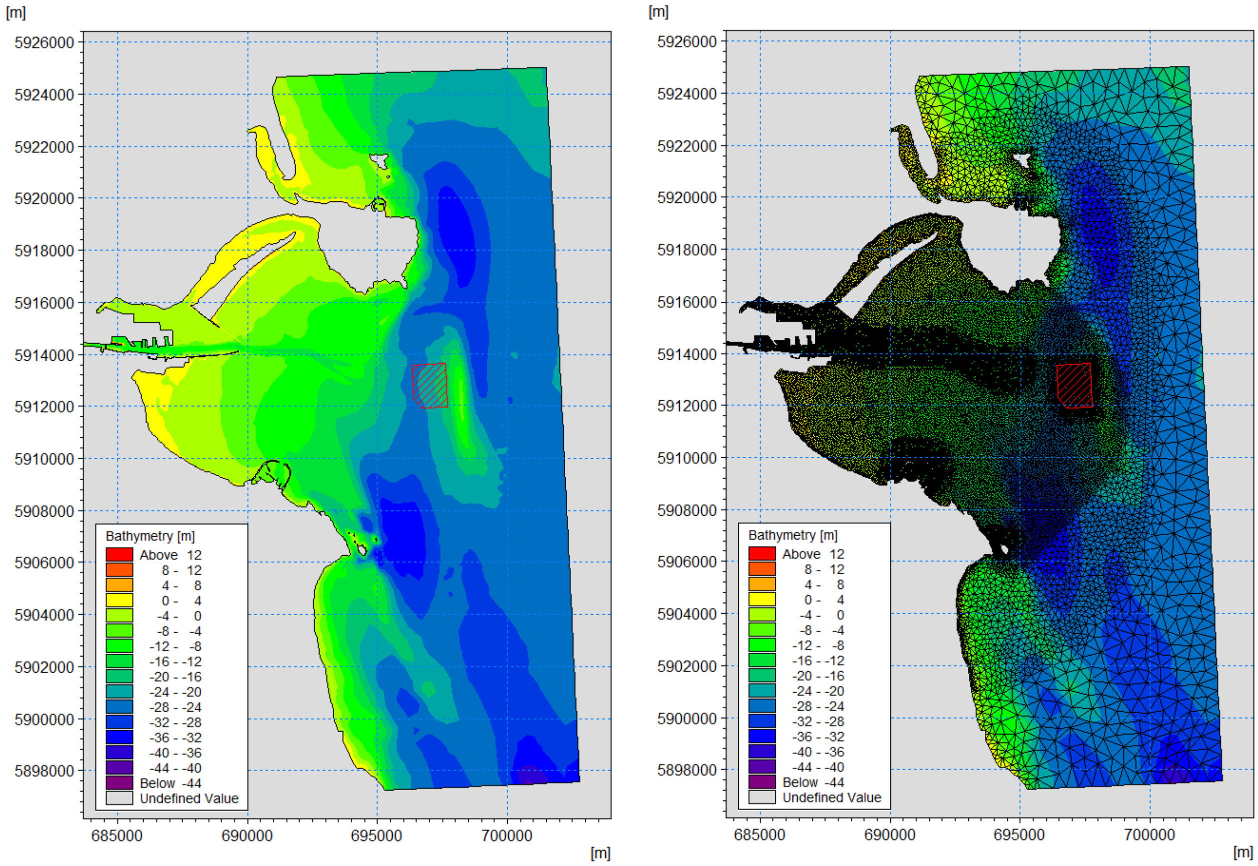


Figure 4-4 Extent and bathymetry (left) and mesh structure (right) of the Dublin Bay model. Location of the licenced dump site shown by red hatch area.

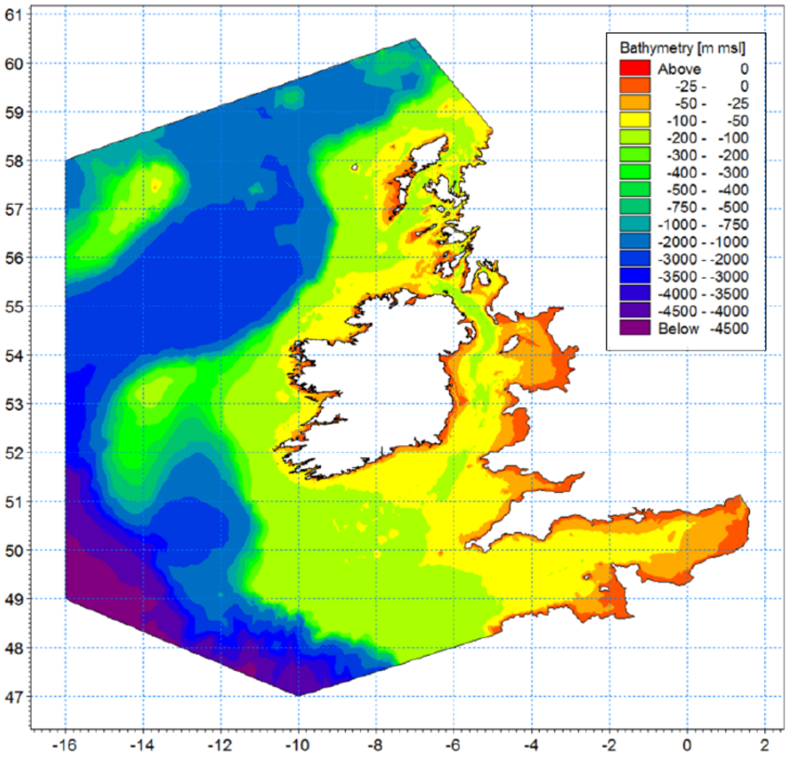


Figure 4-5 Extent and bathymetry of Irish Sea Tidal and Storm Surge model

4.1.4 Silt deposition arising from each dredging project

The coarser fraction of the silt, i.e., the sand fraction that had a mean grain size of 200µm was found to behave differently relative to the two finer fractions that had mean grain diameters of 20µm and 3µm in that it remained almost exclusively within the immediate vicinity of the licenced dump site. Conversely, the two finer silt fractions were carried away by the tidal currents towards the expanse of the Irish Sea.

The predicted total deposition of the silt fractions of the total dredge material disposed under S0024-02, S0004-03, S0033-01 and the 3FM project is presented in Figure 4-6 to Figure 4.9 respectively. As demonstrated by these Figures, the maximum total deposition of silt material within Dublin Bay does generally not exceed 0.40g/m^2.

It should be noted that this is marginal lower than the 0.50g/m^2 as reported in the Additional Sediment Plume Modelling Response to Section 5(2) Notice (RPS, 2021). This can be attributed to how the sediment source term was specified. In previous work including for the ABR Project EIS (RPS, 2014), the source term was defined as a constant spill rate of 108kg/s that was only activated when the dredger was over the dump site. For this assessment, a bespoke source term was defined for each of the 210 individual trips based on dumping logs provided by the dredging contractor. Each source term had a unique spill rate reflective of the corresponding dumping profile. In most instances, spill rates were much higher but persisted for shorter durations.

Given the higher spill rates and suspended concentrations, sediments tended to floc together and settle much faster. As a consequence, more silt material remained within the vicinity of the dump site and less silt material dispersed and settled throughout Dublin Bay.

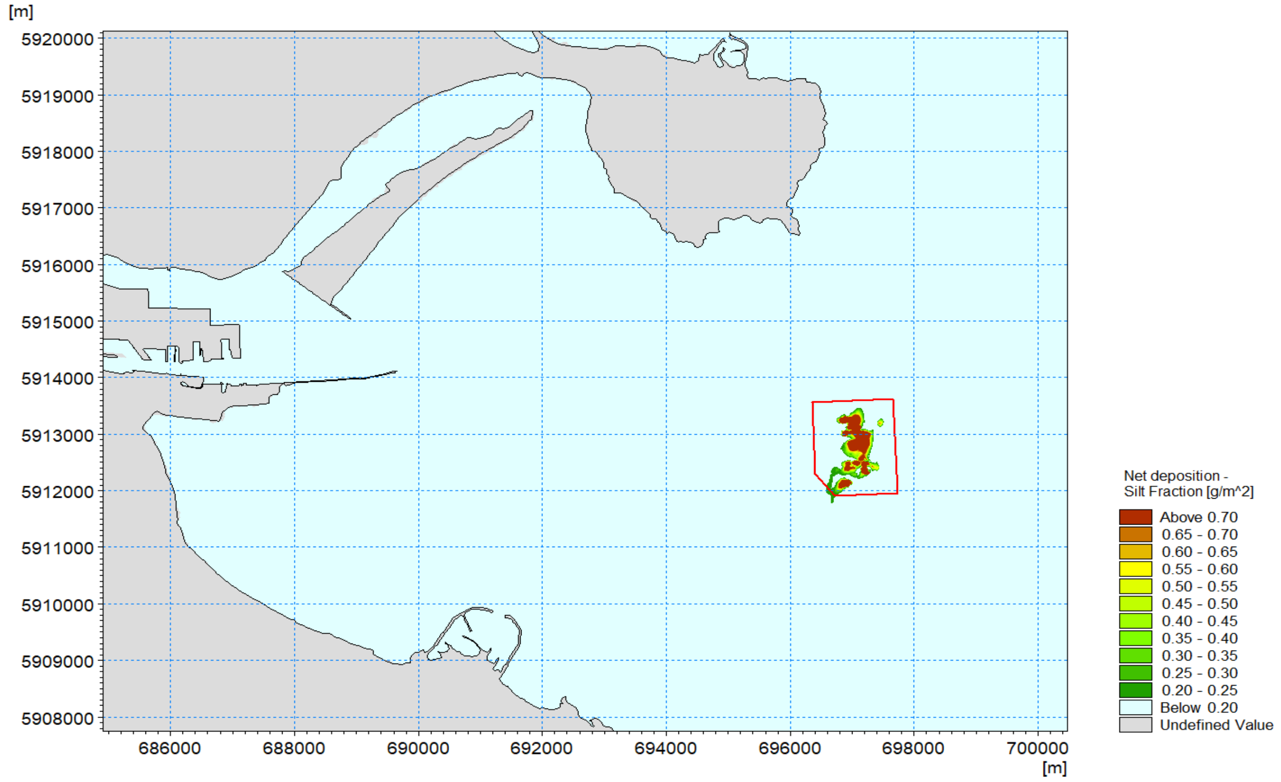


Figure 4-6 Total deposition of silt material following the dumping at sea activities associated with the MP2 Project (S0024-02)

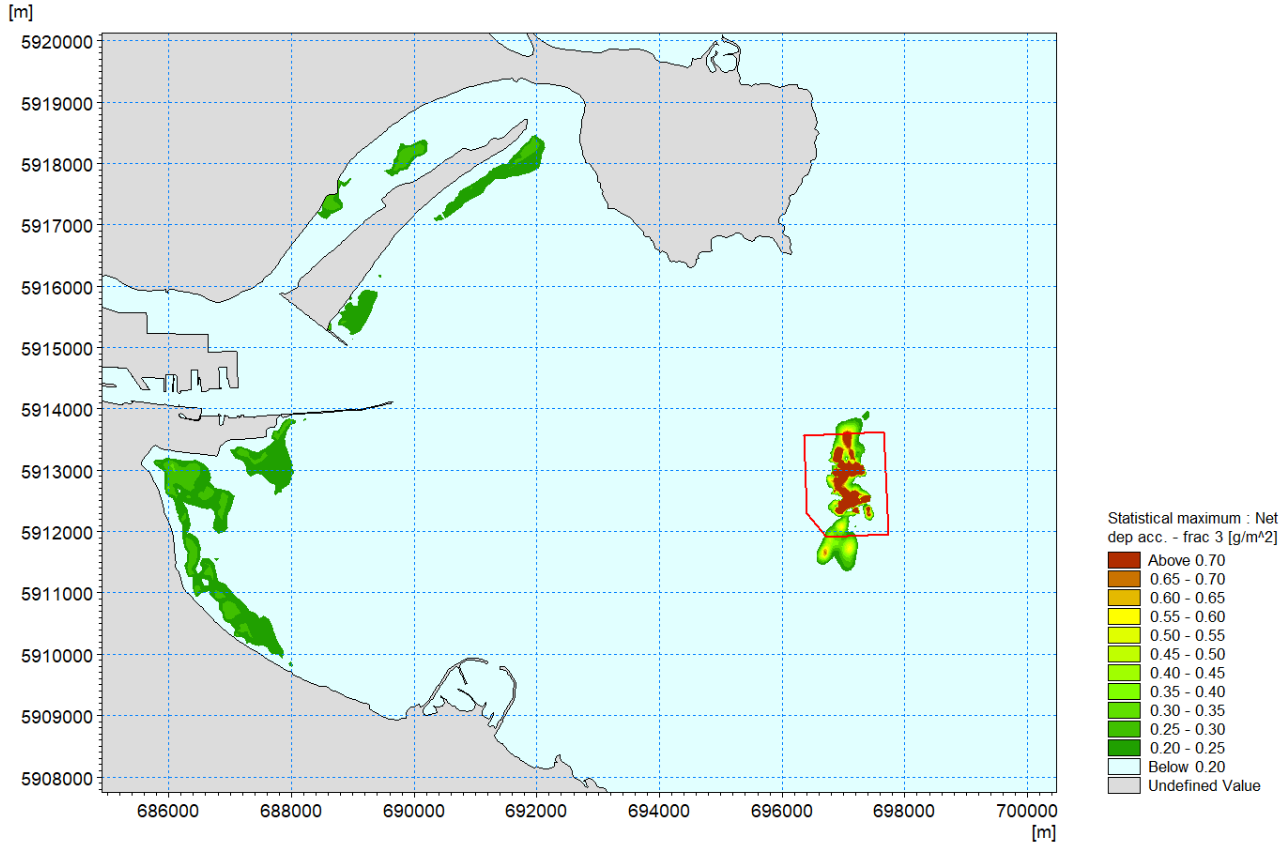


Figure 4-7 Total deposition of silt material following the dumping at sea activities associated with the Dublin Port 2022 - 2029, Maintenance Dredging Programme (S0004-03)

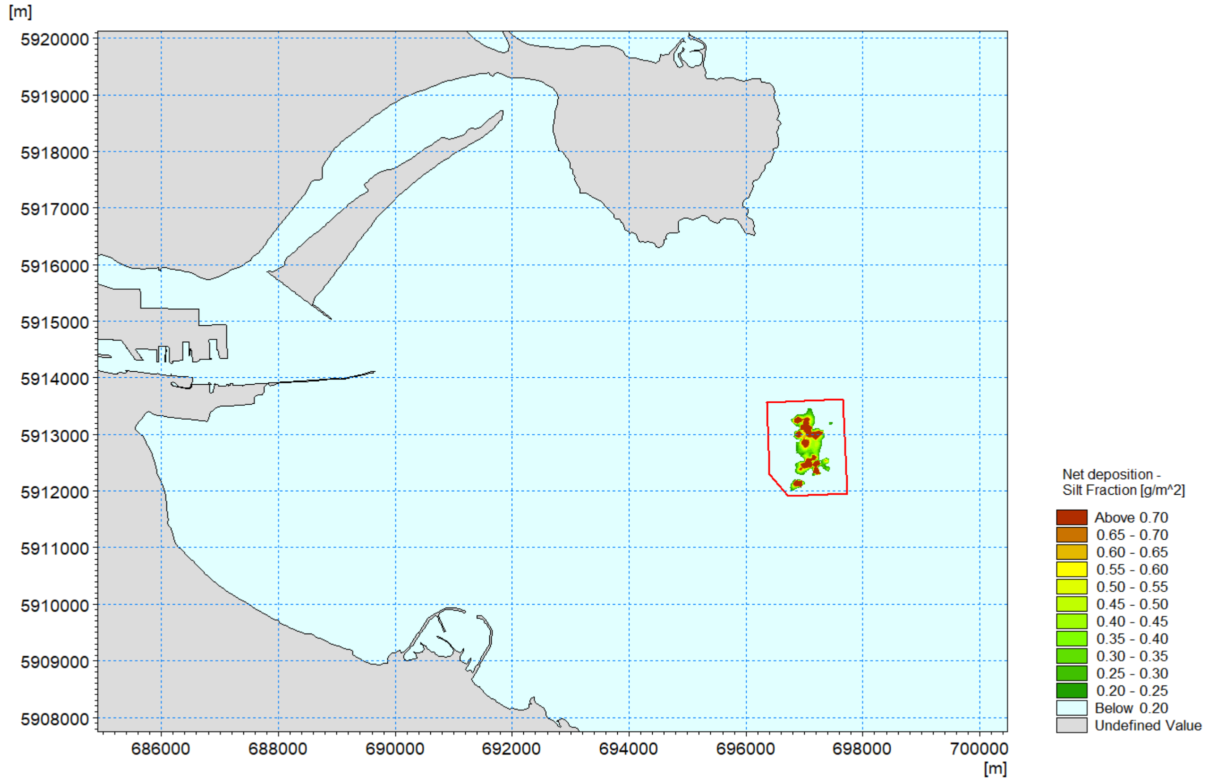


Figure 4-8 Total deposition of silt material following the dumping at sea activities associated with the Dublin Harbour Capital Dredging Project (S0033-01)

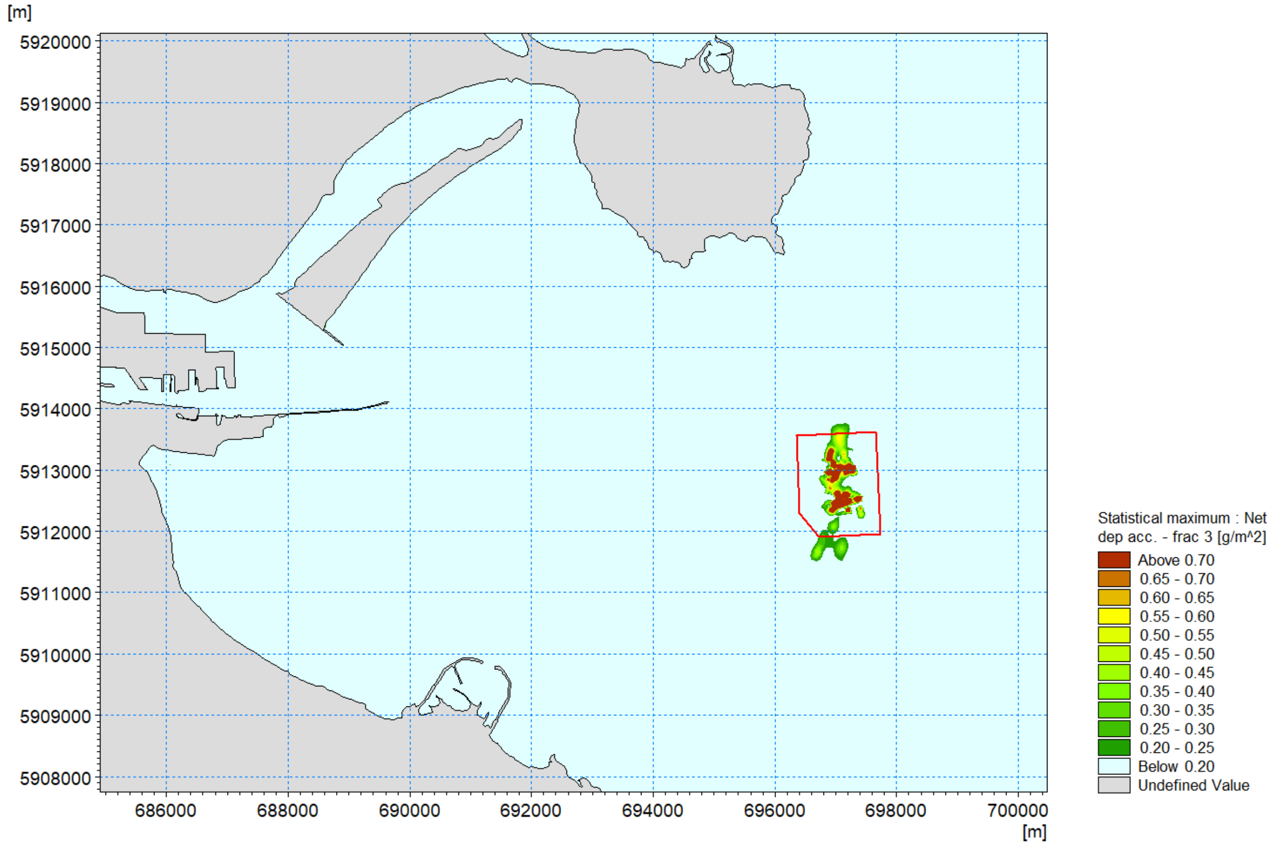


Figure 4-9 Total deposition of silt material following the dumping at sea activities associated with the 3FM Project

4.1.5 Cumulative silt deposition from all four dredging projects (S0024-02, S0004-03, S0033-01 and the 3FM Project)

The cumulative sediment deposition within Dublin Bay as a result of all four dumping at sea activities described in the Section 2 is presented in Figure 4-10. As demonstrated by this Figure, the cumulative total deposition of silt material beyond the immediate vicinity of the disposal site is generally less than 0.60g/m^2. This magnitude of deposition translates to a maximum change in bed level thickness of *c.* 0.45µm as illustrated in Figure 4-11. This is less than the width of a human hair and is not measurable in the field.

For context, the estimated natural sediment load from the upstream Liffey catchment is estimated at circa 200,000 tonnes per annum (DPC Maintenance Dredge AER 2017, Dumping at Sea Permit S0004-01). If dispersed over the Port area between East Link and Poolbeg Lighthouse and the Tolka Estuary; this is roughly equivalent to a natural sediment load of 30 kg/m^2 in any year (30,000 g/m^2). This is equivalent to an average depth of 2cm (based on a silt material).

> It is clear that the impact of sediment deposition from dumping activities is several magnitudes lower compared to natural sedimentation and can therefore be considered to be *de minimis*.

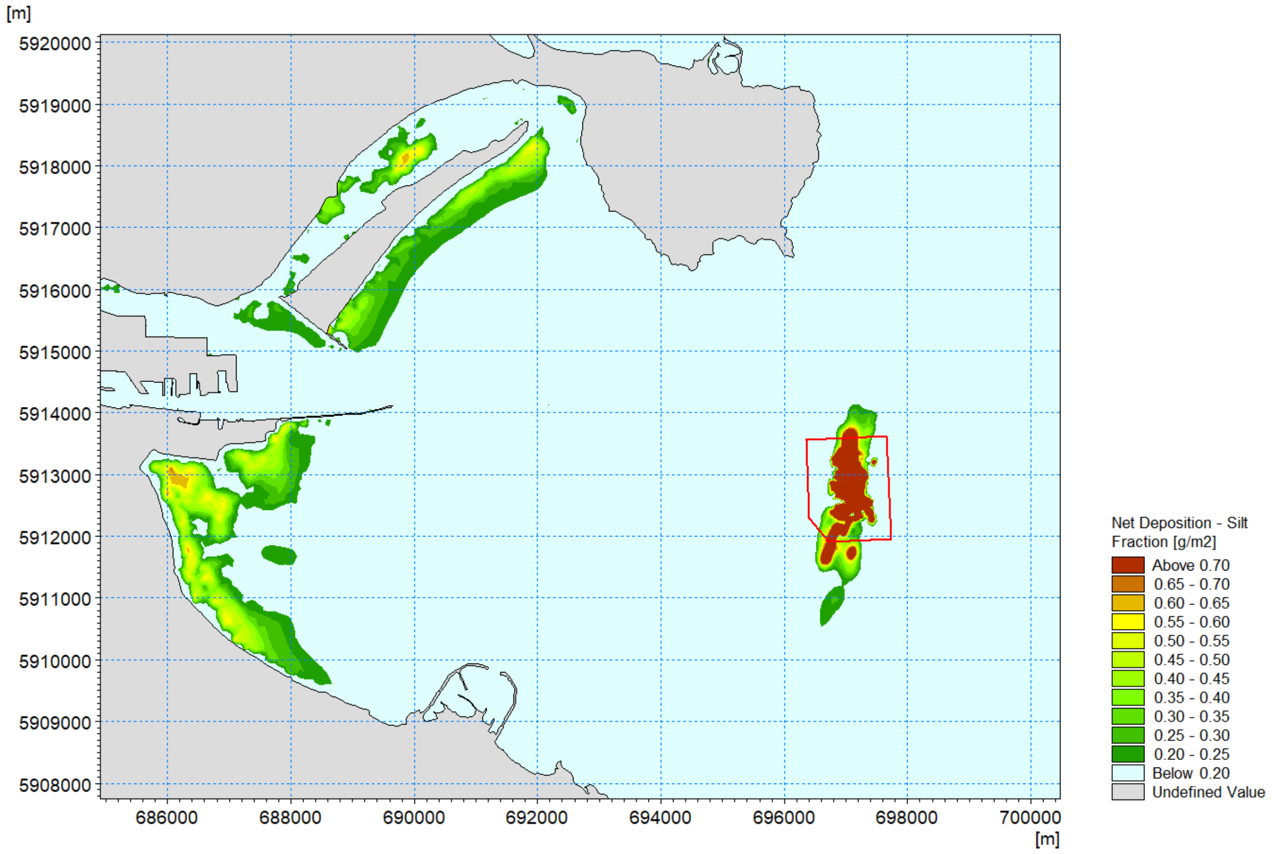


Figure 4-10 Cumulative total deposition of silt material following the dumping at sea activities associated with S0024-02, S0004-03, S0033-01 and the 3FM Project

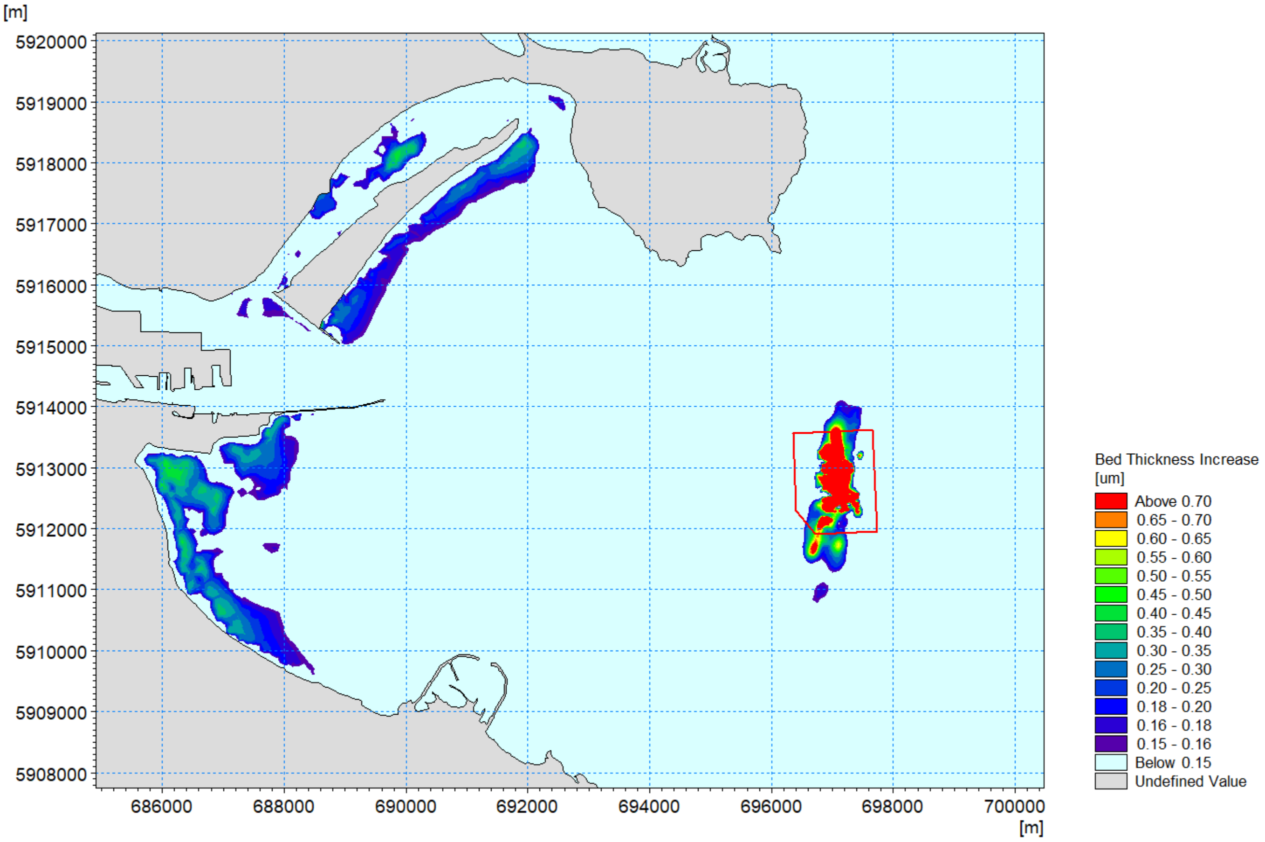


Figure 4-11 Cumulative bed thickness increase as a result of silt deposition from S0024-02, S0004-03, S0033-01 and the 3FM Project

4.2 Sand deposition arising from dredging activities

4.2.1 Sand deposition at the dump site

As noted previously and based on earlier work (RPS, 2014), the sand fraction of the dredge material was found to behave differently to silt material in that the sand fraction of dredge material immediately fell and settled on the dump site owing to the high fall velocities associated with this material. This is demonstrated in Figure 4-12 which illustrates the deposition of *c.* 1million cubic metres of sand material across the dump site following the continuous disposal of sand over the course of 6 months.

These findings are in line with other studies which concluded that sand fractions with higher fall velocities and higher critical shear stress parameters (relative to silt material) tend to remain in the locale of the disposal site with minimal re-suspension occurring (CEFAS, 2021).

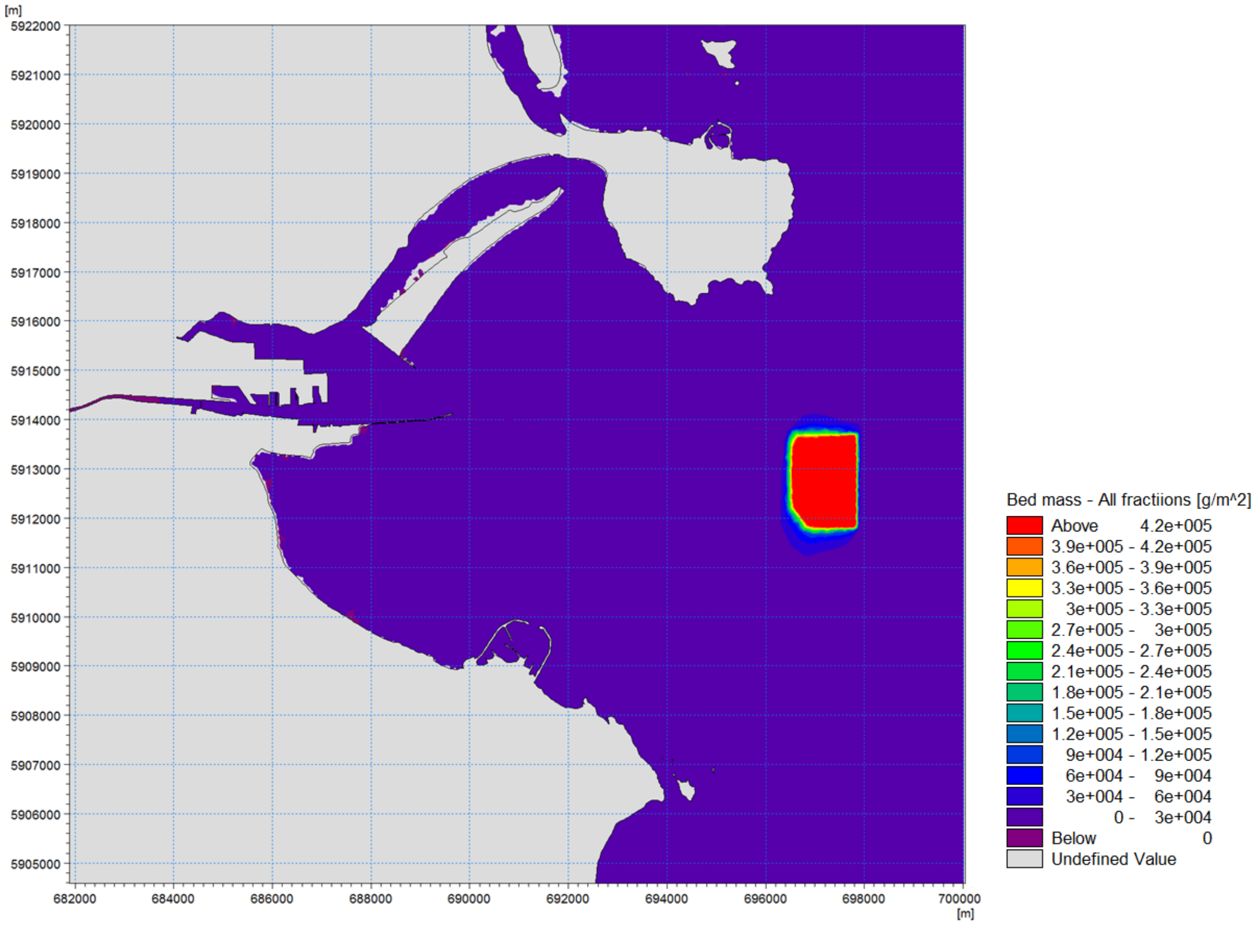


Figure 4-12 Total sand deposition after six months of continuous disposal of sand spoil material

4.2.2 Assessing the movement of coarse material

To assess the potential movement of the coarse material on the dump site, RPS utilised a two-stage approach which firstly involved reviewing site-specific high-resolution bathymetric surveys of the dump site to measure changes in seabed elevations and thus derive rates of change. Given that much of the dump site is characterised by well-defined sand waves, the output from this assessment was used as a proxy to determine the long-term potential for sediment erosion and movement.

Secondly, to further support this assessment, RPS undertook a bespoke numerical modelling exercise to quantify the erosion and movement of coarse material based on met-ocean conditions.

The output of these assessments was used to estimate the long-term fate of coarse sediment material which is deposited on the dump site as a result of dredging operations within Dublin Port.

4.2.3 Review of site specific bathymetric surveys

As part of DPC's extensive environmental monitoring programme, Hydromaster Ltd. is contracted to undertake high-resolution bathymetric surveys of the dump site before and after dredging campaigns. By way of example, the dump site was surveyed prior to the first capital dredging campaign under S0024-02 on 13th October 2022 and again on 7th December 2022 upon completion of the campaign (total volume disposed of during this period equated to 339,683m^3). The output from both of these surveys is illustrated in Figure 4-14. The elevation between these surveys is presented in Figure 4-18 with positive values representing deposition and negative values representing erosion (or sediment movement).

As will be seen from Figure 4-14, the elevation of the dump site ranges between *c.* -24m along the western boundary and *c.* -11m along the eastern boundary. Other notable features from this survey include two areas near the centre of the dump site whereby depths are *c.*5m shallower than the immediately surrounding area.

In addition to these shallower areas, distinct sand waves can also be observed in the shallower areas, particularly along the northeast and southern boundaries of the site.

Using a series of Geographical Information System (GIS) tools that were specifically developed for terrain analyses and the assessment of ridge forms, it was possible to examine both these surveys in greater detail to extenuate key morphological features. The output from this process is presented in Figure 4-15 and clearly illustrates the presence of prominent sand waves common to both surveys and also the deposition of dredge material in the post dredge campaign survey.

By using GIS to digitise key sand wave features common to both surveys and to extract key elevation contours (see Figure 3-16), RPS calculated the spatial difference between the morphological features of both surveys. This involved assessing the spatial change of more than 40,000 unique vertices. These differences were then divided by the duration between the two surveys to estimate rates of movement.

The output of this assessment found that the transport of the coarse material was greatest in shallower water, but that even in these areas the average rate of movement equated to *c.* 0.10m/day. In deeper waters whereby the seabed is not exposed to the same wave radiation or tidal stresses, the average rate of movement equated to just *c.* 0.05m/day. The dominant direction of sediment transport was generally from south to north, however, there was variation across the dump site.

It is worth noting that these surveys were undertaken in October and December 2022, during which period the Marine Institute's M2 wave buoy recorded relatively heavy sea conditions as illustrated in Figure 4-13.

Given that the dump site is approximately 1.6km in length, it is estimated that coarse fraction of spoil material disposed of at the centre of the dump site would take between c. 10 – 40 years to move beyond the boundary of the dump site.

Whilst the actual rate of movement would be subject to prevailing storm and tidal conditions, this assessment confirms that coarse material remains within the boundary of the dump site for a prolonged period of time.

Table 4-1 Average rate of sediment transport based on a difference assessment of high resolution surveys of the dump site on 13.10.2022 and 07.12.2022

Contour [m]	Average Rate of movement [metres / day]
-24	0.055
-23	0.068
-22	0.053
-21	0.048
-20	0.076
-19	0.084
-18	0.160
-17	0.169
-16	0.123
-15	0.130
-14	0.174
Average	**0.104**

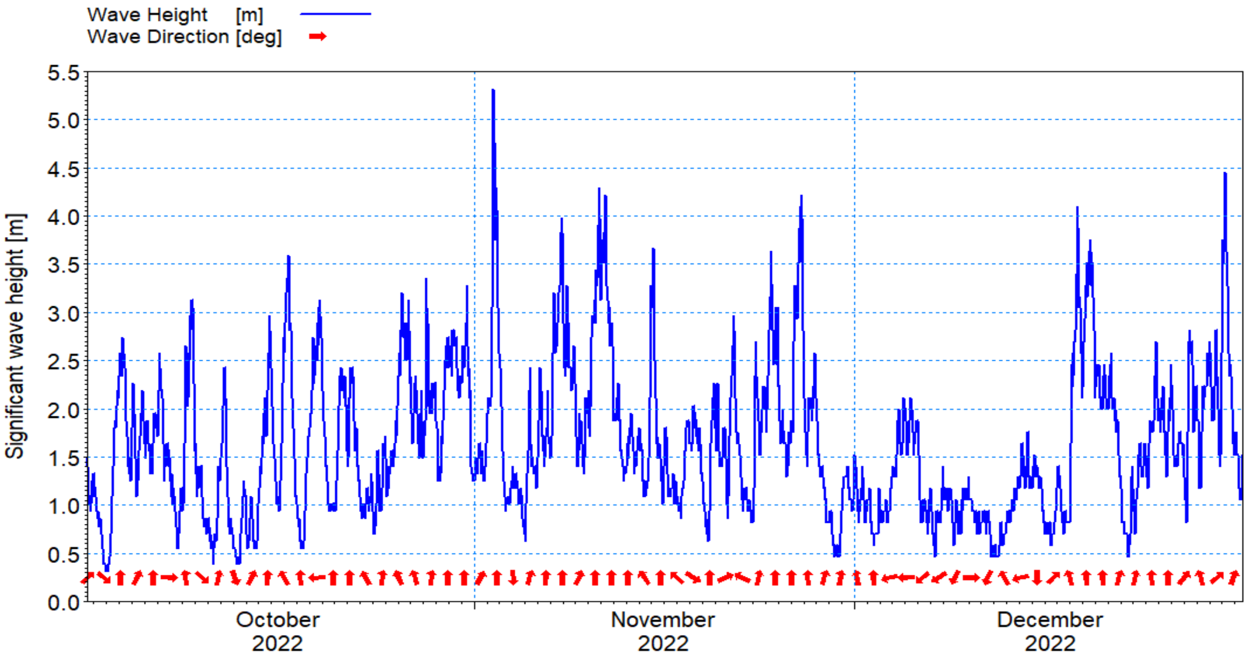


Figure 4-13 Wave climate as recorded by the Marine Institute's M2 wave buoy between October and December 2022.

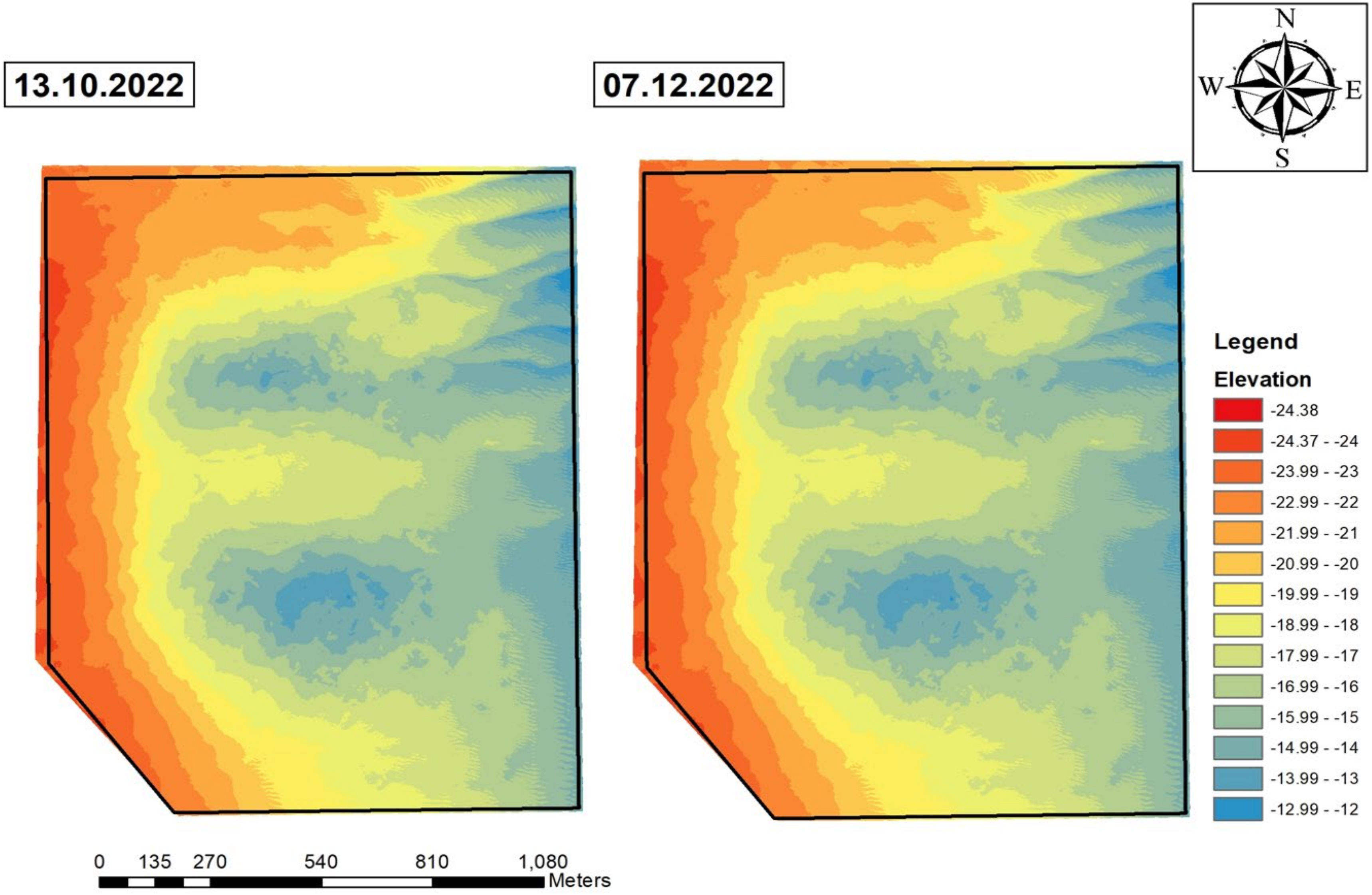


Figure 4-14 Pre and post dredging campaign bathymetric surveys at the licenced offshore dump site at the approaches to Dublin Bay

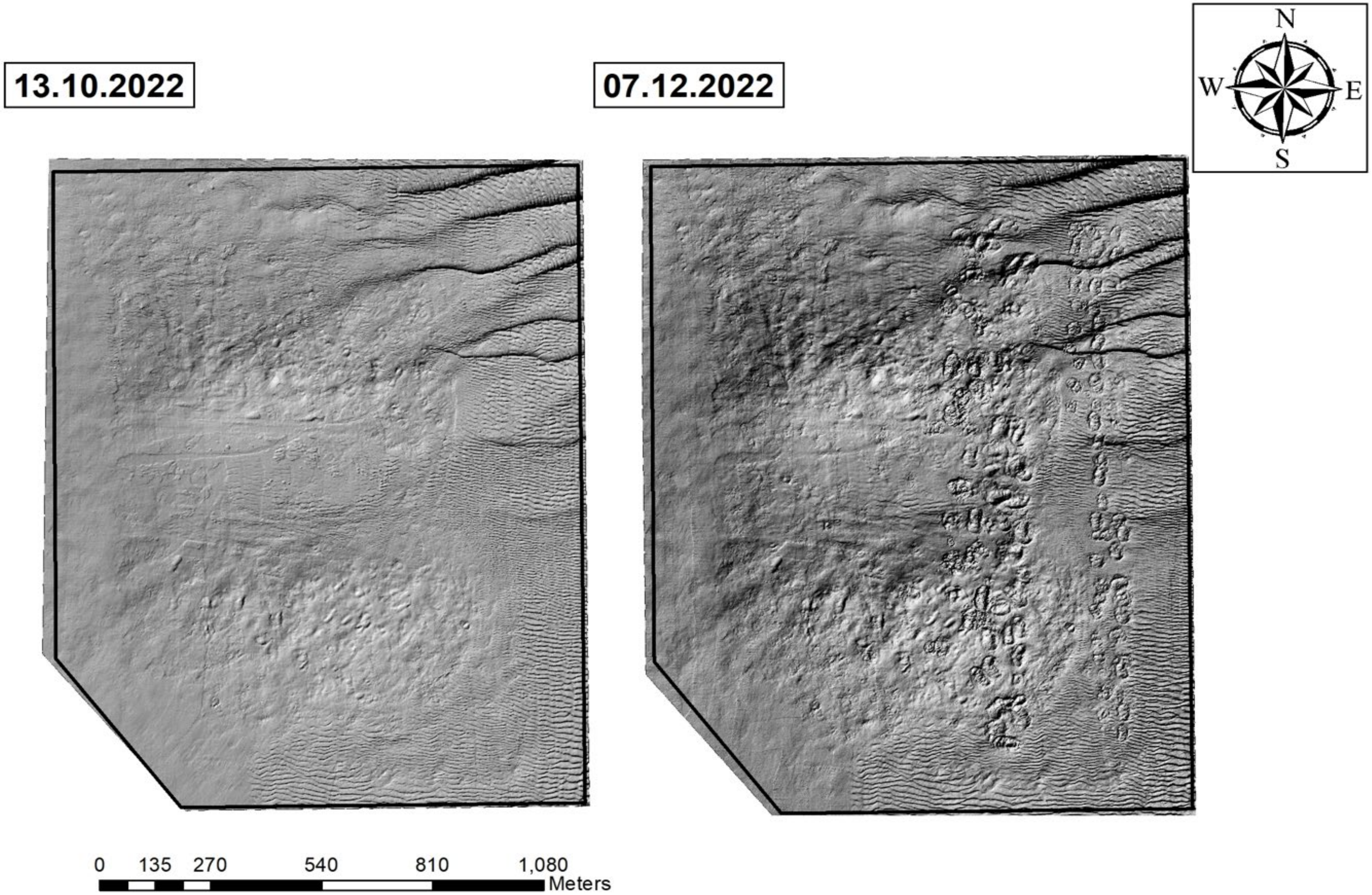


Figure 4-15 Sand wave and other morphological features identified from a terrain analyses of both survey datasets

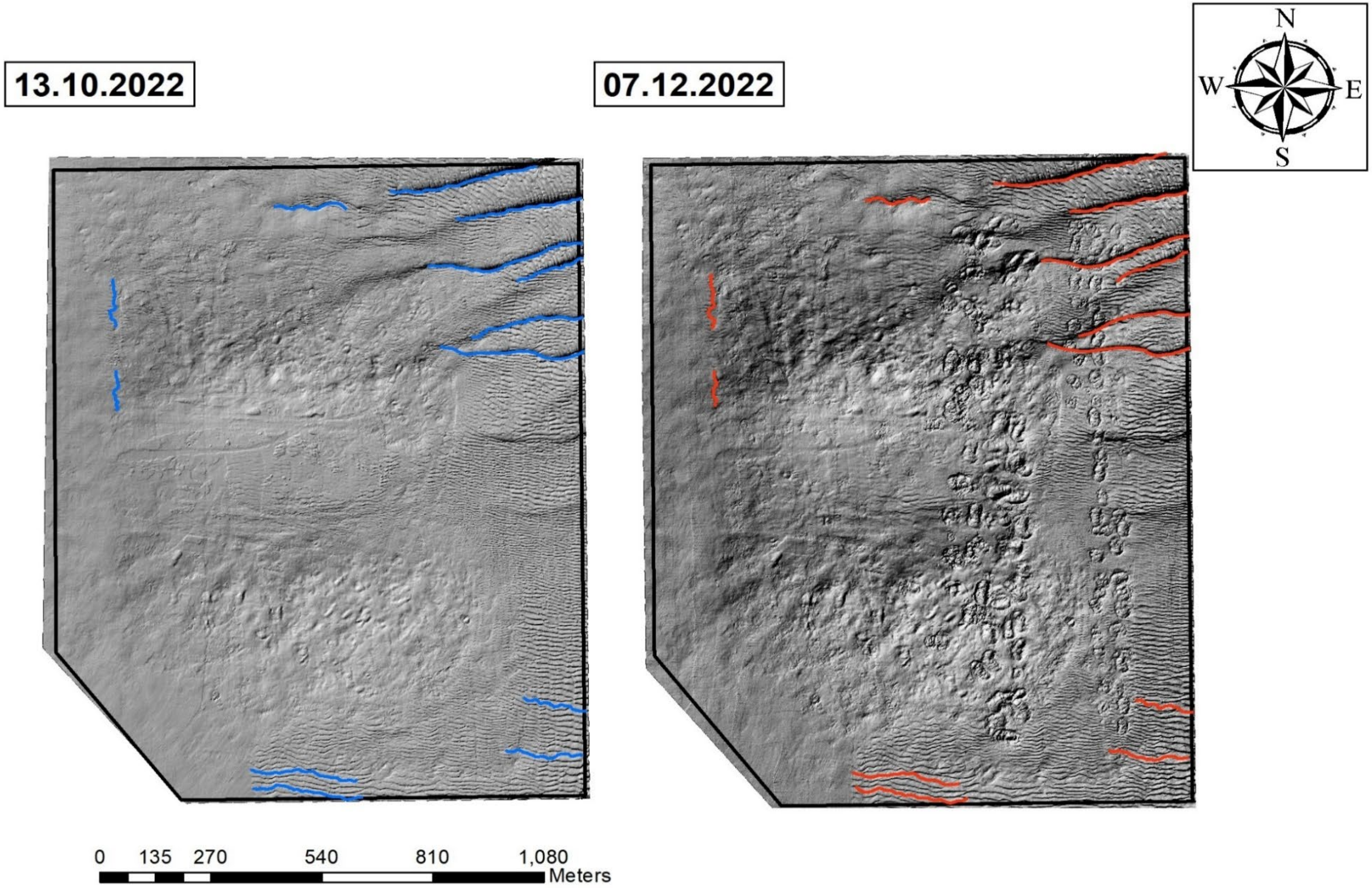


Figure 4-16 Sand wave features common to both surveys identified by blue and red vectors that were used to assess movement of bed material

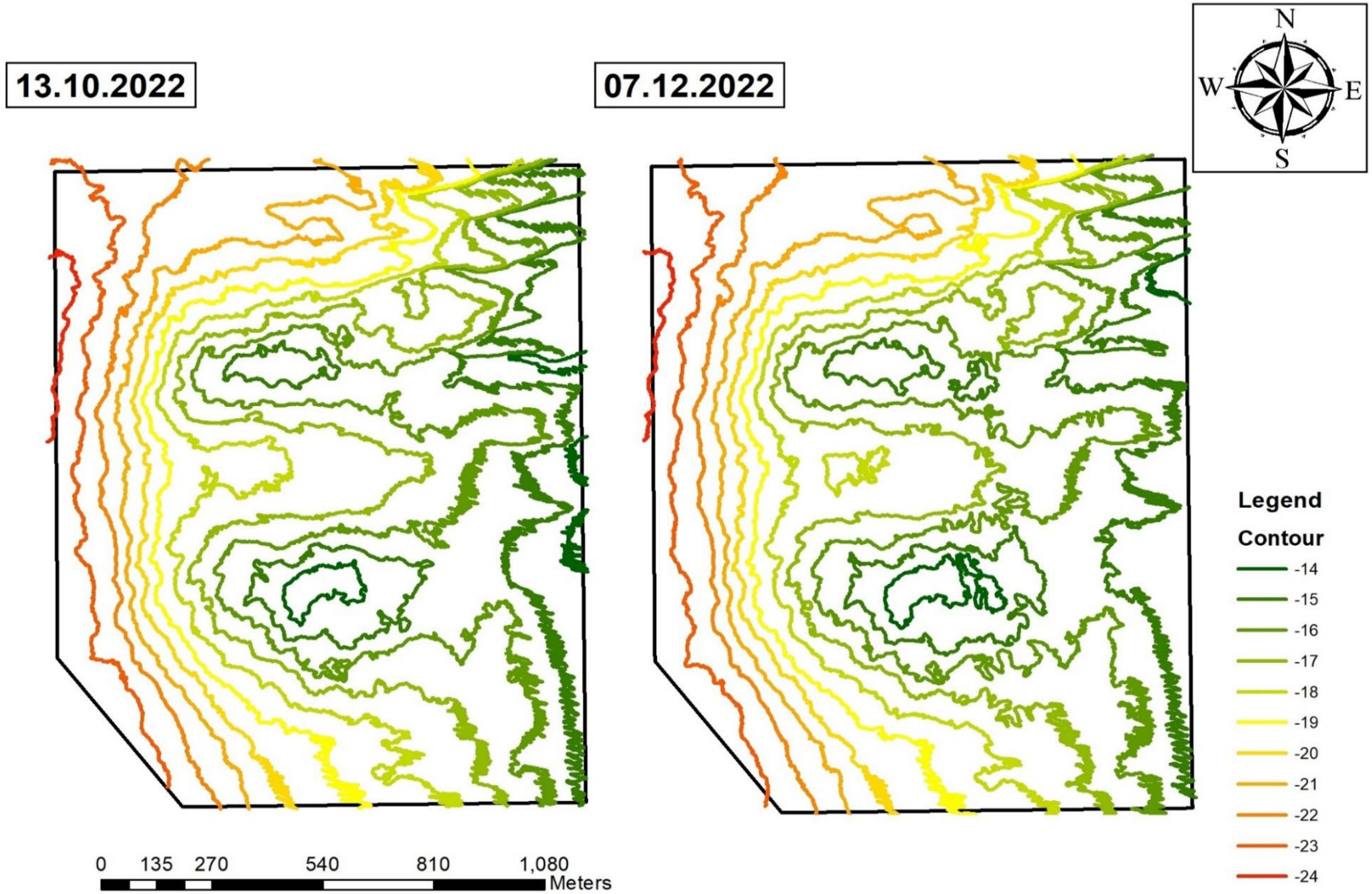


Figure 4-17 Elevation contours of both surveys used to assess the movement of bed material at the dump site

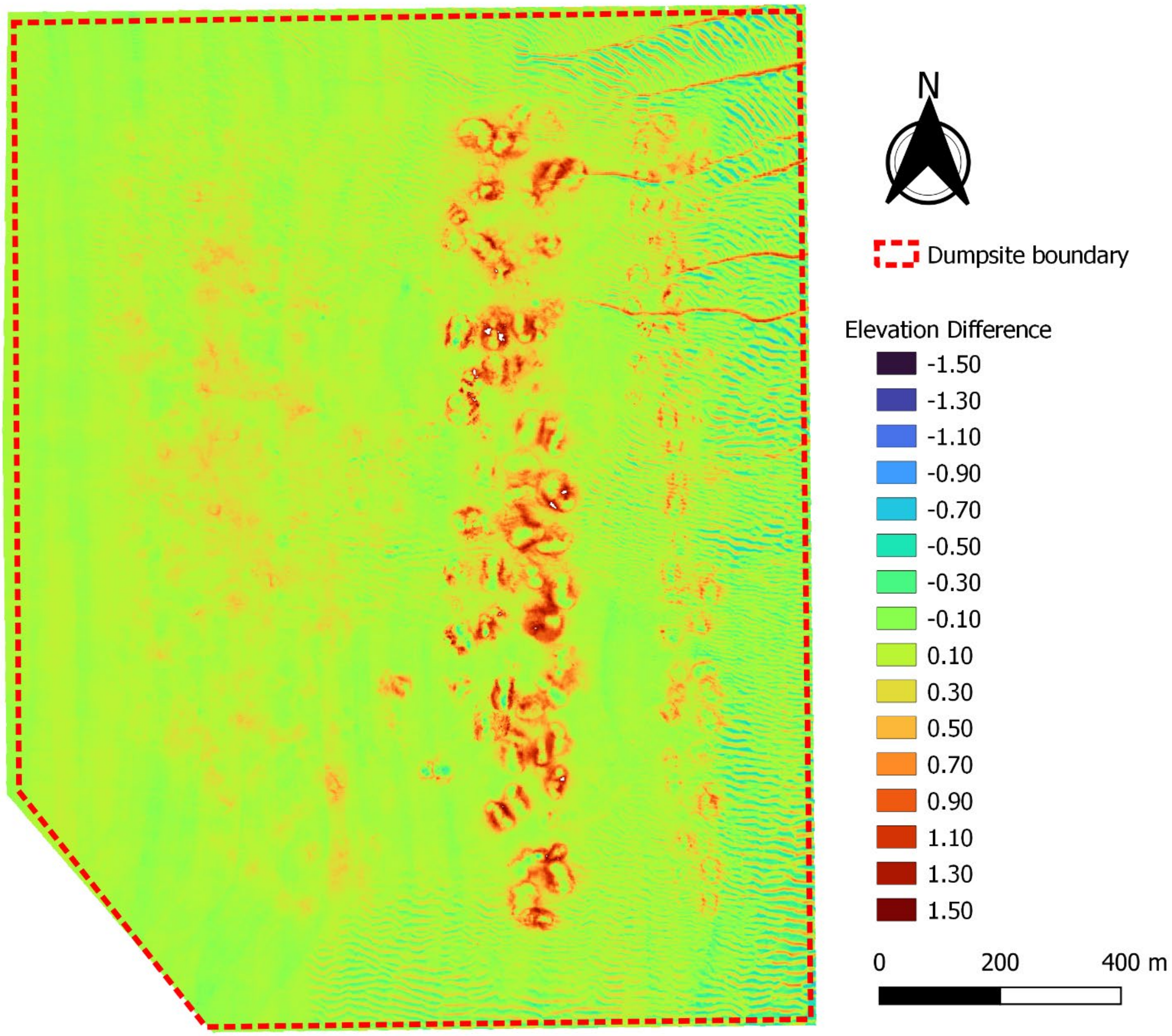


Figure 4-18 Elevation difference between pre and post dredge campaign surveys (*post minus pre*).

4.2.4 Numerical modelling of coarse material

In addition to reviewing high resolution site-specific surveys recorded before and after the capital dredging campaign in Q4 of 2022, RPS also utilised state-of-the-art modelling software to assess the potential erosion and movement of coarse material on the dump site.

Given that the assessment described in the previous Section established that the rate of sediment transport was extremely low (i.e., less than 0.15m/day), it was recognised that long-term morphological modelling could not be undertaken using a conventional two-dimensional modelling approach. This was due to two reasons:

1. The finest cell resolution of the two-dimensional numerical models equates to *c.* 100m^2 which is equivalent to a 10x10m cell. The rate of sediment movement is therefore orders of magnitude smaller than what conventional two-dimensional models are designed to resolve. Thus, standard error margins associated with the models are likely to be significantly greater than any actual morphological change.
2. Using a coupled two-dimensional model to resolve hydrodynamics, spectral waves and sediment transport is very computationally intensive, with a simulation designed to represent 1-month taking several weeks to complete. Thus, undertaking simulations to represent long-term changes of 6 – 12 months would take several months in real time to complete.

To overcome this constraint, RPS utilised the Littoral Process (LITPACK) module which was developed by DHI to calculate sediment transport based on a Quasi Three-Dimensional Sediment Transport model (STPQ3D). This module calculates instantaneous and time-averaged hydrodynamics and sediment transport in two horizontal directions for a single point and can perform long-term assessment very quickly to a high degree of accuracy.

Importantly, this module accounts for many key processes that are critical to governing sediment transport including:

- Wave motion and wave radiation stresses.
- Turbulence and eddy viscosities.
- Bed load transport and suspended load transport.
- Near-bed orbital velocities.
- Shear stresses and ripples

4.2.4.1 Modelling approach & output

To inform the LITPACK model, RPS derived the wave conditions experienced on the dump site between 2022 and 2023 based on data recorded by the Marine Institute’s M2 wave buoy. Tidal conditions for the model were derived from the Dublin Port tide gauge for the same period, whilst tidal current conditions were extracted from an existing calibrated hydrodynamic model of the dump site.

Having established boundary conditions, coarse material which was representative of the sand to be dredged from Dublin Port was introduced at various depths which corresponded to the 10 contours described in Table 4-1. The material was defined with a Dn50 size of 0.20mm and was represented using three discrete fractions to account for potential spreading across the sediment grading curve.

The model was run for a total of 1 year which included the October and December period during which the bathymetric surveys described in Section 4.2.3 were undertaken. The output of this simulation produced rates of sediment transport for the sand material at each of the ten unique depth contours. Based on these results, it was found that a sand particle with a Dn50 size of 0.20mm could move, on average, at a rate of between 0.05 and 0.17m/day depending on available water depth. A comparison of these model results and the output from the bathymetric survey assessment is presented in Figure 4-19.

> It will be noted from Figure 4-19 that both the observed and modelled rates of sediment transport correlate extremely well. Furthermore, it will be seen that sediment transport under tidal conditions alone does not exceed 0.005m/day regardless of the depth. This further demonstrates that the coarser sand material on the dump site will likely only be mobilised by wave action.

When material does become mobilised through wave action, the direction of transport will correspond to the direction of the prevailing tidal currents, which at the dump site tends to be towards the north during flood tides and towards the south during ebb tides. Over the long-term, the net movement of coarse material will be influenced primarily by the direction of residual tidal movements, which as illustrated in Figure 4-20, is towards the north.

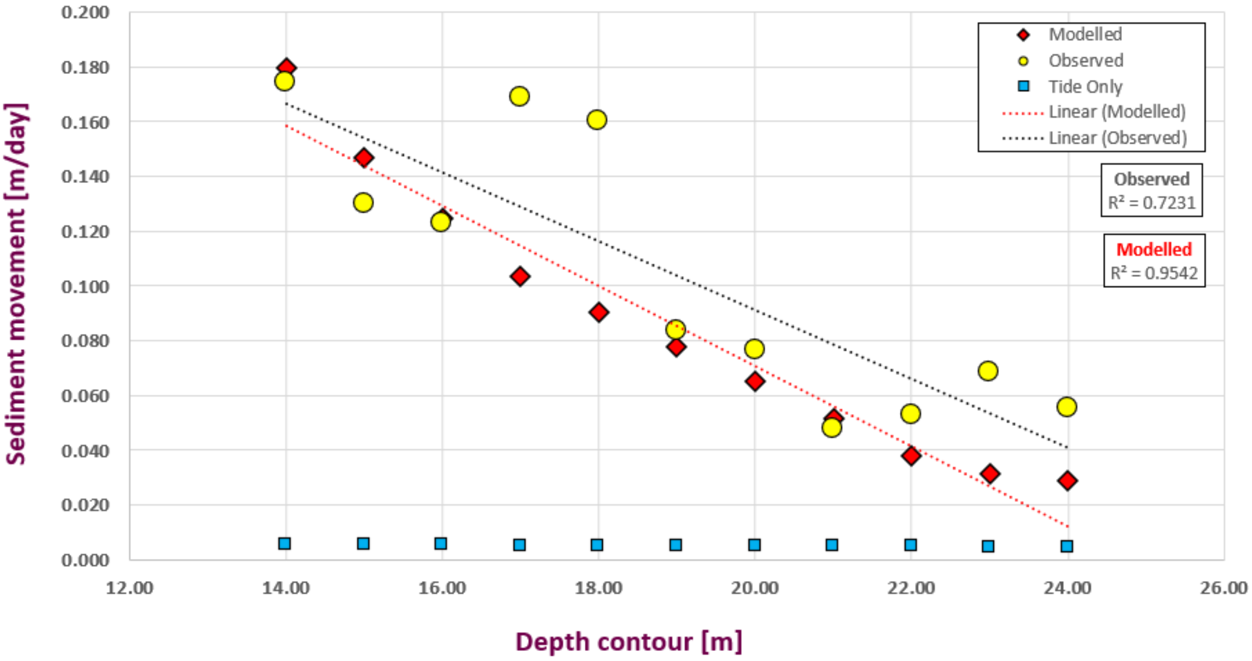


Figure 4-19 Comparison of sediment movement rates at the dump site as derived from numerical modelling and an assessment of bathymetric survey data. Modelled sediment Dn50 = 0.20m

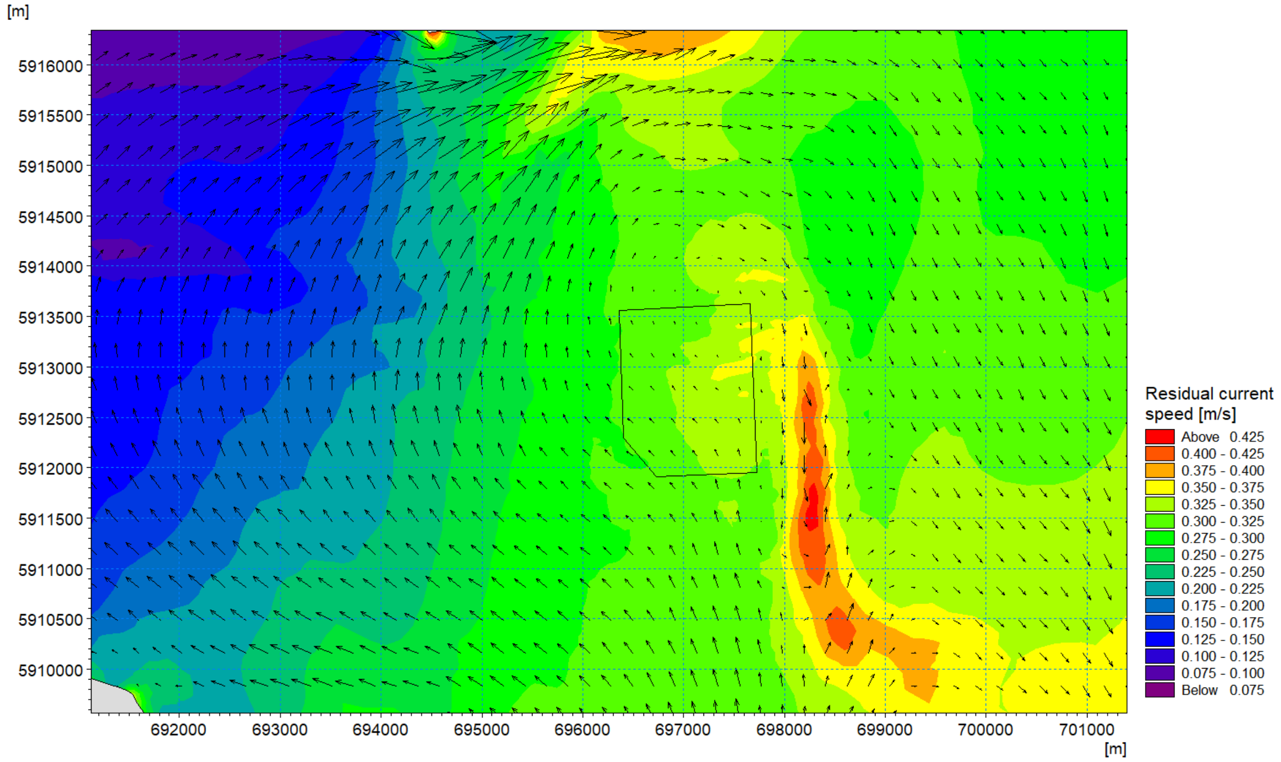


Figure 4-20 Residual current speeds at the dump site

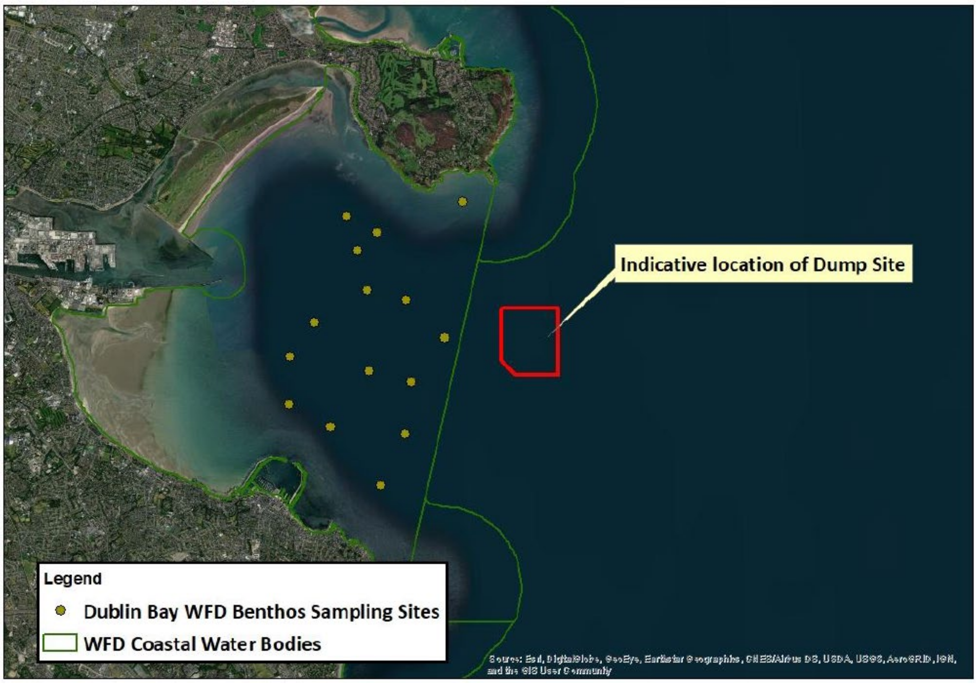
4.3 Context provided by Marine Institute Studies

Since 2012, the Marine Institute, has carried out monitoring to determine macroinvertebrate ecological quality status (EQS) in coastal and transitional waters around the Irish Coast in order to fulfil requirements of the Water Framework Directive (WFD). As part of this programme, sampling must be carried out within each waterbody, including Dublin Bay, at least twice within the 6-year cycle (once every three years).

Based on the sampling and monitoring of 15 individual locations illustrated in Figure 4-21, the seabed material was found to comprise of muddy and fine sand or very fine sands at all stations. Coarse material was found to contribute an insignificant part of the sediment. Furthermore, the benthic communities surveyed in Dublin Bay were characteristic of the shallow muddy fine sand sediments sampled. Taxa common throughout the stations included, amongst others, the polychaetes *Glycera tridactyla, Nephtys hombergii, Spiophanes bombyx* and *Chaetozone christiei.*

> Work undertaken by the Marine Institute which included extensive sampling and monitoring throughout Dublin Bay concluded that the effects of dredging (loading) and spoil disposal appear to be contained within the areas in question and do not appear to be impacting the wider seabed invertebrate communities in Dublin Bay.

The results of the Marine Institute's long-term (*since 2012*) environmental benthic surveys therefore support the findings presented in this report which conclude that the movement of coarse material into Dublin Bay as a result of disposing of dredge material at the dump site is *extremely* limited and highly unlikely to result in a large-scale deposition event in Dublin Bay.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 4-21 Dublin Bay Water Framework Directive benthos macro-invertebrate sampling points (n=15) in relation to the dump site

4.4 Conclusion

When considered in context of natural sedimentation within the Port Area (i.e., 30,000 g/m^2/yr which is equivalent to a deposition rate of *c.*2cm/yr), it is clear that the impact of sediment deposition from all dumping activities is several magnitudes lower than natural sedimentation rates. The impact of predicted sediment deposition from all capital and maintenance dredging dumping activities can therefore be considered to be *de minimis*.

In conclusion, the computational modelling studies of the capital and maintenance dredging dumping activities within the licensed dump site located at the approaches to Dublin Bay, west of the Burford Bank, in adherence with the key mitigation measures set out in Section 2, will ensure that cumulatively they will comply with, or will not result in the contravention of the following Directives:

- The Habitats Directive 82/43/EEC and Birds Directive 2009/147/EEC,
- The Water Framework Directive 2000/60/EC,
- The Marine Strategy Framework Directive 2008/56/EC.

5 BIBLIOGRAPHY

CEFAS Modelling the Fate of Dredged Material Following Disposal at the Nab Tower Disposal Site [Report]. - 2021.

Dublin Port Company DPC MP2 Project, Environmental Impact Assessment Report [Report]. - 2020.

Hydromaster Dublin Bay Sediment Plume Monitoring Report [Report]. - 2020.

Hydromaster Dublin Bay Sediment Plume Monitoring Report [Book]. - 2020.

RPS ABR Sediment Plume Validation Study [Report]. - 2021.

RPS Additional Sediment Plume Modelling, Response to Section 5(2) Notice [Report]. - 2021.

RPS Alexandra Basin Redevelopment Project - Construction Environmental Management Plan [Report]. - 2018.

RPS Alexandra Basin Redevelopment Project - Construction Environmental Management Plan [Book]. - 2018.

RPS Alexandra Basin Redevelopment Project - Environmental Impact Statement [Report]. - 2014.

RPS Alexandra Basin Redevelopment Project - Environmental Impact Statement [Book]. - 2014. - Vol. 1.

RPS Irish Coastal Protection Strategy Study [Report]. - 2003.

RPS Irish Coastal Protection Strategy Study [Book]. - 2003.

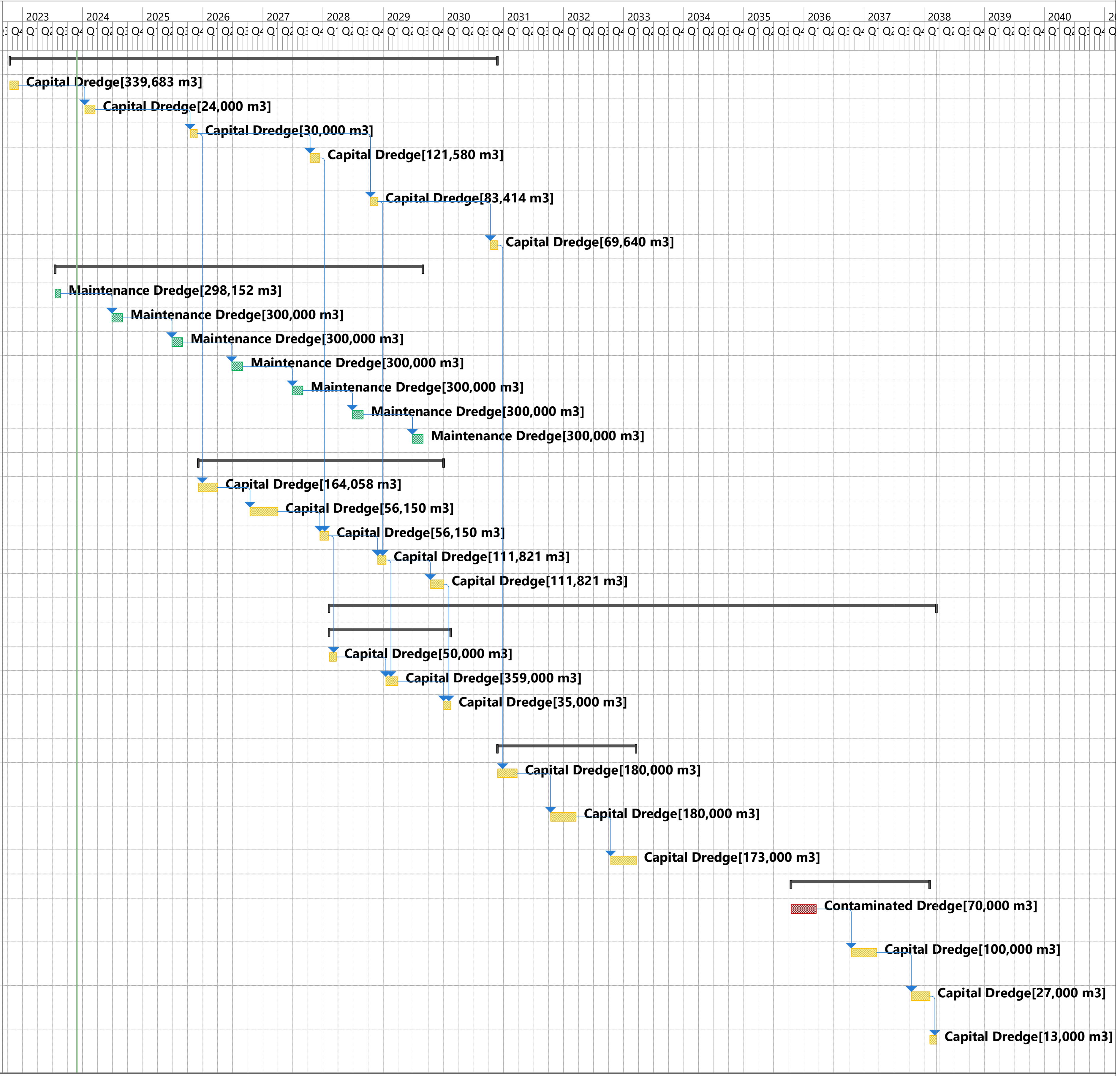
Appendix A

A.1 Dublin Port Overarching Dredging Programme

Dublin Port Company
Forecast Dredge Volumes

COMHLACHT CHALAFORT ÁTHA CLIATH
DUBLIN PORT COMPANY

ID	Task Name	Duration	Start Month	End Moth
1	**MP2 Project Capital Dredging (D@S Permit S0024-02)**	**395.8 wks**	**Oct-2022**	**Nov-2030**
2	Dredging Campaign No.1 Berth 53 Phase 1	36 days	Oct-2022	Dec-2022
3	Dredging Campaign No.2 Berth 53 Phase 2	44 days	Jan-2024	Mar-2024
4	Dredging Campaign No.3 Berth 53 Scour Protection	6 wks	Oct-2025	Nov-2025
5	Dredging Campaign No.4 Berth 52 Channel Widening	8 wks	Oct-2027	Dec-2027
6	Dredging Campaign No.5 Quay Rd and Oil Jetty pocket	6 wks	Oct-2028	Nov-2028
7	Dredging Campaign No.6 Berth 50A Pockets	6 wks	Oct-2030	Nov-2030
8	**Maintenance Dredging (D@S Permit S0004-03)**	**298.6 wks**	**Jul-2023**	**Aug-2029**
9	Maintenance Dredging Campaign No. 1	22 days	Jul-2023	Aug-2023
10	Maintenance Dredging Campaign No. 2	9 wks	Jun-2024	Aug-2024
11	Maintenance Dredging Campaign No. 3	9 wks	Jun-2025	Aug-2025
12	Maintenance Dredging Campaign No. 4	9 wks	Jun-2026	Aug-2026
13	Maintenance Dredging Campaign No. 5	9 wks	Jun-2027	Aug-2027
14	Maintenance Dredging Campaign No. 6	9 wks	Jun-2028	Aug-2028
15	Maintenance Dredging Campaign No. 7	9 wks	Jun-2029	Aug-2029
16	**Dublin Harbour Capital Dredging Project**	**198 wks**	**Dec-2025**	**Jan-2030**
17	Navigation Channel	14 wks	Dec-2025	Mar-2026
18	Berth Pocket Widening Campaign No.1	21 wks	Oct-2026	Mar-2027
19	Berth Pocket Widening Campaign No.2	6 wks	Dec-2027	Feb-2028
20	Basins Campaign No.1	6 wks	Nov-2028	Jan-2029
21	Basins Campaign No.2	10 wks	Oct-2029	Jan-2030
22	**3FM Project - Application Lodgment Spring 2024**	**518.4 wks**	**Feb-2028**	**Mar-2038**
23	**Turning Circle**	**100 wks**	**Feb-2028**	**Feb-2030**
24	Turning Circle Campaign No.1 - New Sea Wall	6 wks	Feb-2028	Mar-2028
25	Turning Circle Campaign No.2 - Main Dredge	10 wks	Jan-2029	Mar-2029
26	Turning Circle Campaign No.3 - Post Sludge Jetty Demolition	6 wks	Jan-2030	Feb-2030
27	**Lo-Lo Terminal (Area N) Berthing Pocket**	**118.6 wks**	**Nov-2030**	**Mar-2033**
28	Lo-Lo Terminal (Area N) Berthing Pocket Campaign No.1	15 wks	Nov-2030	Mar-2031
29	Lo-Lo Terminal (Area N) Berthing Pocket Campaign No.2	22 wks	Oct-2031	Mar-2032
30	Lo-Lo Terminal (Area N) Berthing Pocket Campaign Nc	22 wks	Oct-2032	Mar-2033
31	**Maritime Village / Marina**	**120.6 wks**	**Oct-2035**	**Feb-2038**
32	Maritime Village / Marina (top 1.0m at Maritime Village / Marina)	22 wks	Oct-2035	Mar-2036
33	Maritime Village / Marina - Main Dredge Campaign No.1	22 wks	Oct-2036	Mar-2037
34	Maritime Village / Marina - Main Dredge Campaign No.2	16 wks	Oct-2037	Feb-2038
35	**Ro-Ro Terminal (Area K) – Localised Scour Protection to 220 kV cables**	**6 wks**	**Feb-2038**	**Mar-2038**



Project: DPC Capital & Maintenance Dredge
Date: 28/11/2023

Task	▬	Maintenance Dredge	▨	Milestone	◆	Deadline	⇩
Capital Dredge	▨	Contaminated Dredge	▨	Summary	⊓	Progress	▬

Appendix B

B.1 Model Validation

Introduction

For more than a decade, RPS have been providing Dublin Port Company with an extensive suite of engineering design, environmental assessment, planning and consent services needed to support Strategic Infrastructure Development (SID) projects, including the Alexandra Basin Redevelopment (ABR), Masterplan 2 (MP2) and most recently the third and final Masterplan project (3FM).

Through this work and using industry standard software, RPS have developed, calibrated and validated a range of hydraulic models to assess coastal processes within the Dublin Port area and wider vicinity. This Appendix presents the key findings from the validation exercise which is relevant to this study.

Model Validation Process

The Time Series Comparator tool provided within MIKE was used to undertake statistical analysis of modelled and measured datasets for both tidal and wave parameters.

The MIKE tool provides several performance measures and statistics including the Index of Agreement which is also known as d_2 or "*model skill*". Model performance may be assessed using two main types of metrics: those related to absolute values such as the mean absolute error (MAE) or the root-mean-square error (RMSE) and those which are normalised such as the model skill (d_2) or the Coefficient of determination (R^2).

The MIKE analysis provides three normalised parameters directly:

- Coefficient of determination R^2 being the square of the Pearson's product-moment correlation coefficient. It ranges from 0 to 1 with larger values indicating a better fit.
- Coefficient of efficiency or Nash-Sutcliffe coefficient E (Nash and Sutcliffe, 1970)[1]. It ranges from minus infinity to 1 with larger values indicating a better fit.
- Index of agreement d_2 (Willmott et al., 1985)[2]. It ranges from 0 to 1 with large values indicating a better fit.

Having developed a value relating to goodness-of-fit between measured and modelled data it is necessary to determine if the model is fit for the purpose of assessment. Classification is a useful tool in this respect. The simplest form of classification, shown in Table A.2, may be applied to those metrics whose values range from zero to unity.

Table A.2: Coefficient of Determination Interpretation

Coefficient of Determination (R^2)	Interpretation
0	The model does not predict the outcome
Between 0 and 1	The model partially predicts the outcome
1	The model perfectly predicts the outcome

---

[1] Nash, J.E., Sutcliffe, J., (1970), River flow forecasting through conceptual models, Part I A discussions of principles, J. Hydrol., 10, 282-290.

[2] Willmott, C.J., Ackleson, S.G., Davis, R.E., Feddema, J.J, Klink, K.M., Legates, D.R., O'Donnell, J., Rowe, C.M., (1985), Statistics for the evaluation and comparison of models, J. Geophys. Res., 90, 8995-9005.

On the other end of the scale more complex classifications have been developed, such as that proposed by Ladson for application of the coefficient of efficiency in stream flow modelling (Ladson, 2008)[3]. This is a dual system in which a reduced level of fit is accepted as satisfactory for the validation phase compared with that from the calibration phase parameters, Table A.3.

Table A.3: Coefficient of Efficiency Interpretation

Classification	Coefficient of Efficiency Calibration	Coefficient of Efficiency Validation	
Excellent	E ≥ 0.93	E ≥ 0.93	🟦
Good	0.8 ≤ E < 0.93	0.8 ≤ E < 0.93	🟩
Satisfactory	0.7 ≤ E < 0.8	0.6 ≤ E < 0.8	🟨
Passable	0.6 ≤ E < 0.7	0.3 ≤ E < 0.6	🟧
Poor	E < 0.6	E < 0.3	🟥

For the purposes of this study the classification proposed by Sutherland is applied to the model output (Sutherland *et al* 2004)[4]. This classification is applied to metrics based around the normalising the Mean Absolute Error (MAE), where an allowance is made for the potential inaccuracy of the monitoring equipment, to derive an Average Relative Mean Absolute Error (ARMAE), as shown in Table 4.1. Model results from the study were analysed without accounting for potential device errors in the first instance (i.e. RMAE); therefore, the classification was applied on a conservative basis with a value of <0.7 providing a satisfactory level of model accuracy.

For each of the model parameters the MIKE timeseries comparator was used to derive statistics and performance measures.

Table 4.1: Average Relative Mean Absolute Error (ARMAE) Interpretation

Classification	Range of ARMAE	
Excellent	< 0.2	🟦
Good	0.2 – 0.4	🟩
Reasonable	0.4 – 0.7	🟨
Poor	0.7 – 1.0	🟧
Bad	> 1.0	🟥

---

[3] Ladson, A. R. (2008) Hydrology: an Australian Introduction. Oxford University Press.

[4] J. Sutherland, D.J.R. Walstra, T.J. Chesher, L.C. van Rijn, H.N. Southgate. (2004), Evaluation of coastal area modelling systems at an estuary mouth. Coastal Engineering 51, 119– 142.

Tidal Regime Validation

The validation process of the baseline Dublin Port 3D hydrodynamic model was undertaken using data recorded by two Acoustic Doppler Current Profilers (ADCPs) that were moored in the Port and Dublin Bay as part of a previous monitoring programme. The location of these devices is illustrated in Figure A.1.

The validation process focused on establishing agreement between the model output and recorded observations and thus assessing overall model performance based on several key parameters including tidal range, current speed and direction.

Data from the tide gauge at Dublin Port was also used to verify simulated surface elevations.

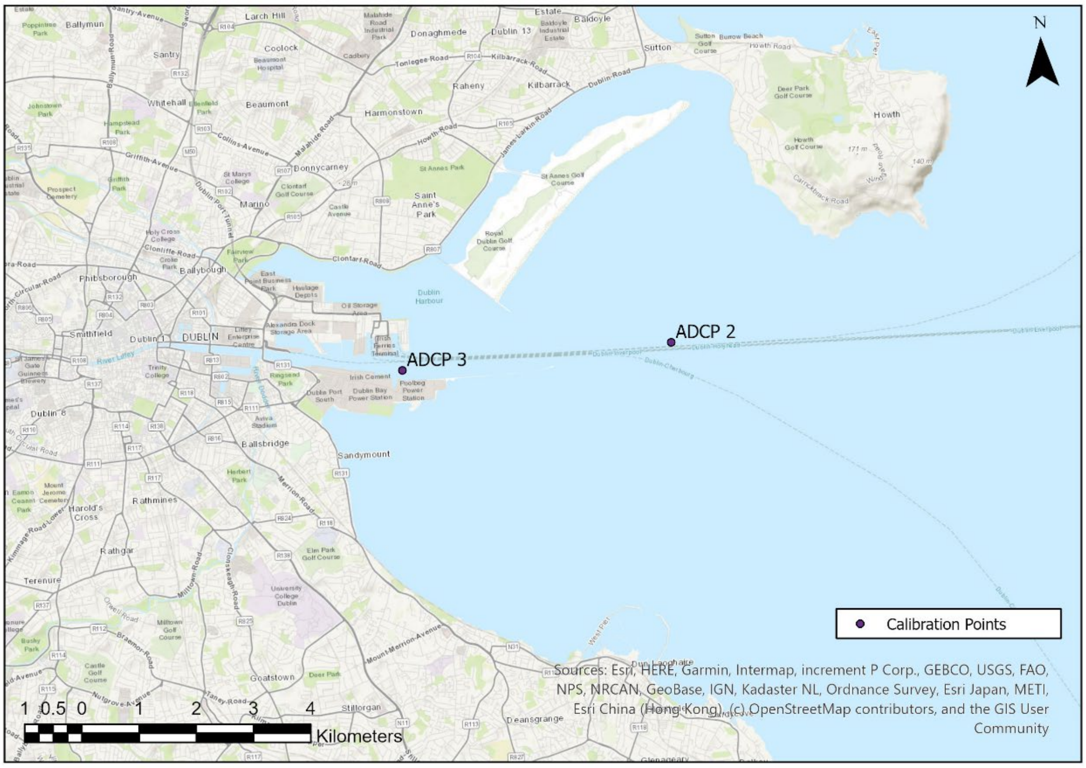


Figure A.1: Location of the ADCP devices in Dublin Bay that were used to validate the baseline 3D hydrodynamic model

The statistics and performance measures ascertained from the MIKE comparator software were supplemented to provide the Averaged Absolute Value (AAV) for the simulation to determine the Relative Mean Absolute Error (RMAE). Table A.1 presents a summary of the statistics and performance measures for the calibration period at each of the two ADCPs and Dublin Port tide gauge.

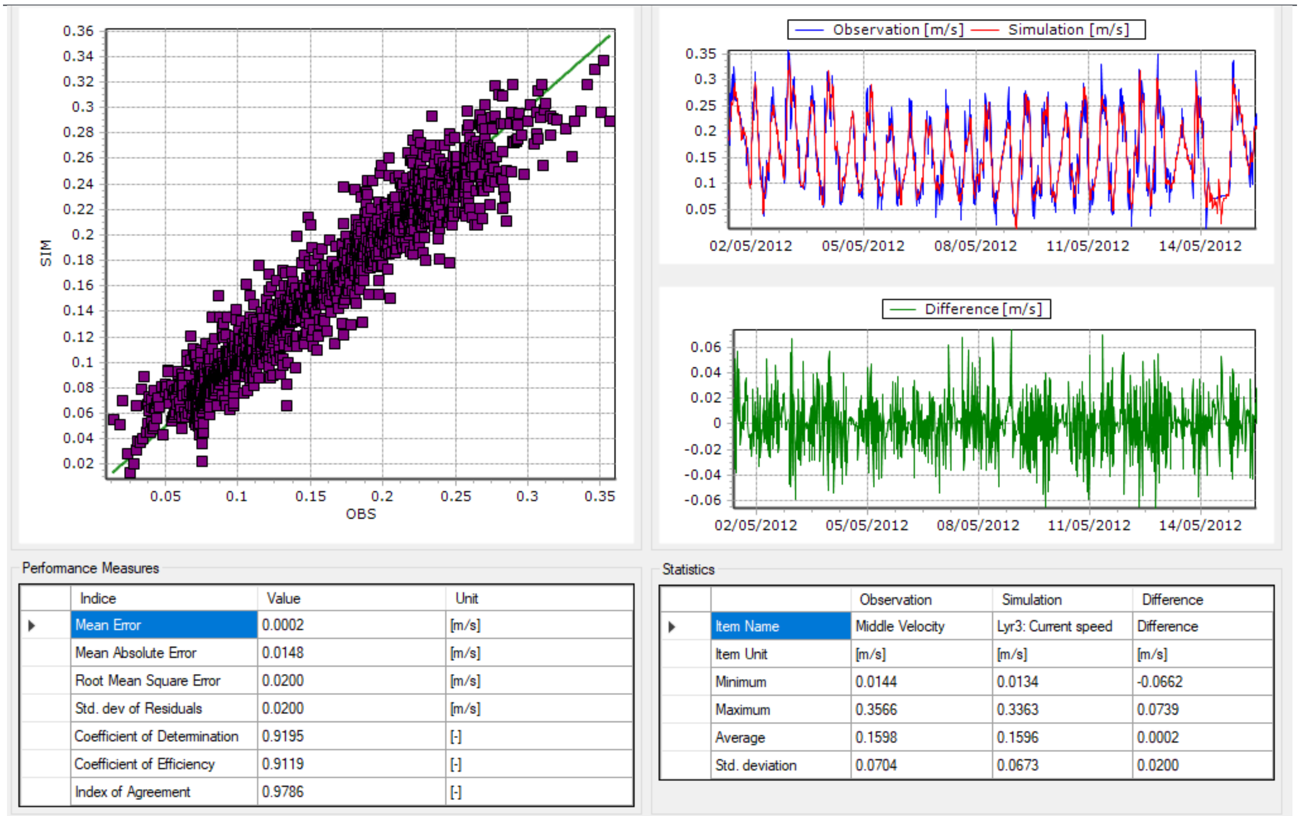
Based on this validation exercise, it was found that:

- Applying the Sutherland ARMAE classification, without any allowance for measuring device inaccuracies, shows that the goodness of fit for all parameters would be classed as either **'good' (green) or 'excellent' (blue)** at both locations.
- When the Ladson classification is applied on the coefficient of efficiency, all parameters are also rated **'satisfactory'** to **'excellent'**.

The hydrodynamic model described and used to inform the assessment presented in this document was therefore considered accurate and fit for purpose.

Table A.1: Model calibration performance metrics

Metric	**Statistic**			**Performance Measure**			
Parameter	**Average Absolute Value Observed AAV**	**Mean Absolute Error MAE**	**Root Mean Square Error RMSE**	**Coeff of Determination R^2**	**Coeff of Efficiency E**	**Index of Agreement d_2**	**Relative Mean Absolute Error ARMAE**
Dublin Port Tide Gauge							
Surface Elevation	0.1158	0.0461	0.0554	0.9973	0.9972	0.993	0.39
Inner ADCP – Current Velocity							
Surface layer	0.1835	0.0285	0.0387	0.8859	0.8652	0.9682	0.16
Middle layer	0.1313	0.0217	0.0324	0.8814	0.8619	0.6972	0.17
Bottom layer	0.0859	0.0178	0.0234	0.7839	0.7067	0.9344	0.21
Outer ADCP – Current Velocity							
Surface layer	0.1866	0.0210	0.0310	0.9494	0.9484	0.9870	0.11
Middle layer	0.1598	0.0148	0.0200	0.9195	0.9119	0.9786	0.09
Bottom layer	0.1392	0.0130	0.0175	0.8990	0.8857	0.9725	0.09
Inner ADCP – Current Direction [rad]							
Surface layer	0.6319	14.5418	19.8945	0.9171	0.9152	0.9784	0.04
Middle layer	0.2902	15.4551	20.8287	0.8872	0.8829	0.9702	0.18
Bottom layer	0.7607	13.9571	20.3591	0.9197	0.9101	0.9783	0.03
Outer ADCP – Current Direction [rad]							
Surface layer	4.4792	15.3744	27.7267	0.9461	0.9364	0.9848	0.29
Middle layer	4.0308	14.2014	23.2595	0.9481	0.9393	0.9855	0.28
Bottom layer	1.5296	15.7842	23.8407	0.9292	0.9222	0.9811	0.09



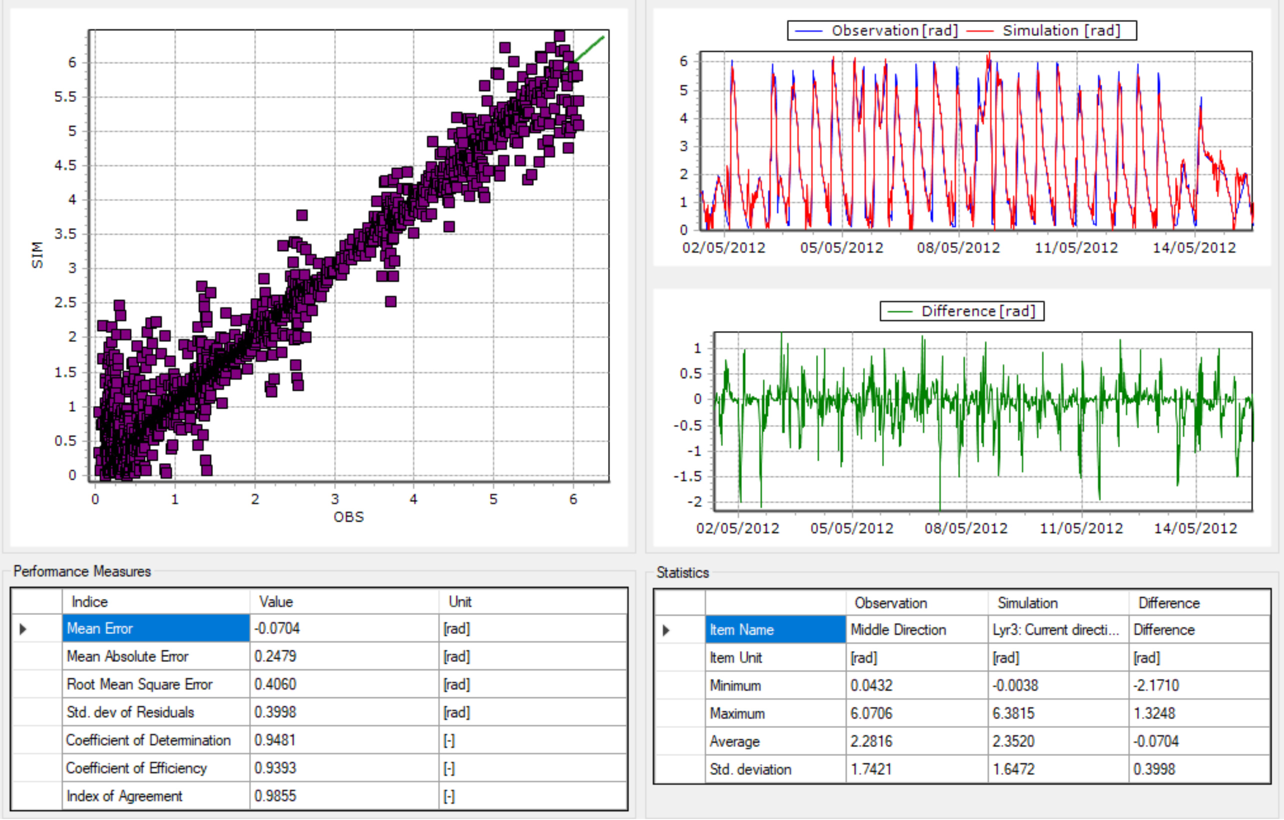
Performance Measures

Indice	Value	Unit
Mean Error	0.0002	[m/s]
Mean Absolute Error	0.0148	[m/s]
Root Mean Square Error	0.0200	[m/s]
Std. dev of Residuals	0.0200	[m/s]
Coefficient of Determination	0.9195	[-]
Coefficient of Efficiency	0.9119	[-]
Index of Agreement	0.9786	[-]

Statistics

	Observation	Simulation	Difference
Item Name	Middle Velocity	Lyr3: Current speed	Difference
Item Unit	[m/s]	[m/s]	[m/s]
Minimum	0.0144	0.0134	-0.0662
Maximum	0.3566	0.3363	0.0739
Average	0.1598	0.1596	0.0002
Std. deviation	0.0704	0.0673	0.0200

Figure A.2: Statistical comparison of middle current velocity from the Outer ADCP and the model



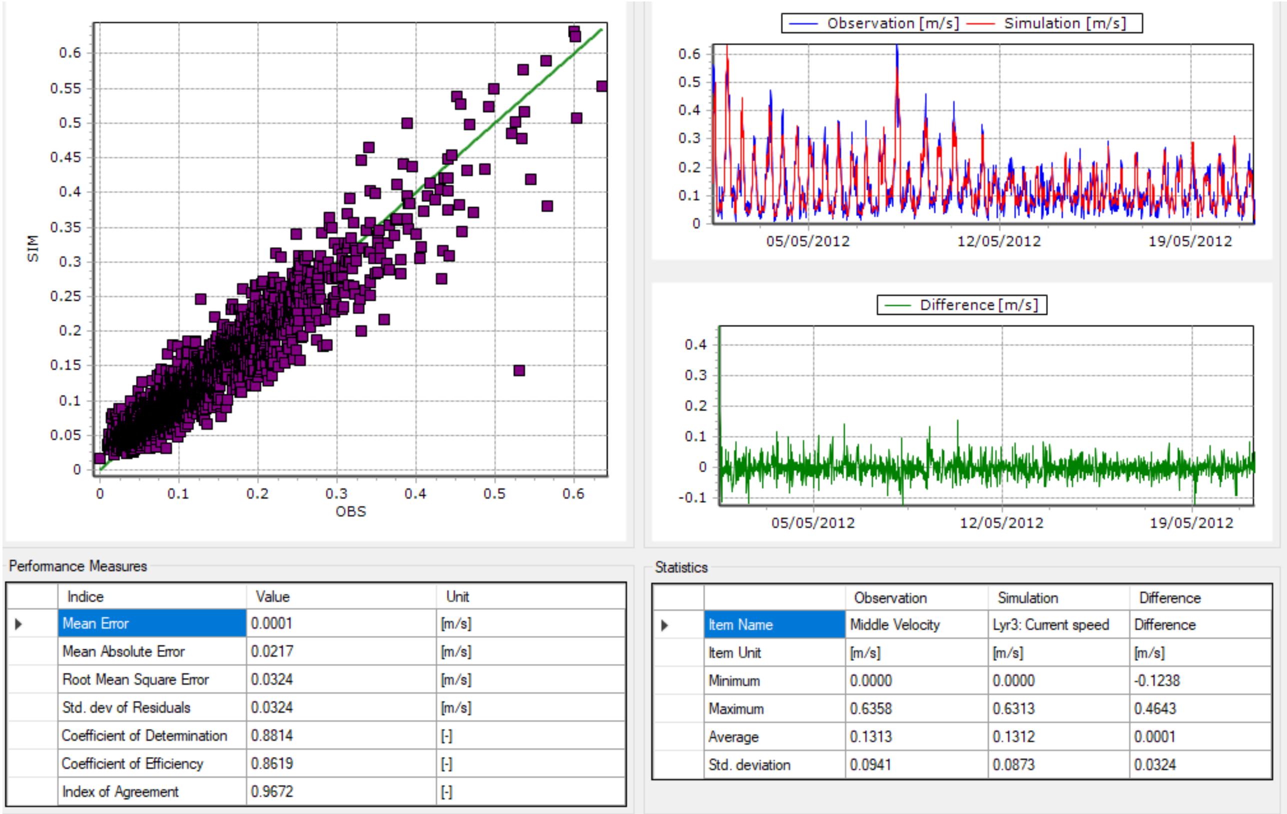
Performance Measures

Indice	Value	Unit
Mean Error	-0.0704	[rad]
Mean Absolute Error	0.2479	[rad]
Root Mean Square Error	0.4060	[rad]
Std. dev of Residuals	0.3998	[rad]
Coefficient of Determination	0.9481	[-]
Coefficient of Efficiency	0.9393	[-]
Index of Agreement	0.9855	[-]

Statistics

	Observation	Simulation	Difference
Item Name	Middle Direction	Lyr3: Current directi...	Difference
Item Unit	[rad]	[rad]	[rad]
Minimum	0.0432	-0.0038	-2.1710
Maximum	6.0706	6.3815	1.3248
Average	2.2816	2.3520	-0.0704
Std. deviation	1.7421	1.6472	0.3998

Figure A.3: Statistical comparison of middle current direction from the Outer ADCP and the model



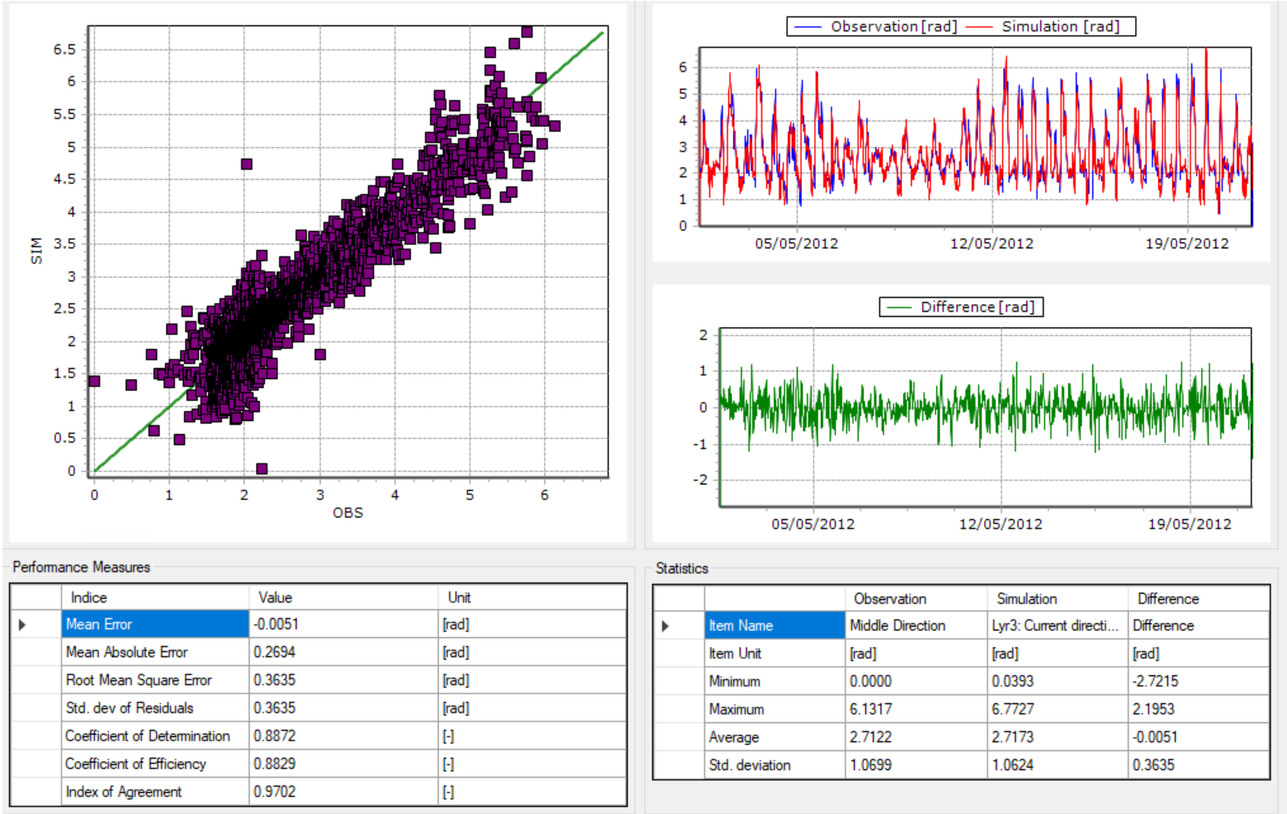
Performance Measures

	Indice	Value	Unit
▶	Mean Error	0.0001	[m/s]
	Mean Absolute Error	0.0217	[m/s]
	Root Mean Square Error	0.0324	[m/s]
	Std. dev of Residuals	0.0324	[m/s]
	Coefficient of Determination	0.8814	[-]
	Coefficient of Efficiency	0.8619	[-]
	Index of Agreement	0.9672	[-]

Statistics

		Observation	Simulation	Difference
▶	Item Name	Middle Velocity	Lyr3: Current speed	Difference
	Item Unit	[m/s]	[m/s]	[m/s]
	Minimum	0.0000	0.0000	-0.1238
	Maximum	0.6358	0.6313	0.4643
	Average	0.1313	0.1312	0.0001
	Std. deviation	0.0941	0.0873	0.0324

Figure A.4: Statistical comparison of middle current velocity from the Inner ADCP and the model



Performance Measures

	Indice	Value	Unit
▶	Mean Error	-0.0051	[rad]
	Mean Absolute Error	0.2694	[rad]
	Root Mean Square Error	0.3635	[rad]
	Std. dev of Residuals	0.3635	[rad]
	Coefficient of Determination	0.8872	[-]
	Coefficient of Efficiency	0.8829	[-]
	Index of Agreement	0.9702	[-]

Statistics

		Observation	Simulation	Difference
▶	Item Name	Middle Direction	Lyr3: Current directi...	Difference
	Item Unit	[rad]	[rad]	[rad]
	Minimum	0.0000	0.0393	-2.7215
	Maximum	6.1317	6.7727	2.1953
	Average	2.7122	2.7173	-0.0051
	Std. deviation	1.0699	1.0624	0.3635

Figure A.5: Statistical comparison of middle current direction from the Inner ADCP and the model

Wave Validation

The spectral wave model was verified using data collected by an Acoustic Wave and Current Profile (AWAC) device which was deployed in the centre of the licensed spoil site in Dublin Bay as part of a previous monitoring programme. The location of this device is illustrated in Figure A.6.

For the purposes of the validation exercise, wave simulations were run and compared for the following two periods when notable wave activity was recorded by the AWAC device:

- **Event 1:** 01/01/2018 to 09/03/2018
- **Event 2:** 29/01/2021 to 01/03/2021

The output for the significant wave height and wave periods at the site over the calibration period is presented in Figure A.7. An example of the MIKE timeseries comparator output for the wave components at the site is shown in Figure A.8.

Based on this validation exercise, it was found that:

- Applying the Sutherland classification, without any allowance for measuring device inaccuracies, shows that the goodness of fit for all parameters would be classed as either **'good' (green) or 'excellent' (blue)** during both events.
- When the Ladson classification is applied on the coefficient of efficiency, all parameters are also rated **'excellent' for both events**.

The spectral wave model described and used to inform the assessment presented in this document was therefore considered accurate and fit for purpose.

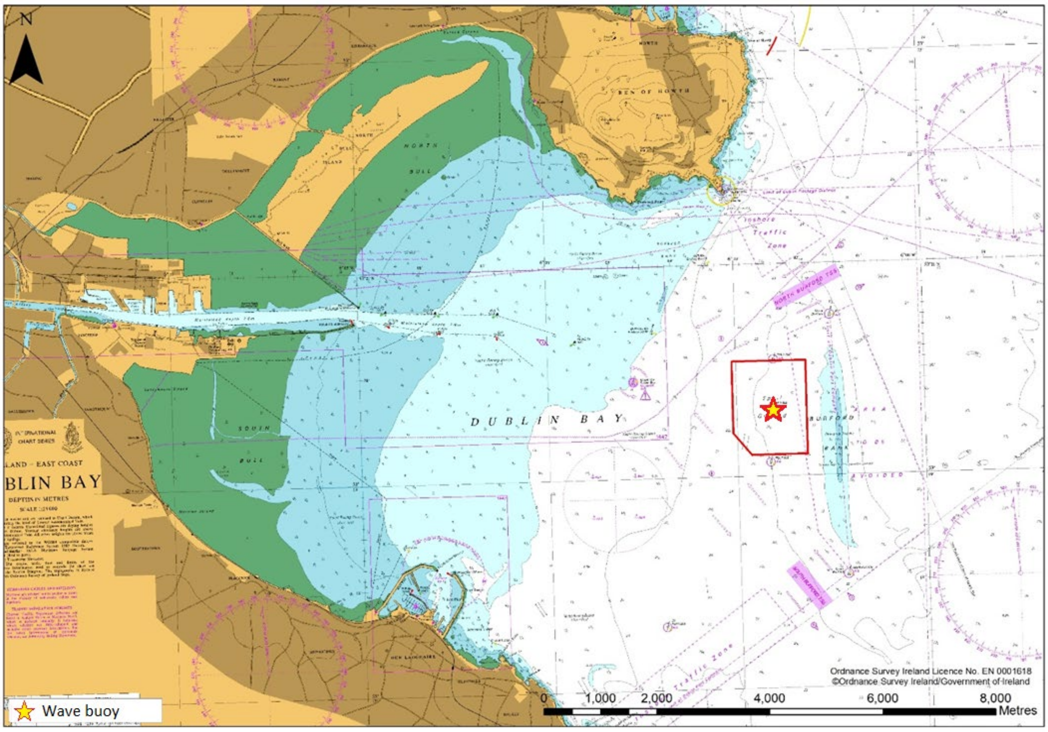
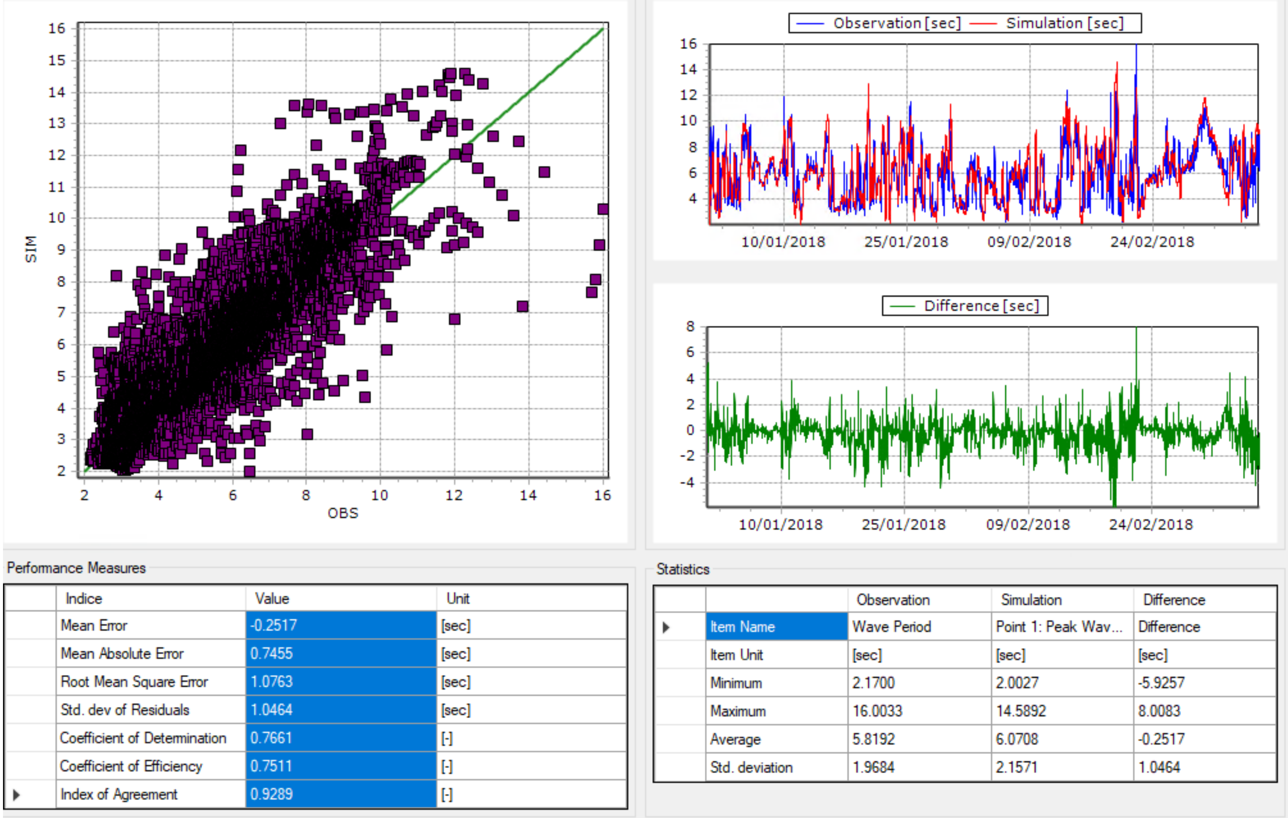


Figure A.6: Location of the licensed dredged spoil disposal site

Table 4.2: Validation statistics for significant wave height and period

Metric	Statistic			Performance Measure			
Parameter	**Average Absolute Value Observed** **AAV**	**Mean Absolute Error** **MAE**	**Root Mean Square Error** **RMSE**	**Coeff of Determination** **R^2**	**Coeff of Efficiency** **E**	**Index of Agreement** **d_2**	**Relative Mean Absolute Error*** **ARMAE**
Early Event							
Wave period	5.8192	0.7455	1.0763	0.7661	0.7511	0.9289	0.13
Sig. Wave Height	0.8516	0.0972	0.1341	0.9624	0.9531	0.9882	0.12
Later Event							
Wave period	7.4180	0.7157	1.0735	0.8299	0.7500	0.9443	0.10
Sig. Wave Height	1.0912	0.1041	0.1390	0.9591	0.9539	0.9874	0.10



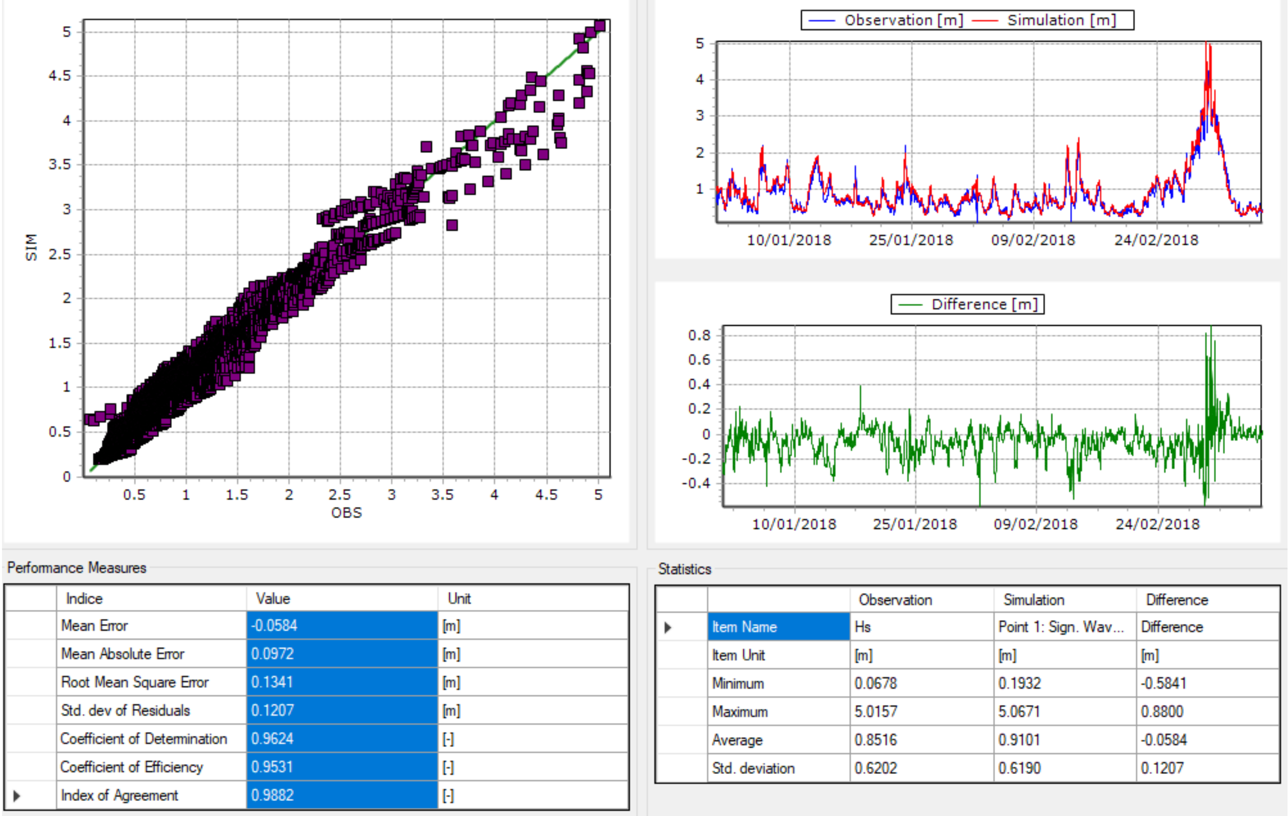
Performance Measures

	Indice	Value	Unit
	Mean Error	-0.2517	[sec]
	Mean Absolute Error	0.7455	[sec]
	Root Mean Square Error	1.0763	[sec]
	Std. dev of Residuals	1.0464	[sec]
	Coefficient of Determination	0.7661	[-]
	Coefficient of Efficiency	0.7511	[-]
▶	Index of Agreement	0.9289	[-]

Statistics

		Observation	Simulation	Difference
▶	Item Name	Wave Period	Point 1: Peak Wav...	Difference
	Item Unit	[sec]	[sec]	[sec]
	Minimum	2.1700	2.0027	-5.9257
	Maximum	16.0033	14.5892	8.0083
	Average	5.8192	6.0708	-0.2517
	Std. deviation	1.9684	2.1571	1.0464

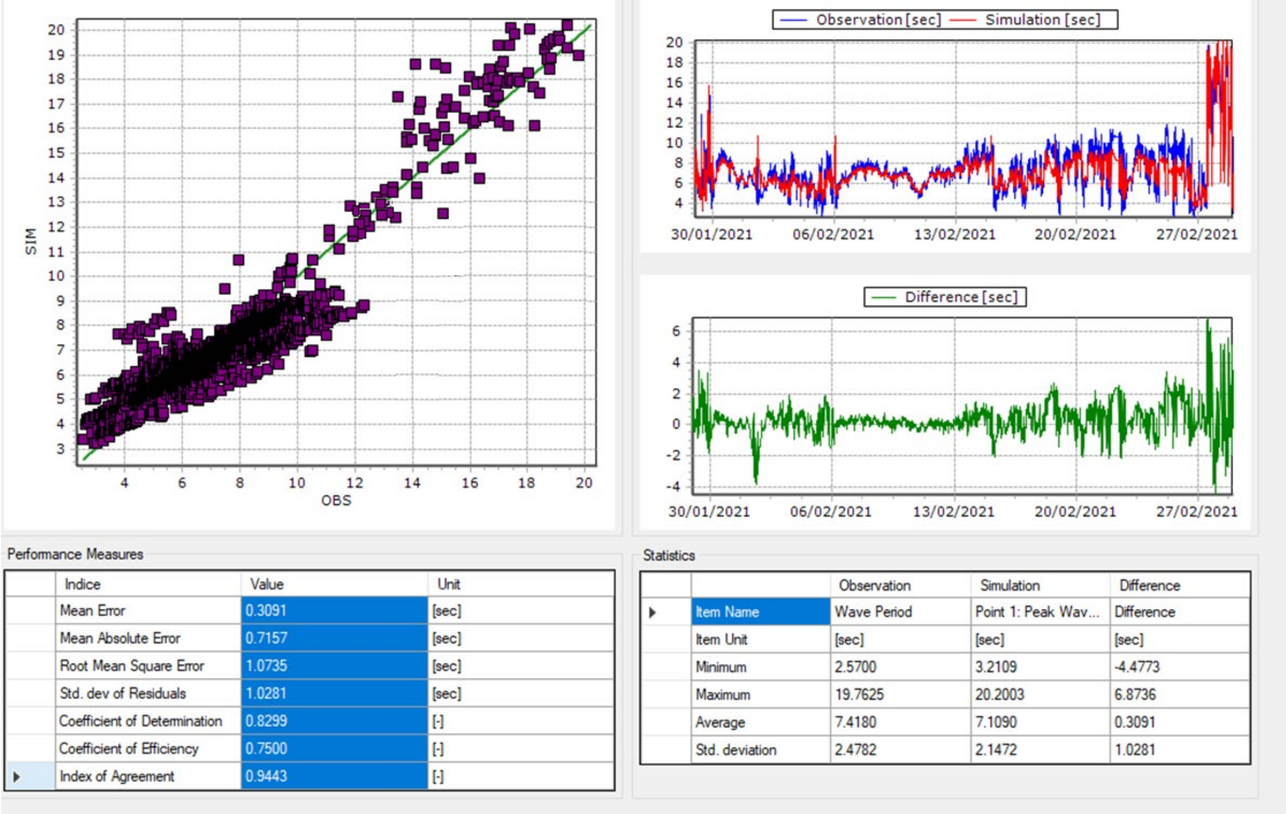
Figure A.7: Statistical comparison of wave period between the modelled and observed for the 2018 storm event



Indice	Value	Unit
Mean Error	-0.0584	[m]
Mean Absolute Error	0.0972	[m]
Root Mean Square Error	0.1341	[m]
Std. dev of Residuals	0.1207	[m]
Coefficient of Determination	0.9624	[-]
Coefficient of Efficiency	0.9531	[-]
Index of Agreement	0.9882	[-]

	Observation	Simulation	Difference
Item Name	Hs	Point 1: Sign. Wav...	Difference
Item Unit	[m]	[m]	[m]
Minimum	0.0678	0.1932	-0.5841
Maximum	5.0157	5.0671	0.8800
Average	0.8516	0.9101	-0.0584
Std. deviation	0.6202	0.6190	0.1207

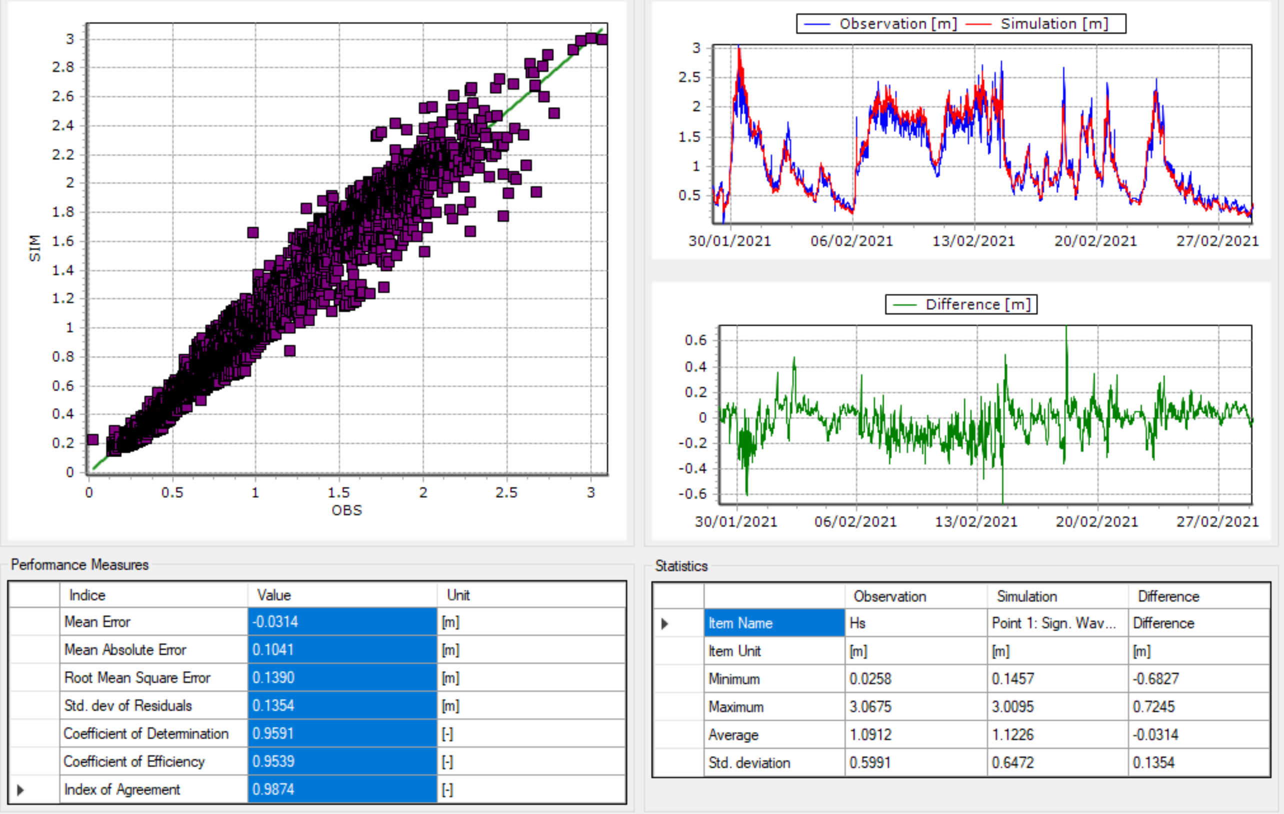
Figure A.8: Statistical comparison of significant wave height between the modelled and observed for the 2018 storm event



Indice	Value	Unit
Mean Error	0.3091	[sec]
Mean Absolute Error	0.7157	[sec]
Root Mean Square Error	1.0735	[sec]
Std. dev of Residuals	1.0281	[sec]
Coefficient of Determination	0.8299	[-]
Coefficient of Efficiency	0.7500	[-]
Index of Agreement	0.9443	[-]

	Observation	Simulation	Difference
Item Name	Wave Period	Point 1: Peak Wav...	Difference
Item Unit	[sec]	[sec]	[sec]
Minimum	2.5700	3.2109	-4.4773
Maximum	19.7625	20.2003	6.8736
Average	7.4180	7.1090	0.3091
Std. deviation	2.4782	2.1472	1.0281

Figure A.9: Statistical comparison of wave period between the modelled and observed for the 2021 storm event



Performance Measures

	Indice	Value	Unit
	Mean Error	-0.0314	[m]
	Mean Absolute Error	0.1041	[m]
	Root Mean Square Error	0.1390	[m]
	Std. dev of Residuals	0.1354	[m]
	Coefficient of Determination	0.9591	[-]
	Coefficient of Efficiency	0.9539	[-]
▶	Index of Agreement	0.9874	[-]

Statistics

		Observation	Simulation	Difference
▶	Item Name	Hs	Point 1: Sign. Wav...	Difference
	Item Unit	[m]	[m]	[m]
	Minimum	0.0258	0.1457	-0.6827
	Maximum	3.0675	3.0095	0.7245
	Average	1.0912	1.1226	-0.0314
	Std. deviation	0.5991	0.6472	0.1354

Figure A.10: Statistical comparison of significant wave height between the modelled and observed for the 2021 storm event

Appendix C

C.1 Sediment Plume Validation Modelling

ALEXANDRA BASIN REDEVELOPMENT (ABR) PROJECT

CAPITAL DREDGING PROGRAMME

Sediment Plume Validation Modelling

IBE1686 Sediment Plume
Validation Modelling
Final
9 September 2020

rpsgroup.com

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
Draft	Review	KC	AKB	AGB	28/08/2020
Final	Circulation to OEE	KC	AKB	AGB	09/09/2020

Approval for issue

Dr A G Barr	Alan Barr	9 September 2020

Prepared by:

RPS

Kristopher Calder BSc (Hons) MSc C.Sci MCIWEM C.WEM AMICE
Associate - Water Environment and Flood Risk Management

Elmwood House
74 Boucher Road, Belfast
Co. Antrim BT12 6RZ

T +44 2890 667 914
E kristopher.calder@rpsgroup.com

Prepared for:

Dublin Port Company

Eamon McElroy
Port Engineer

Dublin Port Centre
Alexandra Road, Dublin 1

T 01 8876000
E emcelroy@dublinport.ie

Contents

Appendices

1 INTRODUCTION

1.1 Background

Dublin Port Company (DPC) was granted a Dumping at Sea Permit (S0024-01) by the Environmental Protection Agency (EPA) on 13th September 2016 for the loading and dumping at sea of dredged material arising from capital dredging as part of the Alexandra Basin Redevelopment (ABR) Project. The permit sets out in detail the conditions under which DPC will carry out loading and dumping at sea operations and the required monitoring programmes.

Condition 4.11 of the Dumping at Sea Permit sets out the sediment plume monitoring at the dump site required to enable the horizontal and vertical extent of the sediment plume generated by the permitted dumping activity at different stages of the tide to be measured.

> *“The permit holder shall carry out sediment plume monitoring in the vicinity of the dumping activity during the first dumping campaign and thereafter as may be required by the Agency.”* Condition 4.11.1
>
> *Furthermore, “The results of the sediment plume monitoring, together with the results of the hydrographic monitoring, shall be used to validate the sediment transport model presented in Appendix C: Coastal Process Modelling to the Natura Impact Statement submitted as part of the application.”* Condition 4.11.3

In response to this statutory requirement, DPC commissioned Techworks Marine Ltd to undertake a comprehensive sediment plume monitoring programme and RPS to undertake a modelling validation study during the first winter dredging campaign (October 2017 to March 2018). The results of this study are presented in the Dumping at Sea Permit S0024-01 Annual Environmental Report 2017.

1.1.1 Review of Sediment Plume Monitoring undertaken during the First Winter Capital Dredging Campaign (October 2017 – March 2018) in Dublin Bay

The first winter dredging capital dredging campaign commenced on 22nd October 2017 and Techworks Marine Ltd undertook their first sediment plume monitoring survey on 27th October 2017 whilst loading and dumping activity was taking place.

The survey was undertaken in full compliance with methodology agreed with the EPA. Turbidity was measured close to the water surface using a meter attached to a small craft (RIB). The location of the turbidity transects were designed to record the full extent of the dredge plume, beyond the footprint of the dump site.

The recorded turbidity levels at 1m below the surface did not differ within the dumping area and in adjacent areas outside the dumping site or at a background site. The results therefore showed that the released dredge spoil did not create a significant dredge plume within the surface waters. This suggests that the dredged material fell rapidly towards the seabed.

All loading and dumping activity during the first winter capital dredging season was confined to one section of the navigation channel and fairway within Dublin Bay (AER 2017, Appendix 2.2). The dredged material is predominately fine sand throughout the dredge area so the behaviour of any sediment plume arising from the dumping operations was expected to be similar for all loading and dumping trips.

Based on the results of the first sediment plume monitoring survey, it was clear that that the monitoring programme needed to be adapted in order to gain a better understanding of the dispersion and fate of marine sediments during dumping operations.

Techworks Marine Ltd therefore designed an adapted dredge plume monitoring programme that measured in-situ turbidity depth profiles at nine locations in the vicinity of the dump site and at a control site. A survey based on this technique took place on 4th December 2017 during loading and dumping operations.

Again, the recorded turbidity levels were low and no significant differentiation could be made between turbidity levels recorded at the dump site and at the background, control site. Techworks Marine Ltd concluded that sediment appears to settle rapidly and proximally to the release point within the dumping site.

At this point, RPS undertook model simulations of the dredge trips that coincided with the dredge plume monitoring surveys. The results are reported in the Annual Environmental Report (AER) 2017 (pages 75 – 84). The model simulations showed that the sediment was predicted to settle rapidly and proximally to the release point within the dumping site in agreement with the survey results.

Techworks Marine Ltd determined that there was no further scientific value in undertaking further plume monitoring surveys during the first winter capital dredging season. This was because that the dredging operations were confined to one section of the navigation channel and fairway within Dublin Bay and the dredged material was predominately a fine sand throughout the dredge area. As such, the behaviour of any sediment plume arising from the dumping operations was expected to be similar for all loading and dumping trips.

1.1.1.1 Conclusions

The following conclusions can be drawn from the review of Sediment Plume Monitoring undertaken during the First Winter Capital Dredging Campaign (October 2017 – March 2018):

- A sediment plume monitoring programme was established in full compliance to the monitoring protocols agreed with the EPA.
- The results of the first sediment plume monitoring survey showed that the released dredge spoil did not create a significant dredge plume within the surface waters. This suggests that the dredged material fell rapidly towards the seabed.
- Based on the results of the first sediment plume monitoring survey, it was clear that that the monitoring programme needed to be adapted in order to gain a better understanding of the dispersion and fate of marine sediments during dumping operations.
- An adapted dredge plume monitoring programme was developed which measured in-situ turbidity depth profiles at nine locations in the vicinity of the dump site and at a control site. Again, the recorded turbidity levels were low and no significant differentiation could be made between turbidity levels recorded at the dump site and at the background, control site. The sediments appear to settle rapidly and proximally to the release point within the dumping site.
- Model simulations of the dredge trips that coincided with the dredge plume monitoring surveys showed that the sediment was predicted to settle rapidly and proximally to the release point within the dumping site in agreement with the survey results.
- There was no further scientific value in undertaking further plume monitoring surveys during the first winter capital dredging season, given the dredging operations were confined to one section of the navigation channel and fairway within Dublin Bay. In addition, the dredged material was predominately a fine sand throughout the dredge area so the behaviour of any sediment plume arising from the dumping operations was expected to be similar for all loading and dumping trips.

1.1.2 Change in Scope – Proposed Sediment Plume Monitoring within the inner Liffey channel

Schedule B.2.4 of the Dumping at Sea Permit requires the Permit Holder to undertake sediment plume monitoring during the first dumping campaign and thereafter as may be required by the Agency.

The AER 2017 sets out the results of the sediment plume monitoring undertaken during the first dumping campaign. The results, as summarised above, demonstrate that for loading and dumping activity within Dublin Bay, sediments settle rapidly and proximally to the release point within the dumping site. This is consistent with the findings of computational modelling (Section 10.6 of the AER 2017).

Based on the results of the sediment plume monitoring undertaken during the first dumping campaign, DPC believes that further sediment plume monitoring for loading and dumping of sediments sourced from the navigation channel and fairway within Dublin Bay would be of no additional scientific value.

DPC however proposed that further sediment plume monitoring and model validation would be undertaken when dredging commenced within the inner Liffey channel. The material to be dredged in this area contains a highly silt content and model simulations showed that the silts where expected to be dispersive in nature during dumping operations.

In accordance with Condition 4.4 of Dumping at Sea Permit S0024-01, DPC proposed this amendment to the scope of the sediment plume monitoring requirements to the EPA, which was subsequently accepted.

1.1.3 Sediment Plume Monitoring undertaken during the Third Winter Capital Dredging Campaign (October 2019 – March 2020) within the inner Liffey channel

Capital dredging within the inner Liffey channel (Dublin Harbour) took place in February - March 2020 during third winter dredging capital dredging campaign (October 2019 – March 2020).

DPC appointed Hydromaster Ltd to undertake a comprehensive sediment plume monitoring survey during the dumping operations (March 2020). Hydromaster's monitoring report is presented separately (Hydromaster, 2020).

DPC appointed RPS to undertake a modelling validation study using the results of the sediment plume monitoring survey undertaken by Hydromaster.

This technical report describes the numerical modelling programme undertaken using results of the sediment plume monitoring, together with the results of hydrographic monitoring, to validate the sediment transport model presented in Appendix C: Coastal Process Modelling to the Natura Impact Statement submitted as part of the application.

The location of the licenced offshore dump site at the approaches to Dublin Bay, west of the Burford Bank is where permitted dumping activities took place is presented in Figure 1.1.

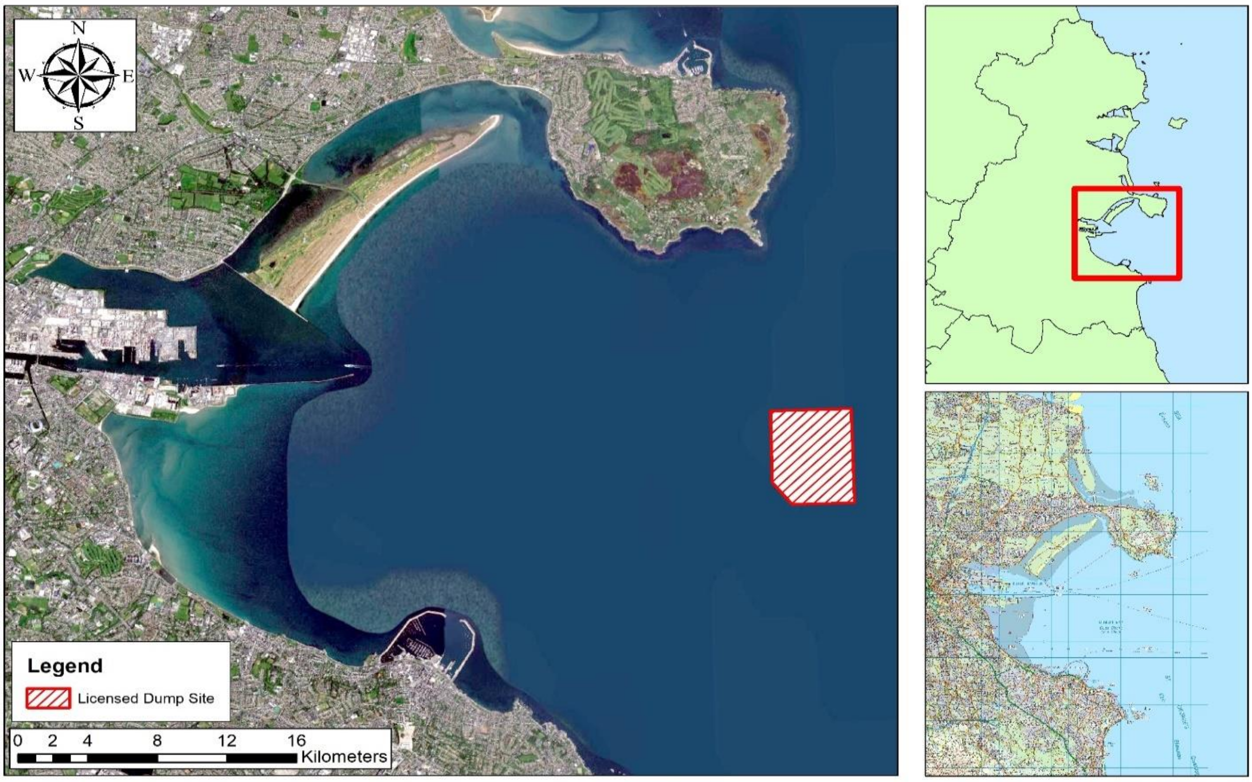


Figure 1.1: Location of the licenced offshore dump site at the approaches to Dublin Bay, west of the Burford Bank

2 OVERVIEW OF THE DUMPING AT SEA CAMPAIGN

2.1 Dredging programme

Based on detailed loading and dumping logs provided by the dredging contractor, the capital dredging campaign in March 2020 comprised 210 individual trips between 09/03/2020 – 28/03/2020 and involved the loading and dumping of 218,686 Total Dry Solids. The quantity of material disposed of per trip averaged 1,041T TDS (*n* =210, *SD* =126 TDS). No overspill of dredged material was permitted within the inner Liffey channel.

Owing to the turbulent nature of the dredging process it was not possible to d characterise and quantity the composition of dredge material during each trip. However, it was reported that the dredge material was generally dominated by silt and sand material with a smaller fraction of gravel.

2.2 Equipment

The dredging and disposal activities under Dumping at Sea Permit S0024-01 were undertaken by Irish Dredging a subsidiary of Royal Boskalis Westminster N.V. The vessel used was the purpose built 4,500m^3 trailing suction hopper dredger "Shoalway" which is illustrated in Figure 2.1 below. This 90m vessel was specifically designed for dredging operations within harbour environments.

Figure 2.1: The trailing suction hopper dredger "*Shoalway"* used for the March 2020 capital dredging campaign within the inner Liffey channel

3 OVERVIEW OF SEDIMENT PLUME MONITORING PROGRAMME

DPC commissioned Hydromaster Ltd to undertake a detailed sediment plume monitoring programme to gather robust data, representative of a range of tidal conditions, which could be used to validate computational plume simulations of the dumping activity. A total of 20 trips were monitored by Hydromaster as summarised in Table 3.1.

Table 3.1: Summary of the 20 dumping trips monitored by Hydromaster between 14th March and 27th March 2020

Date	Dump Trip	Start of Dump Activity	Dump Duration (min)	Turbidity Survey data available?	Corresponding detailed dredge log data available?
14/03/2020	**231**	**17:44:42**	**11**	✓	✓
16/03/2020	**254**	**11:07:52**	**17**	Mid layer data only	✓
17/03/2020	**266**	**09:18:20**	**13**	✓	✓
	267	**10:57:09**	**16**	✓	✓
	268	**12:40:12**	**17**	✓	✓
18/03/2020	**280**	**08:42:53**	**15**	✓	✓
	281	**10:22:01**	**13**	Surface layer data only	✓
	282	**12:16:22**	**14**	Surface layer data only	✓
	283	**13:41:42**	**19**	✓	✓
19/03/2020	**284**	**08:42:05**	**17**	✓	✗
	286	**11:51:01**	**18**	✓	✗
	287	**14:12:02**	**14**	✓	✗
	288	**16:29:44**	**19**	✓	✗
25/03/2020	**356**	**10:36:15**	**11**	✓	✗
	357	**12:08:52**	**14**	✓	✗
	360	**17:46:03**	**17**	✓	✗
27/03/2020	**373**	**15:08:51**	**24**	✓	✓
	374	**17:02:36**	**26**	✓	✓
	375	**19:03:41**	**14**	✓	✓

Note: Only the total dredge quantity per trip was available for 19th and 25th March 2020.

It should be noted that the turbidity measurements show how cloudy/clear the seawater is and is measured in Nephelometric Turbidity Units (NTU). An assessment of sediment samples taken from the inner Liffey channel and Dublin Bay identified a clear relationship between the Total Suspended Solids (TSS) within the seawater and Turbidity (NTU) (RPS, 2018). As shown in Figure 3.1, this assessment found that seawater dominated by silts and sands had a NTU to TSS conversion factor of *c.* 2.5 and 1.5 respectively.

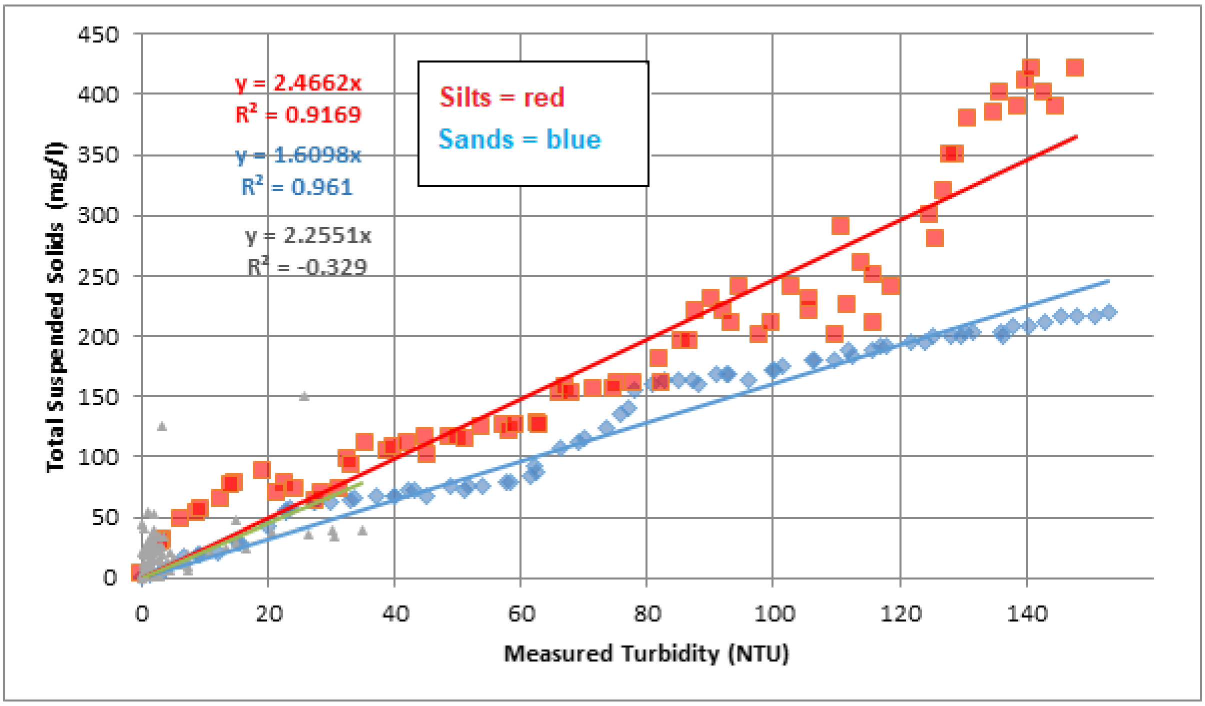


Figure 3.1: Relationship between TSS and NTUs for sand and silt dominated seawater within the Inner Liffey Channel and Dublin Bay (RPS, 2018)

3.1 Measuring Turbidity

Hydromaster utilised a vessel equipped with two turbidity monitors to track sediment plumes arising from the dumping of dredged spoil from the inner Liffey channel.

The survey vessel tracked back and forth across the plume until the turbidity monitors indicated background levels. This enabled the vessel to record spatial and temporally varying data across the plume envelope and produce turbidity tracks similar to the one presented in Figure 3.2 overleaf. The colour scale represents a “heatmap” with highest turbidity values (plume) shown by red and lowest turbidity values shown by blue.

Turbidity data was recorded at the surface and mid-point of the water column for most of the events summarised in Table 3.1 except for event 254 during which an instrumentation failure meant data could only be recorded at the mid-point. No mid layer data was recorded for events 281 and 285 due to a similar issue. Using this approach it was possible to produce plots to show the range of turbidity values between the surface and mid-points of the water column as shown in Figure 3.3.

It is important to note that each data point within this plot represents a turbidity measurement at a different location and at a different moment of time. The data is however very useful in showing the movement and rate of dispersion of the sediment plume.

This data was supported by turbidity measurements recorded at four fixed monitoring buoy locations as shown in Figure 3.4 where turbidity was recorded close to the surface, at mid-depth and close to the seabed.

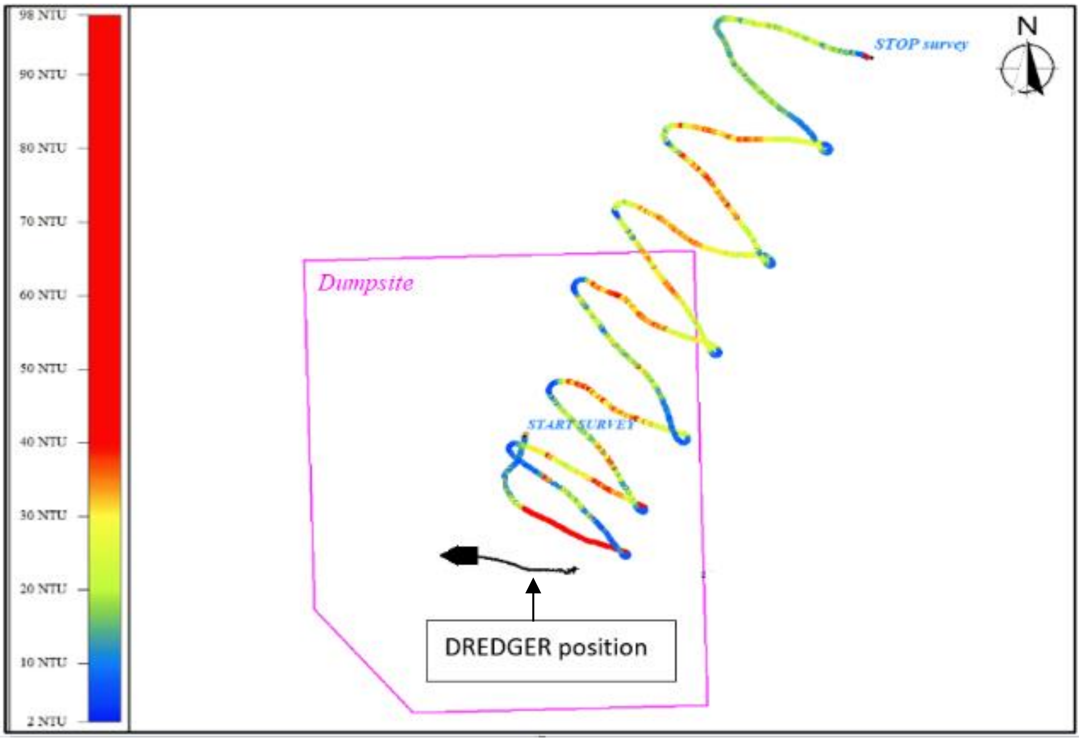


Figure 3.2: Example of a plume survey track with turbidity displayed as NTUs

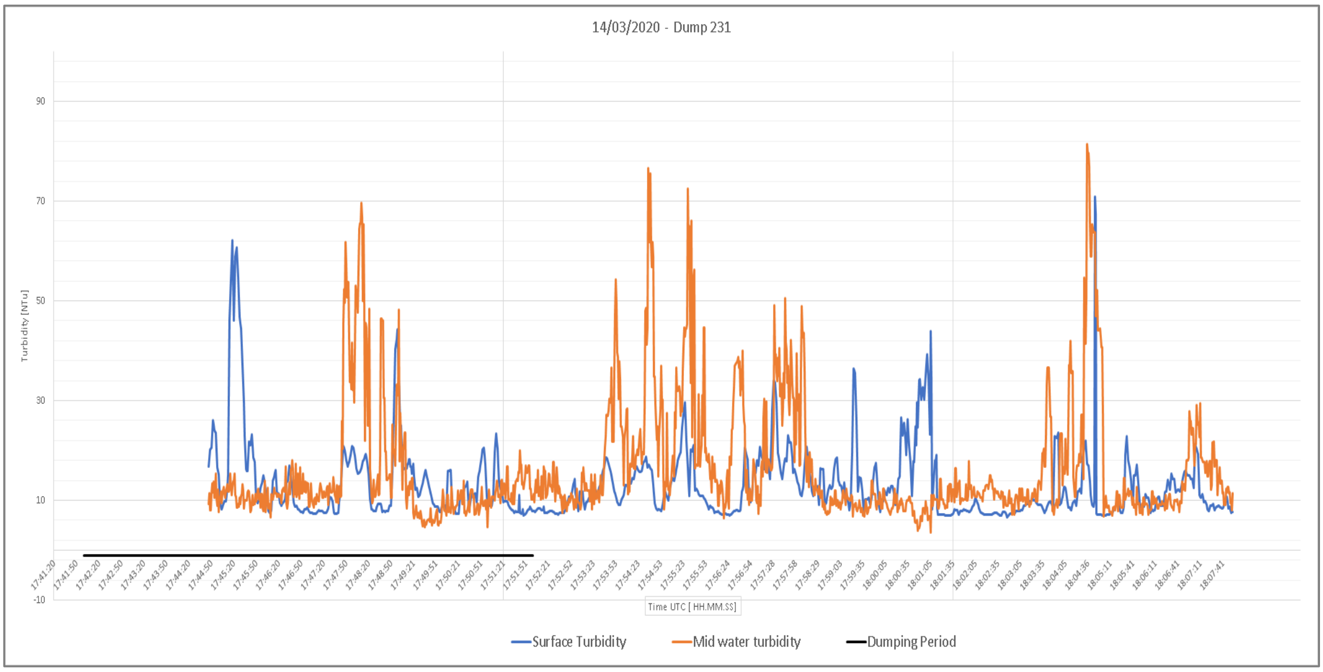
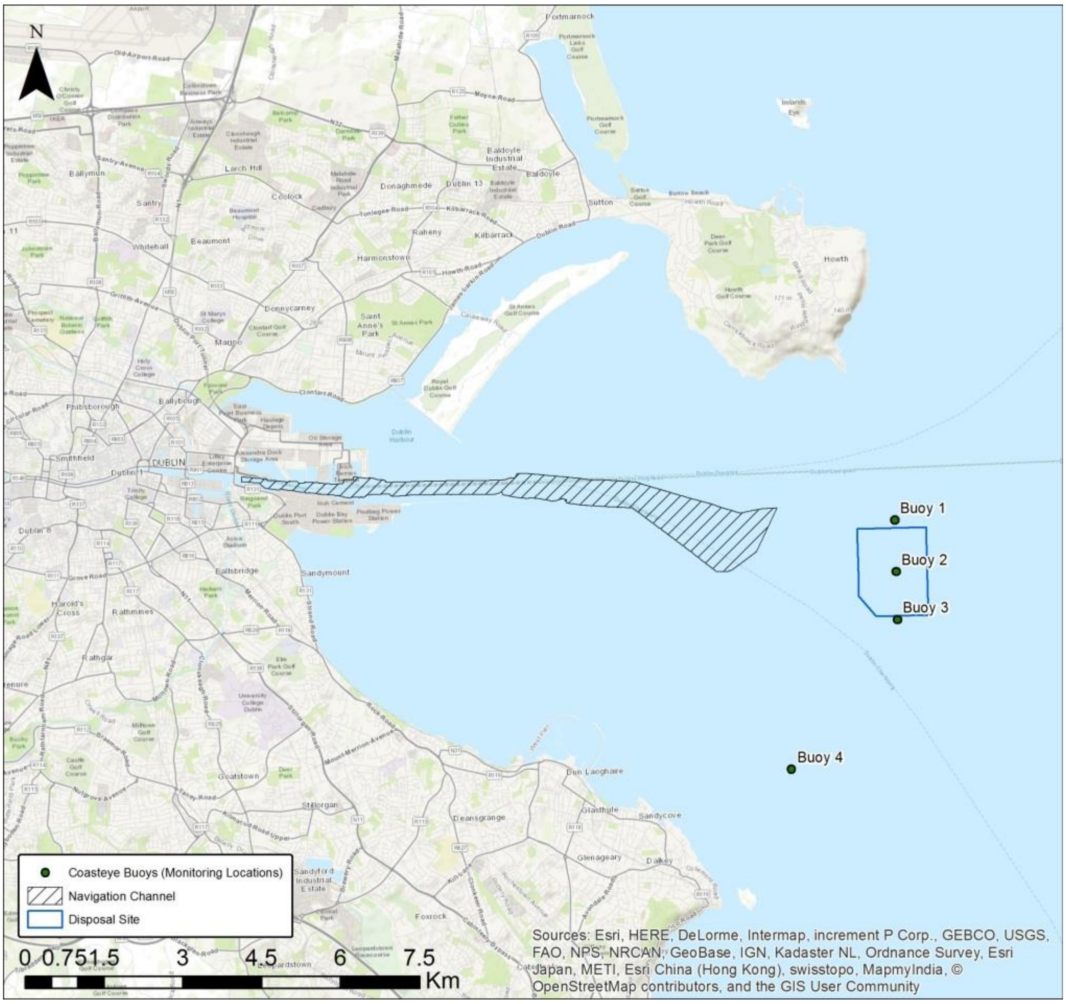


Figure 3.3: Example turbidity readings at the surface and mid-point of the water column during Dump Trip 231



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Figure 3-4: Locations of the Monitoring Buoys at the Dump Site

4 COMPUTATIONAL MODELS

4.1 Modelling Overview

RPS used the MIKE 21 hydrodynamic numerical modelling software package developed by DHI, to undertake the sediment plume simulations presented in Appendix C: Coastal Process Modelling to the Natura Impact Statement submitted as part of the application. The same models were used in the model validation process.

The MIKE system is a state of the art, industry standard, modelling system, based on a flexible mesh approach. This software was developed for applications within oceanographic, coastal and estuarine environments.

A brief synopsis of the MIKE system and modules used for this assessment is outlined below:

- **MIKE 21 FM system** - Using this flexible mesh modelling system, it was possible to simulate the mutual interaction between currents, waves and sediment transport by dynamically coupling the relevant modules in two dimensions.
    - **The Hydrodynamic (HD) module** - This module is capable of simulating water level variations and flows in response to a variety of forcing functions in lakes, estuaries and coastal regions. The HD Module is the basic computational component of the MIKE 21 Model system providing the hydrodynamic basis for the Sediment Transport and Spectral Wave modules. The Hydrodynamic module solves the two-dimensional incompressible Reynolds averaged Navier-Stokes equations subject to the assumptions of Boussinesq and of hydrostatic pressure. Thus the module consists of continuity, momentum, temperature, salinity and density equations. In the horizontal domain both Cartesian and spherical coordinates can be used.
    - **The Sediment Transport module** - The Sediment Transport Module simulates the erosion, transport, settling and deposition of cohesive sediment in marine and estuarine environments and includes key physical processes such as forcing by waves, flocculation and sliding. The module can be used to assess the impact of marine developments on erosion and sedimentation patterns by including common structures such as jetties, piles or dikes. Point sources can also be introduced to represent localised increases in current flows as a result of outfalls or ship movements etc.

4.2 Computational Models and Data Sources

RPS' model of Dublin Bay was created using flexible mesh technology to provide detailed information on the coastal processes around the licenced dump site and Dublin Port as well as the wider Dublin Bay area. The model uses mesh sizes varying from 250,000m^2 (equivalent to 500m x 500m squares) at the outer boundary of the model down to a very fine 225 m^2 (equivalent to 15m x 15m squares) in Dublin Port and around the licenced dump site. The extent, mesh structure and bathymetry of this model is presented in Figure 4.1.

The bathymetry of this model was developed using data gathered from hydrographic surveys of Dublin Port, the Tolka estuary and the dump site since 2017 to present. This resource was supplemented by data from the Irish National Seabed Survey, INFOMAR and other local surveys collated by RPS for the Irish Coastal Protection Strategy Study (RPS, 2003).

Tidal boundaries for the Dublin Bay model shown in Figure 4.1 were taken from the Irish Coastal Protection Strategy Study (ICPSS) tidal surge mode. This mode was developed using flexible mesh technology with the mesh size varying from *c.* 24km along the offshore Atlantic boundary to *c.* 200m around the Irish coastline. This validated model is run three times daily on behalf of the Office of Public Works (OPW) to provide detailed tidal information around the coast of Ireland. The extent and bathymetry of this model is illustrated in Figure 4.2

Boundary conditions used to represent the mean annual river flows for the Liffey, Dodder and Tolka were set at 15.6, 2.3 and 1.4m^3/s respectively.

It should that the same computational models used to support the environmental assessment of the Alexandra Basin Redevelopment project (RPS, 2014) were used for this technical assessment. A previous calibration and validation exercise that utilised recorded data from throughout Dublin Bay concluded that the Dublin Bay model performed very well and provided a very good representation of the coastal processes in the Dublin Port and Dublin Bay.

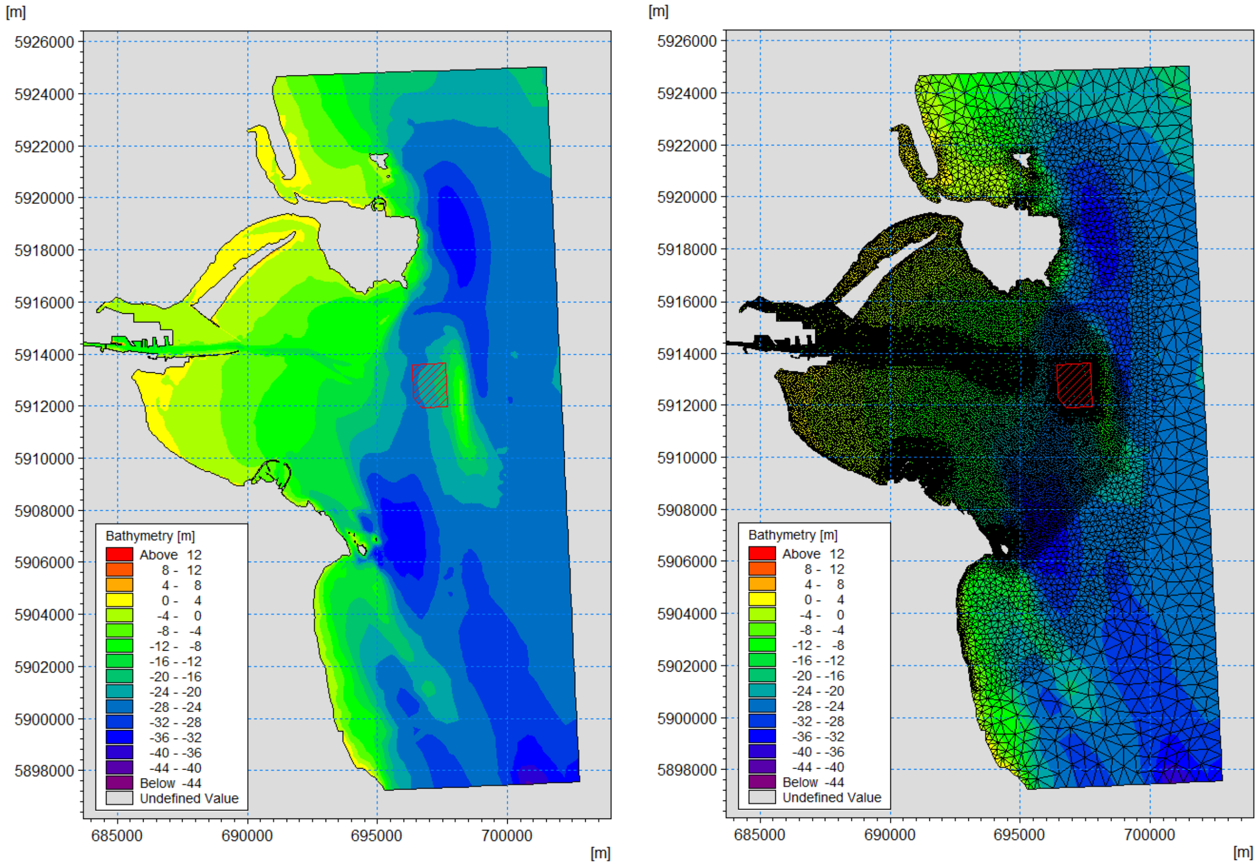


Figure 4.1: Extent and bathymetry (left) and mesh structure (right) of the Dublin Bay model. Location of the licenced dump site shown by red hatch area.

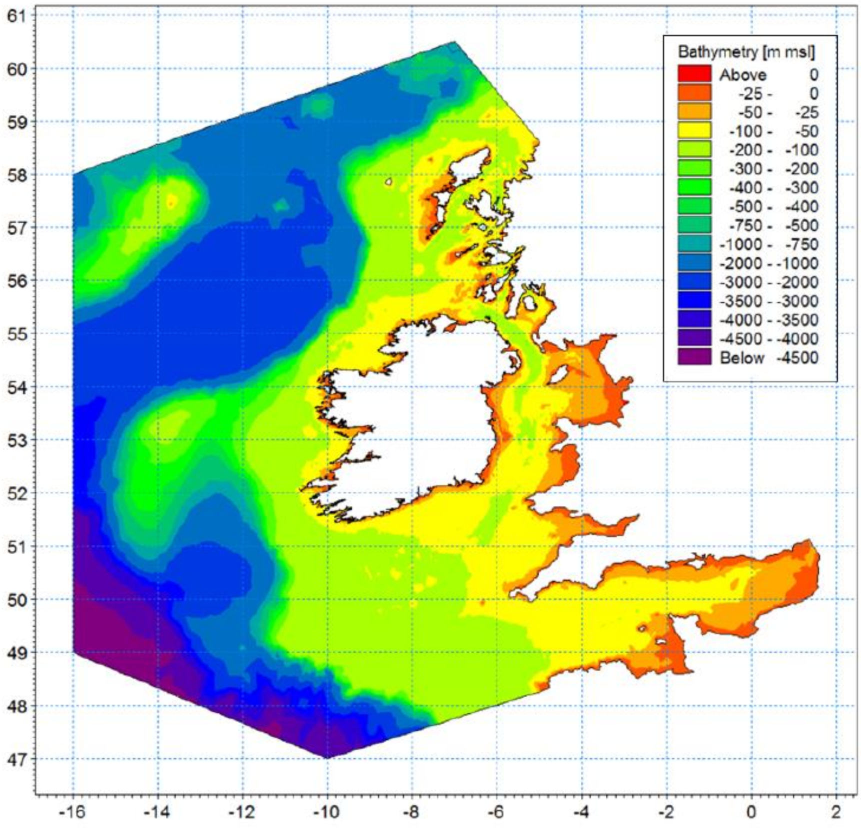


Figure 4.2: Extent and bathymetry of Irish Seas Tidal and Storm Surge model

4.3 Characterisation of Dumping Material

Simulations were undertaken to determine the concentration and distribution of sediment lost to the water column during the dumping events at the licenced offshore dump site. As described in the following Section, the sediment material was first characterised by a number of different mixtures with different sand and silt fractions. Upon identification of the most suitable mixture type and composition, these parameters were used to simulation all 210 dredging trip undertaken in March 2020. It should be noted that all dumping events were assessed using a single simulation so that sediment plumes from previous dumping events were fully accounted for.

The coupled MIKE 21 sediment transport model was used to simulate the fate of the silt released from the barges over the dump site by moving a sediment source along the track that the barge would take as it transversed the dump site area during the disposal operation. The model then simulated the dispersion, settlement and re-erosion of each fraction of the dredged material in response to the tidal currents throughout the model area.

The spill rate and the dump co-ordinates for each dumping event was specified using information from detailed dredge logs provided by the dredging contractor. Given the duration of the dredging and disposal campaign, simulations were run for using a range of spring and neap tidal conditions. These models also included for the effect of wind driven currents.

An example of the dredge track used to specify the location of the sediment source in the models is presented in Figure 4.3 below.

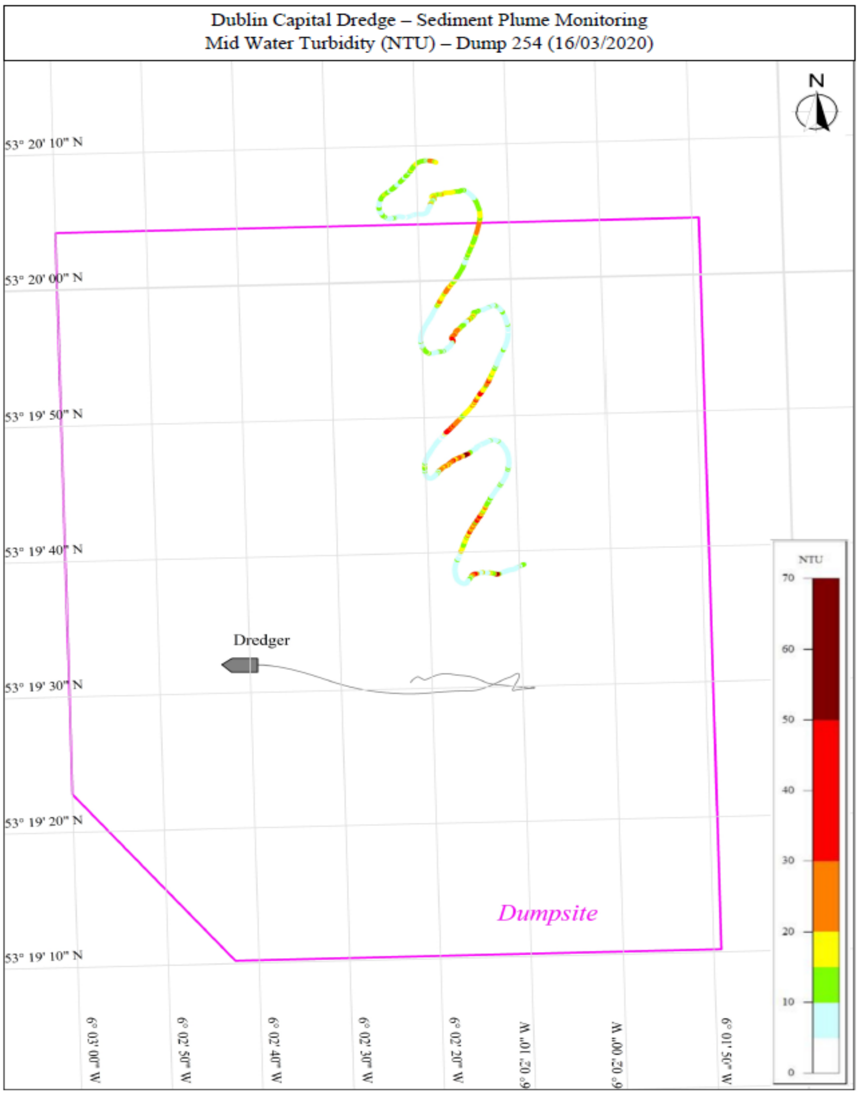


Figure 4.3: Example of the dredge track used to specify the coordinates of the sediment source in the numerical model runs

5 REVIEW OF PARAMETERS USED FOR THE ABR ENVIRONMENTAL ASSESSMENT

The numerical modelling work undertaken in support of the Alexandra Basin Redevelopment (ABR) Project (RPS, 2014) specified sediment material as being characterised by three discrete fractions with mean diameters of 200µm, 20µm and 3µm with each fraction constituting 1/3 of the total volume dredge material (Mixture 1 in Figure 5.1 below). This specification was based on Particle Size Distributions (PSDs) of sediment samples collected from the Harbour area (RPS, 2014).

In order to validate this parameter RPS ran a series of sediment plume models for dump event 231 using a range of different sediment material characteristics. Dump event 231 was chosen for this analyses as it was the first event that Hydromaster collected detailed survey data for. The four different mixture types used for this assessment are summarised in Figure 5.1 and were comprised of various fine sand to fine silt fractions.

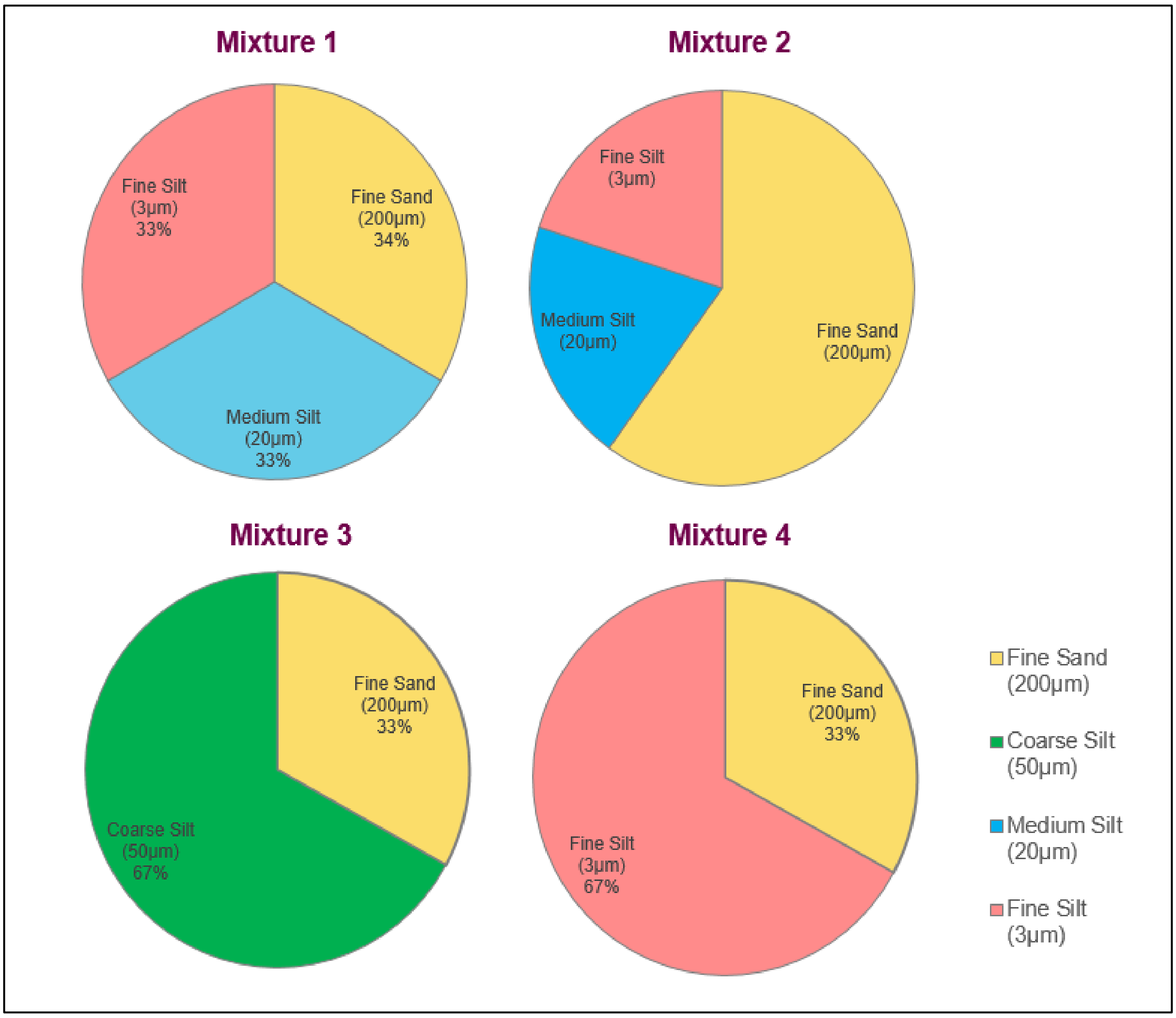


Figure 5.1: Composition of sediment mixtures used to represent the dredge material dumped at the dump site

The output from these simulations are presented in Figure 5.2 to Figure 5.5 for Mixtures 1 – 4 respectively. As demonstrated by these plots, the sediment plumes generated by these mixtures correspond well to recorded data. However, as summarised in Table 5.1 Mixture 1 was found to agree best with recorded turbidity levels with simulated turbidity levels falling within the recorded surface and mid-point measurements 79% of the time.

Based on this information it can be concluded that the sediment was specified correctly in Appendix C: Coastal Process Modelling to the Natura Impact Statement submitted as part of the application. All subsequent model simulations in this study were therefore undertaken using sediment parameters reflective of mixture 1.

Table 5.1: Summary of sediment mixtures and % agreement with actual turbidity levels recorded during dump event 231

Sediment	Composition [%]			
	Mixture 1	Mixture 2	Mixture 3	Mixture 4
Fine Sand (200µm)	33	60	33	33
Coarse Silt (50µm)	n/a	n/a	67	n/a
Medium Silt (20µm)	33	20	n/a	n/a
Fine Silt (3µm)	33	20	n/a	67
Agreement with recorded Turbidity levels during event 231 [%]	79.22	61.66	63.15	68.47

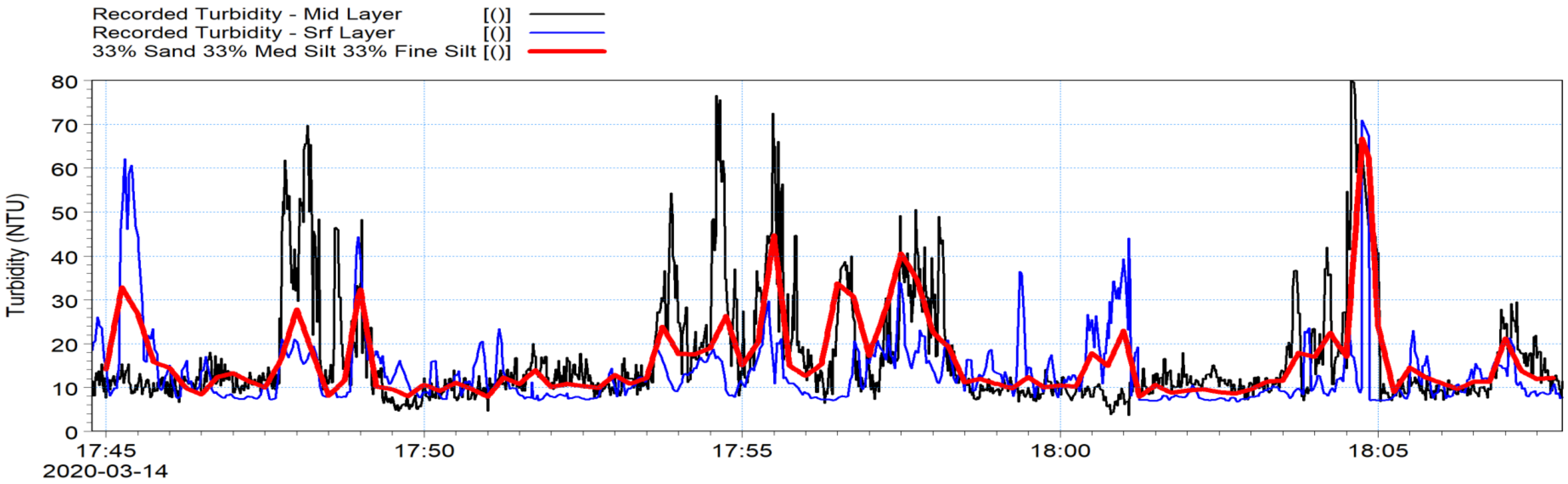


Figure 5.2: Comparison of recorded and simulated turbidity levels during dump event 231 – Mixture 1 (33% fine sand; 33% medium silt; 33% fine silt)

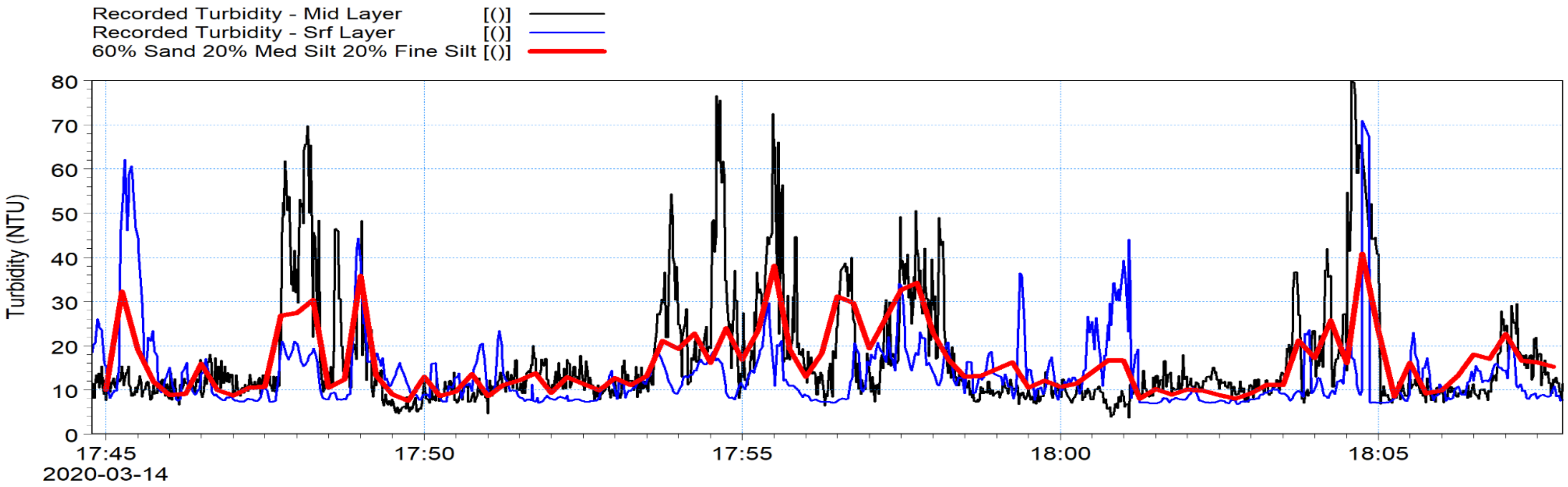


Figure 5.3: Comparison of recorded and simulated turbidity levels during dump event 231 – Mixture 2 (60% fine sand; 20% medium silt; 20% fine silt)

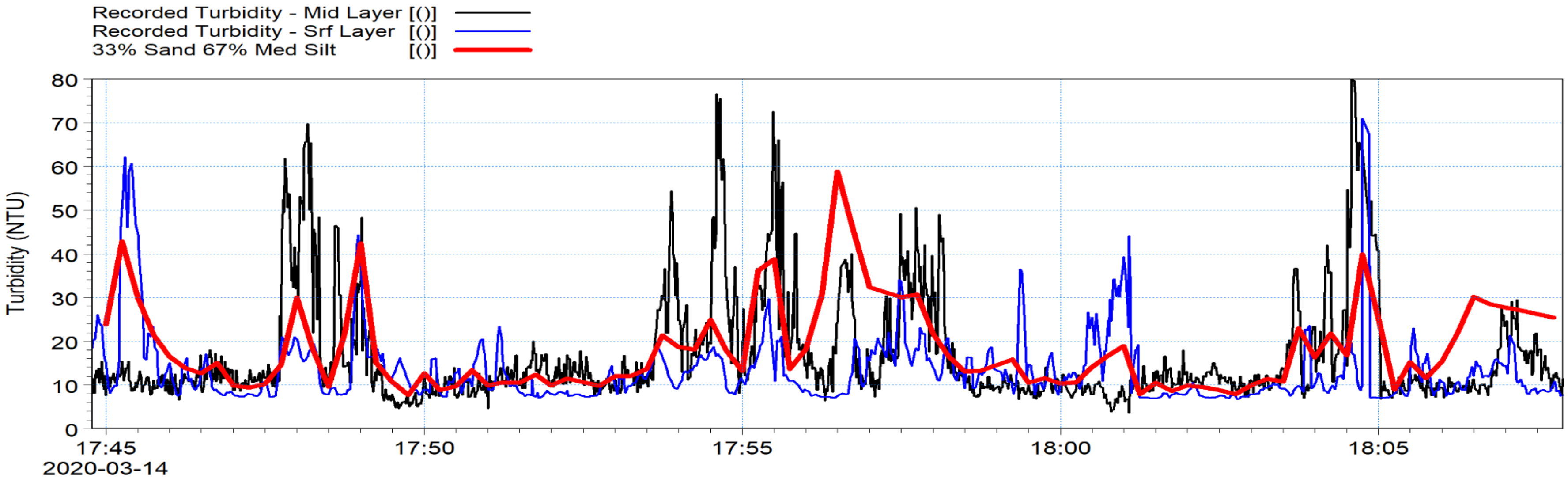


Figure 5.4: Comparison of recorded and simulated turbidity levels during dump event 231 – Mixture 3 (33% fine sand; 67% medium silt)

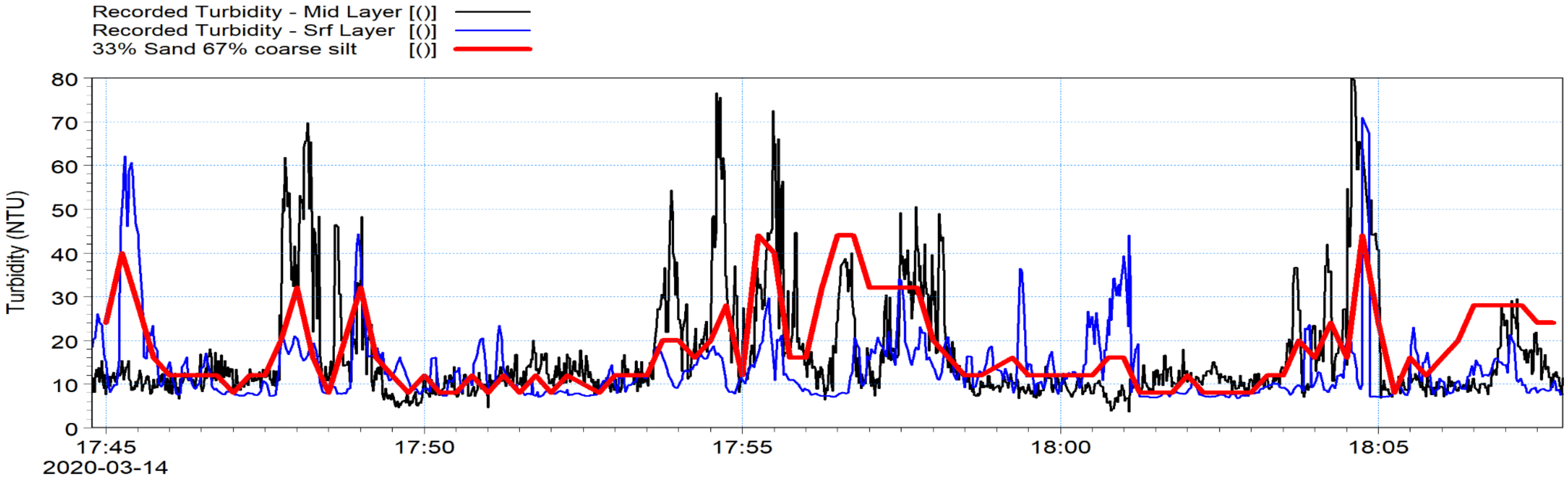


Figure 5.5: Comparison of recorded and simulated turbidity levels during dump event 231 – Mixture 4 (33% fine sand; 67% coarse silt)

6 OUTPUT FROM SEDIMENT PLUME MODELLING

Having determined suitable specifications for the sediment material (see Section 5), RPS produced a series of figures that compares simulated and recorded turbidity levels at the Dump Site.

- To determine the spatial accuracy of the model used, each figure illustrates the extent and concentration of the sediment plume for one time-step relative to the recorded survey tracks.
- The temporal accuracy of the model is demonstrated by time series plots that compare 2D depth averaged simulated turbidity concentration levels with recorded data. These plots remove the spatial element of the data so that a direct comparison of concentrations can be easily made.

As it was not practical to produce a sediment plume plot for every time-step and dump event, RPS instead provided time-series plots for each dump event for which there was suitable data (see Table 3.1 in Section 3).

In total, this equated to 12 individual events across a range of typical spring and neap tidal conditions. Environmental conditions were also varying with dumping events regularly occurring during windy spells with notable wave action from different directions. The results which are presented in Appendix A demonstrate that the computational models accurately simulate the temporal and spatial dispersion of sediment plumes during the dumping activities to a very high degree of accuracy.

6.1 Sediment Plume Envelopes

RPS has produced sediment plume plots for a number of representative dump events presented in Table 6.1 below.

The ***spatial accuracy*** of the numerical model is demonstrated by comparing the spatial extent of the simulated sediment plumes illustrated in the 2D plots and survey tracks in Figure 6.1 to Figure 6.8**.** It will be seen that the general plume envelope size and direction of transport is very similar to the corresponding survey track.

A comprehensive demonstration of the ***temporal accuracy*** of the numerical models is provided by means of time-series plots that compare simulated and recorded data in Figure 6.1 to Figure 6.8**.** These plots show that the 2D depth averaged simulated turbidity concentration usually falls within the envelope of values recorded at the surface and mid water column points.

Importantly, the model accurately represents the dredge plumes from the time of initial release to the point whereby the sediment plume reduces to below background levels, i.e. becomes fully dispersed.

Table 6.1: Index of sediment plume plots across a range of typical tidal conditions

Tidal Phase	Dump #	Figure No.	Time after initial release
Mid-ebb	**231**	Figure 6.1	**19min**
Low water	**254**	Figure 6.2	**21min**
Mid-ebb	**266**	Figure 6.3	**6min**
Low Water	**267**	Figure 6.4	**15min**
Mid-flood	**268**	Figure 6.5	**30min**
Mid-ebb	**280**	Figure 6.6	**28min**
Mid ebb	**281**	Figure 6.7	**31min**
Mid-flood	**283**	Figure 6.8	**1hr 2min**

> The numerical model utilised by RPS accurately simulates the dispersion of sediment across a range of tidal events and environmental conditions to a very high degree of accuracy. It can therefore be concluded that the model is well calibrated and fit for purpose.

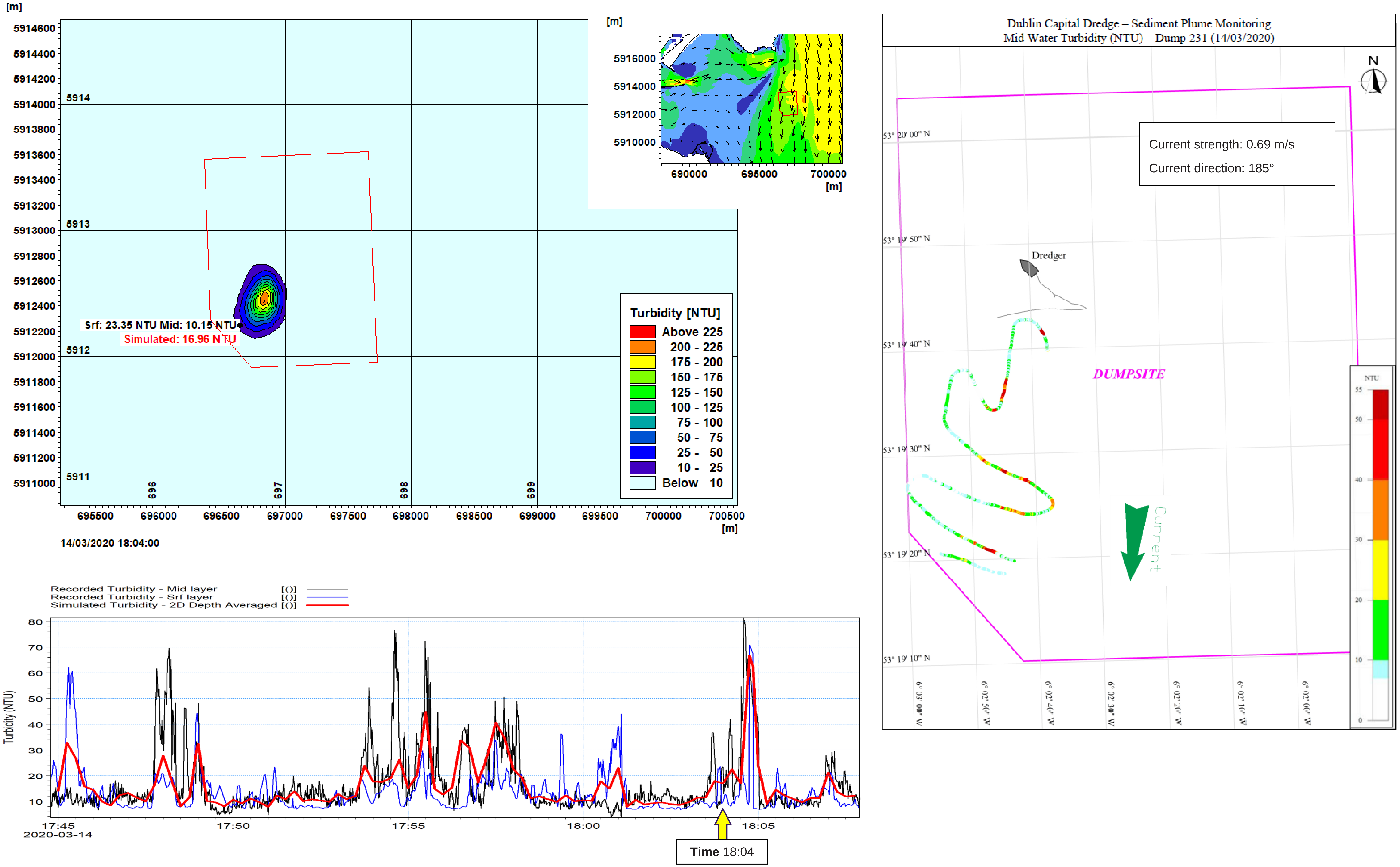


Figure 6.1: Event 231. 2D Sediment plume envelope *c.* 19min after initial sediment release with current speed and direction insert (top left). Extent of survey data (top right) and comparison with simulated data (bottom left)

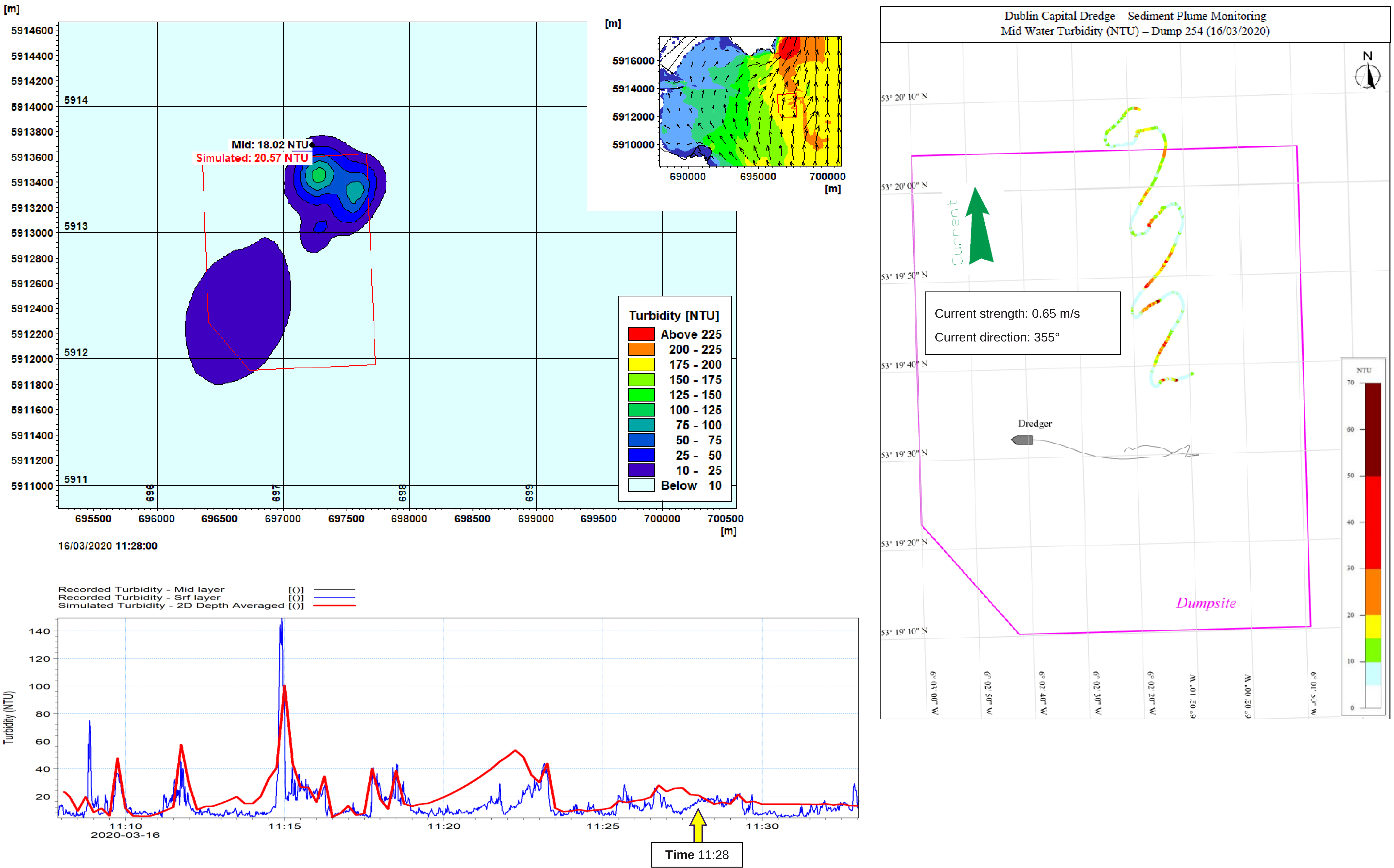


Figure 6.2 Event 254. 2D Sediment plume envelope *c.* 21min after initial sediment release with current speed and direction insert (top left). Extent of survey data (top right) and comparison with simulated data (bottom left)

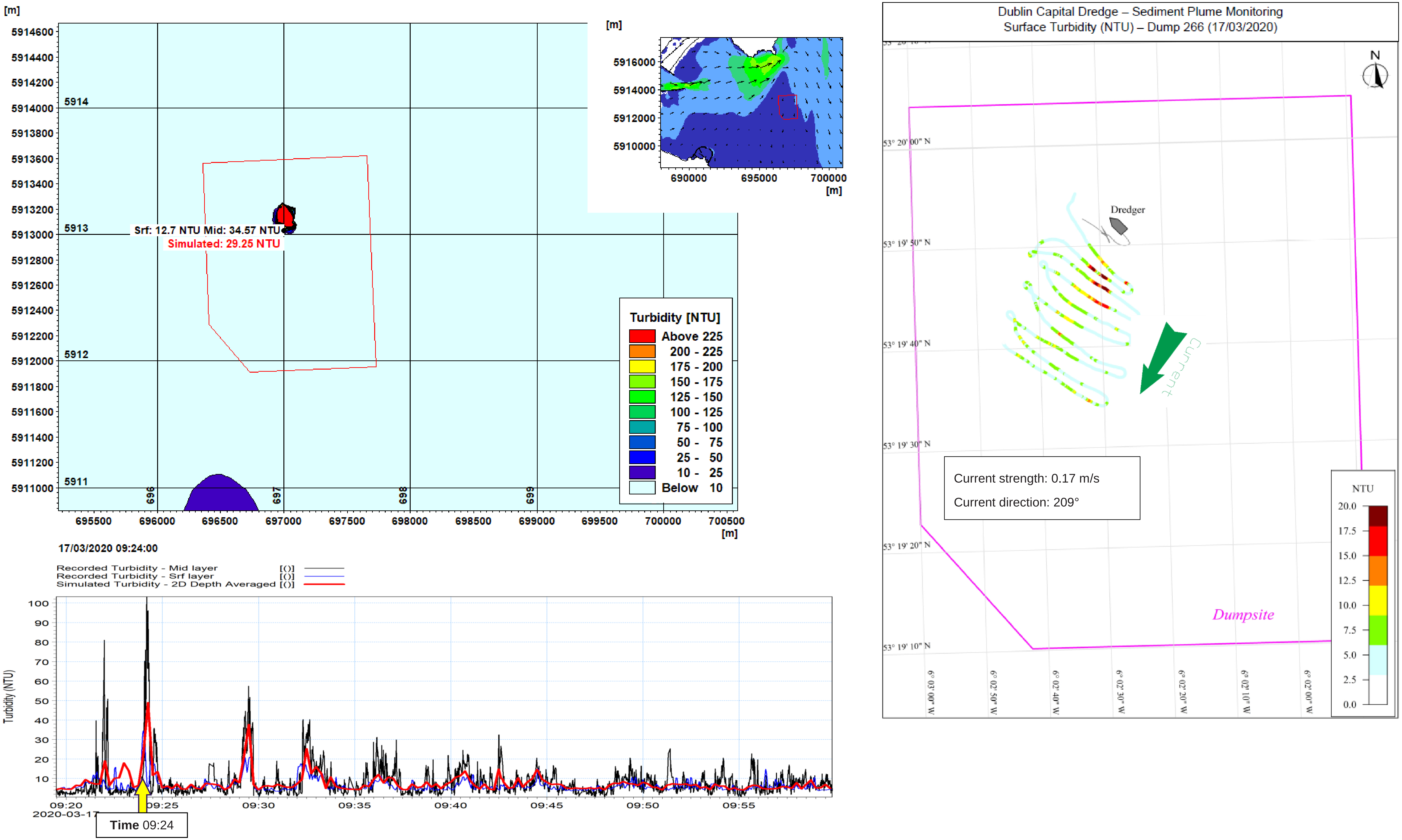


Figure 6.3 Event 266. 2D Sediment plume envelope *c.* 6min after initial sediment release with current speed and direction insert (top left). Extent of survey data (top right) and comparison with simulated data (bottom left)

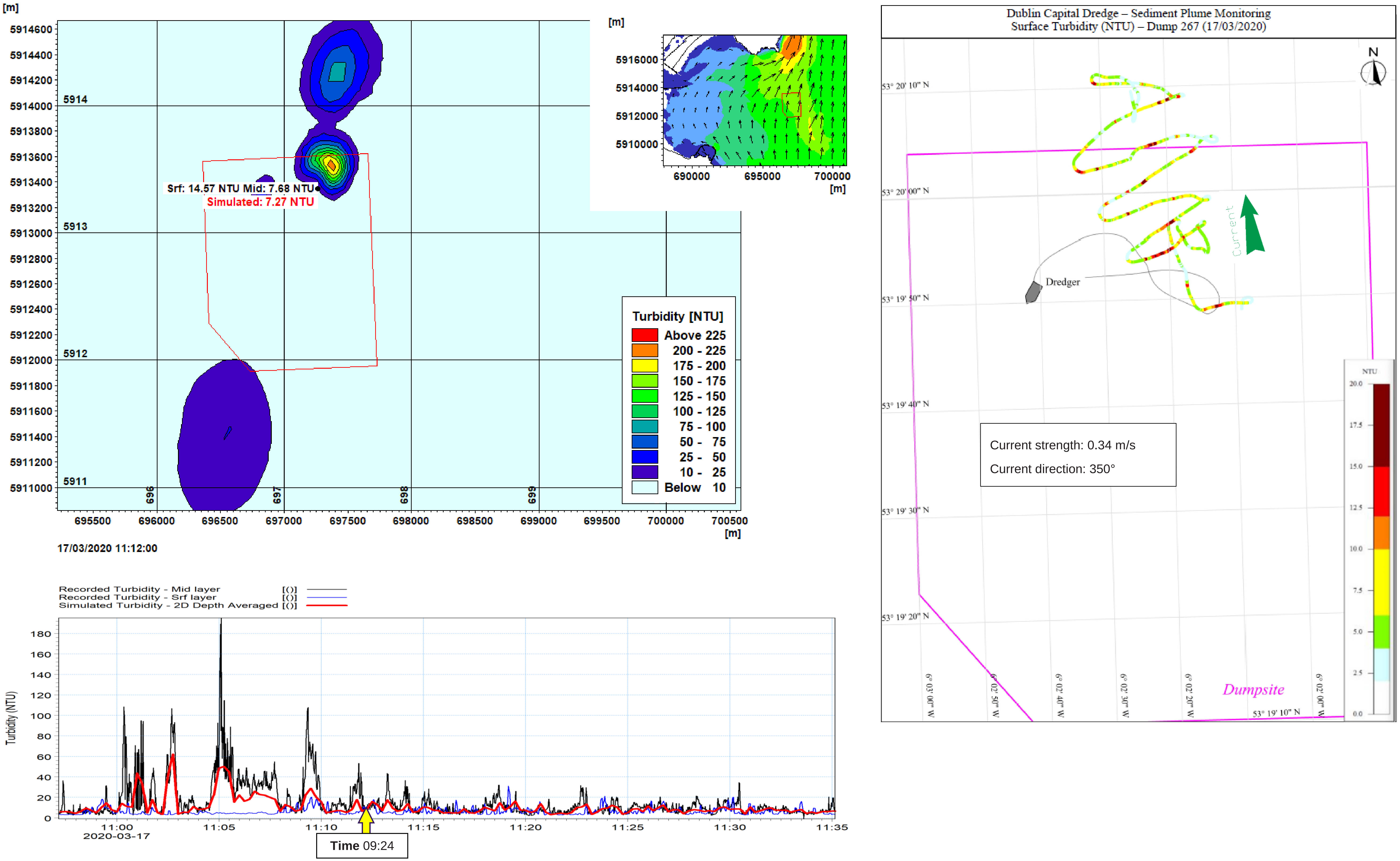


Figure 6.4 Event 267. 2D Sediment plume envelope *c.* 15min after initial sediment release with current speed and direction insert (top left). Extent of survey data (top right) and comparison with simulated data (bottom left)

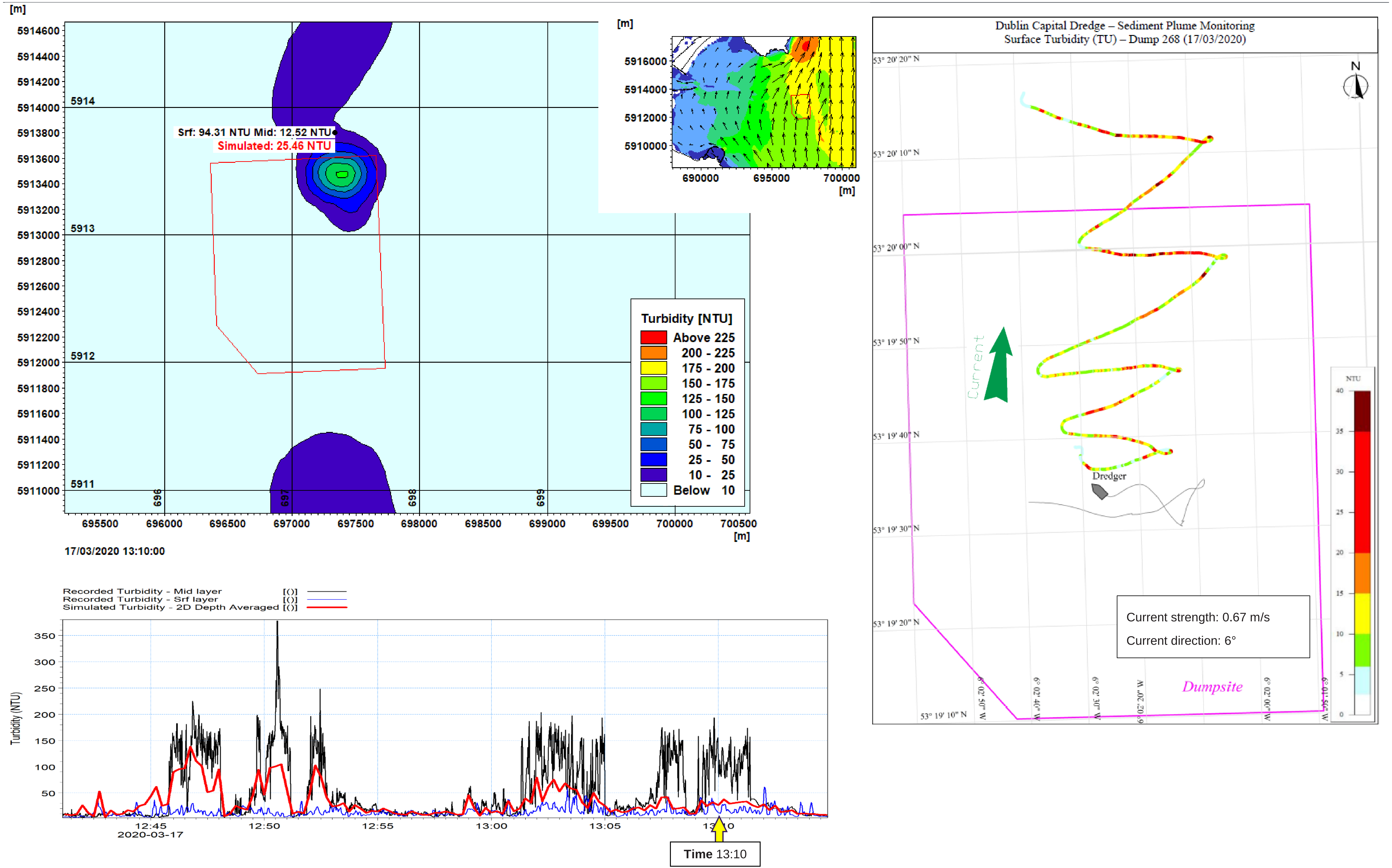


Figure 6.5 Event 268. 2D Sediment plume envelope *c.* 30min after initial sediment release with current speed and direction insert (top left). Extent of survey data (top right) and comparison with simulated data (bottom left)

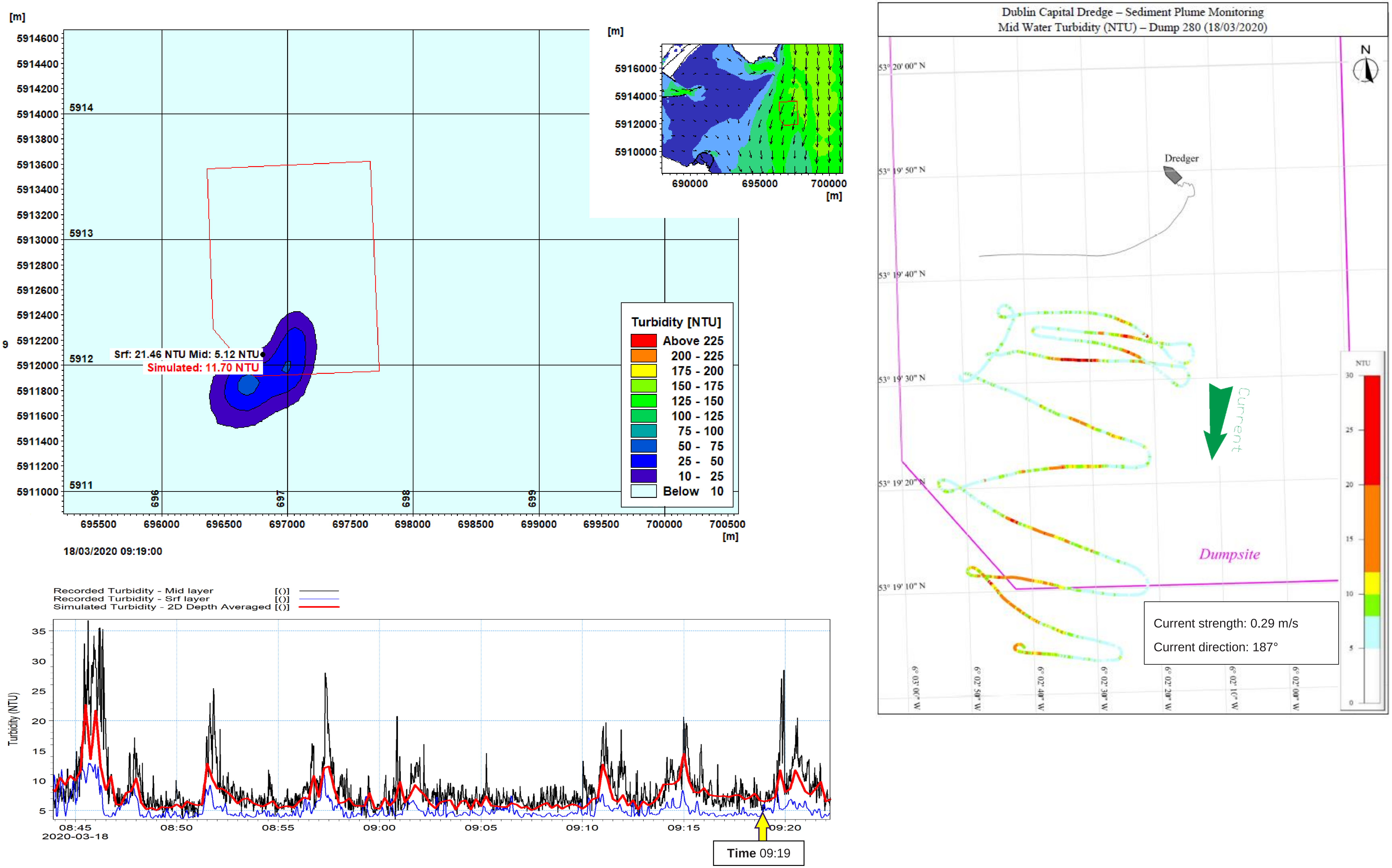


Figure 6.6 Event 280. 2D Sediment plume envelope *c.* 28min after initial sediment release with current speed and direction insert (top left). Extent of survey data (top right) and comparison with simulated data (bottom left)

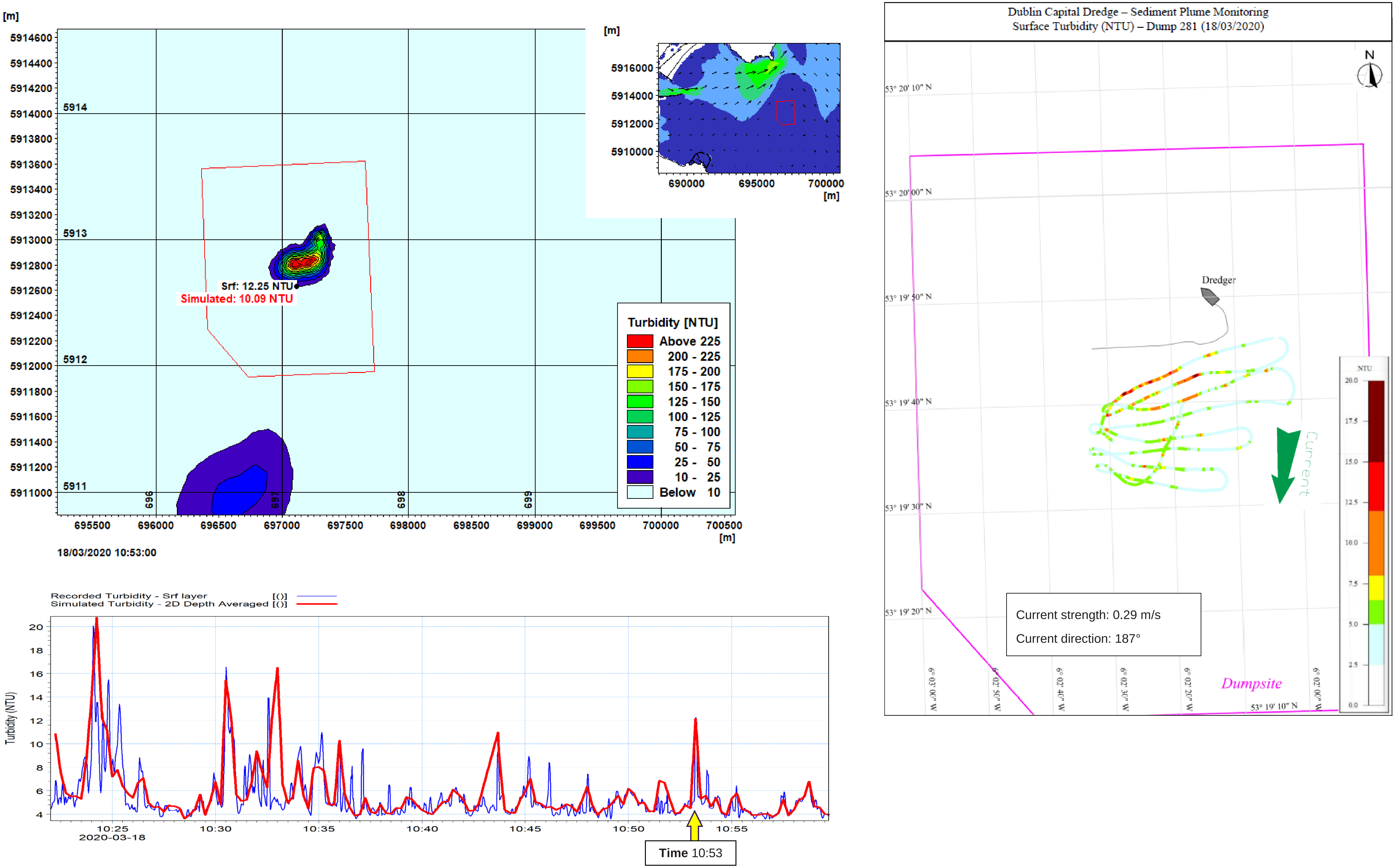


Figure 6.7 Event 281. 2D Sediment plume envelope *c.* 31min after initial sediment release with current speed and direction insert (top left). Extent of survey data (top right) and comparison with simulated data (bottom left)

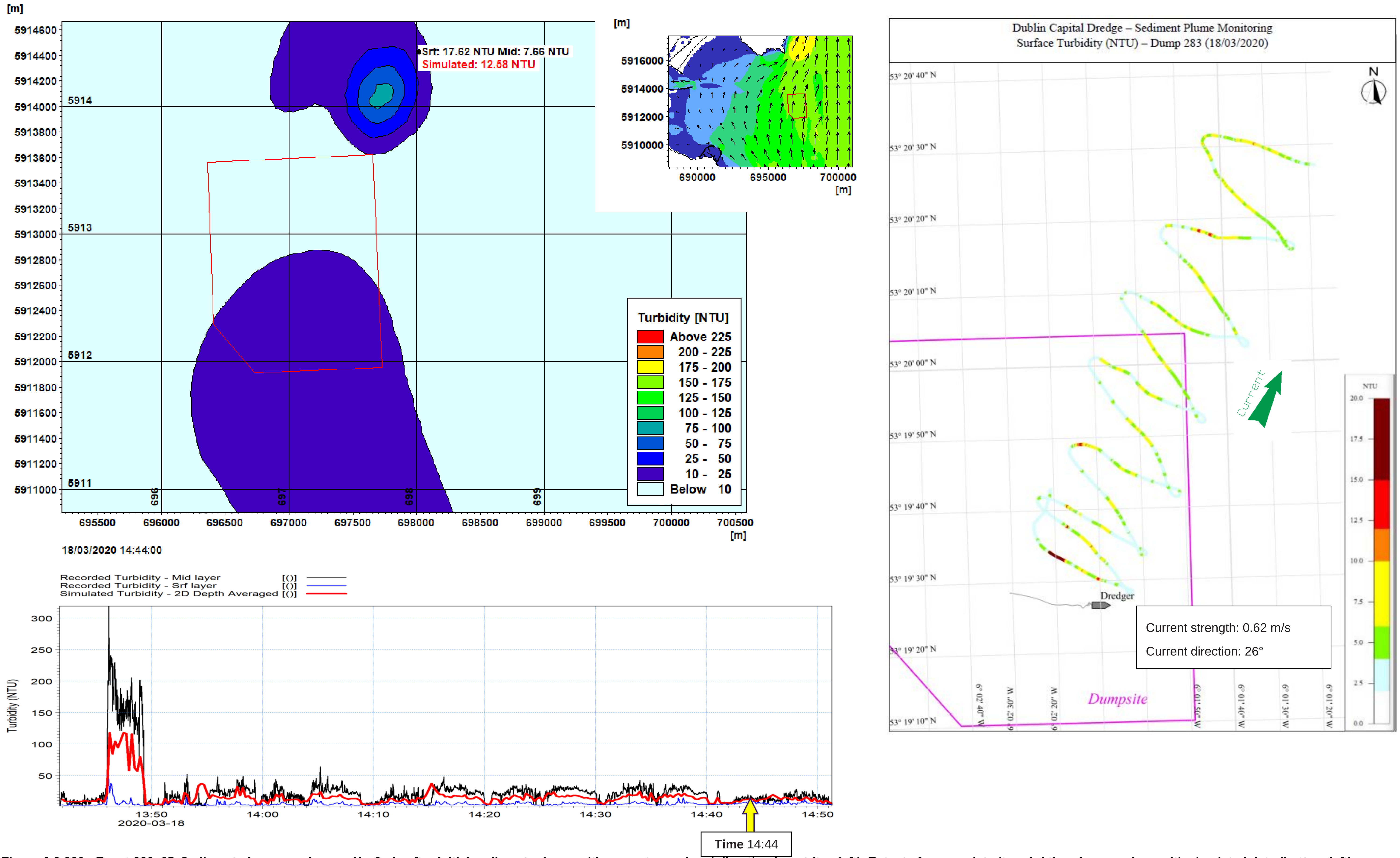


Figure 6.8 283: Event 283. 2D Sediment plume envelope *c.* 1hr 2min after initial sediment release with current speed and direction insert (top left). Extent of survey data (top right) and comparison with simulated data (bottom left)

7 CONCLUSIONS

Dublin Port Company (DPC) was granted a Dumping at Sea Permit (S0024-01) by the Environmental Protection Agency (EPA) on 13th September 2016 for the loading and dumping at sea of dredged material arising from capital dredging as part of the Alexandra Basin Redevelopment (ABR) Project. The permit sets out in detail the conditions under which DPC will carry out loading and dumping at sea.

In order to satisfy Condition 4.11 of this permit RPS undertook an extensive modelling programme to validate the numerical modelling parameters used in Appendix C: Coastal Process Modelling to the Natura Impact Statement submitted as part of the application.

- This was achieved using project specific monitoring data collected by Hydromaster (Hydromaster, 2020).
- Produce sediment plume plots for dumping events of the March 2020 campaign during which dredging took place within the inner Liffey channel over a range of spring and neap tidal conditions.

In summary, this assessment found that:

- The sediment was specified correctly in Appendix C: Coastal Process Modelling to the Natura Impact Statement submitted as part of the application and that the numerical modelling parameters used for this technical assessment were valid and fit for purpose.
- Simulated turbidity levels were generally found to be well within the surface and mid-point envelope of recorded turbidity levels for all dump events.
- Turbidity levels beyond the immediate vicinity of the dump site did not generally exceed the background turbidity levels recorded when there was no dumping. This is confirmed by the Hydromaster survey tracks presented in Appendix A.
- Sediment plumes did not disperse into the inner Dublin Bay area.
- The tidal conditions at the dump site are fully dispersive for material dominated by silt.

> Based on the findings of this technical assessment it can be concluded that the dispersion, fate of sediment plumes arising from the dredging and disposal operations associated with the ABR Project will not significantly impact water quality in Dublin Bay or beyond.

8 REFERENCES

Hydromaster. (2020). Dublin Bay Sediment Plume Monitoring Report.

RPS. (2003). Irish Coastal Protection Strategy Study.

RPS. (2014). Alexandra Basin Redevelopment Project - Environmental Impact Statement (Vol. 1).

RPS. (2014). Appendix C: Coastal Process Modelling to the Natura Impact Statement submitted as part of the Dumping at Sea Permit application.

RPS. (2018). Alexandra Basin Redevelopment Project - Construction Environmental Management Plan.

Appendix A Hydromaster Survey Monitoring Tracks and Comparison with Model Simulations

A.1 Vessel track and Turbidity data (surface and mid-water)

The following Figures have been taken from (Hydromaster, 2020) and display the track of the survey vessel with turbidity data overlaid, the current direction and speed is also displayed:

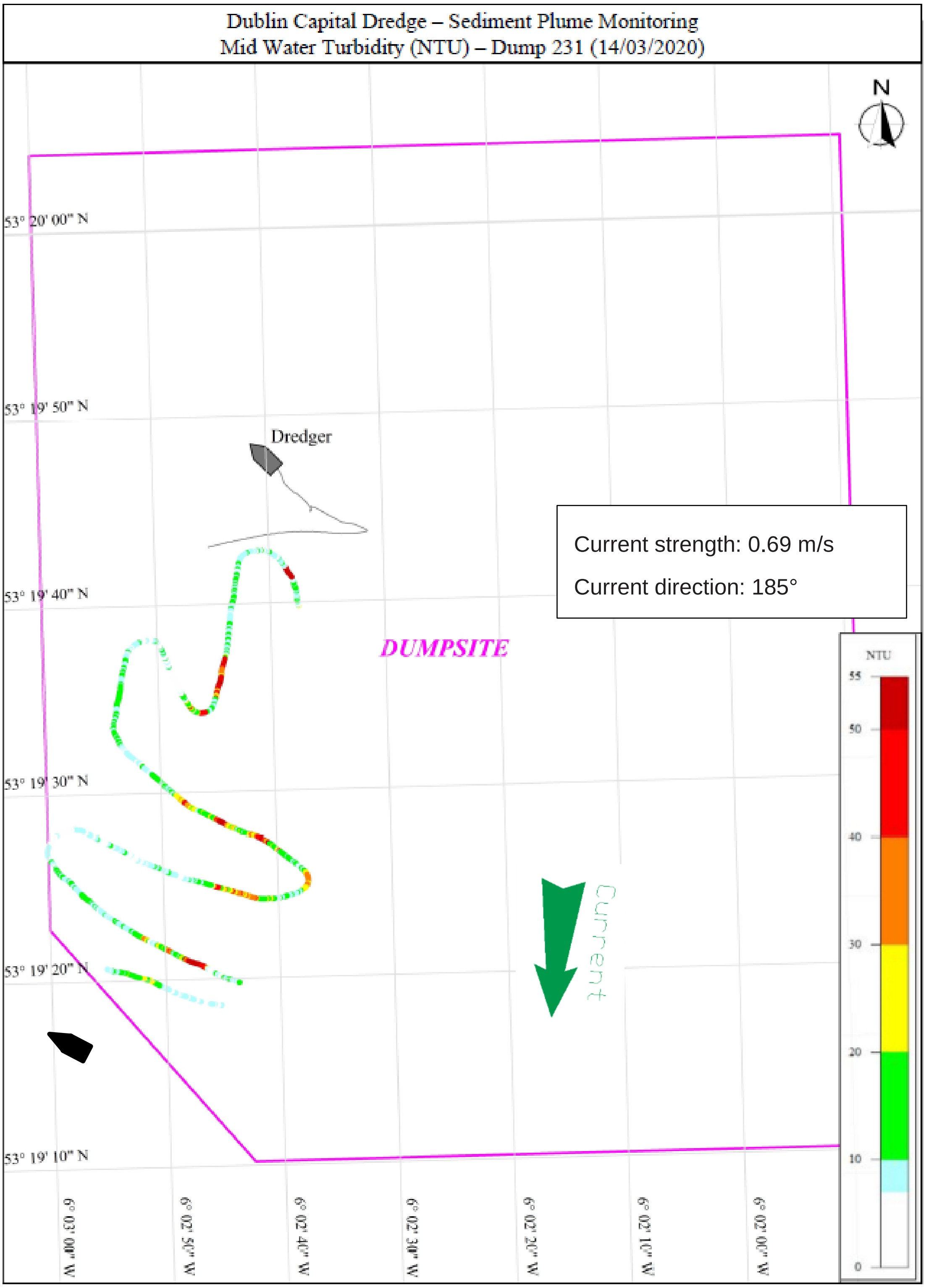
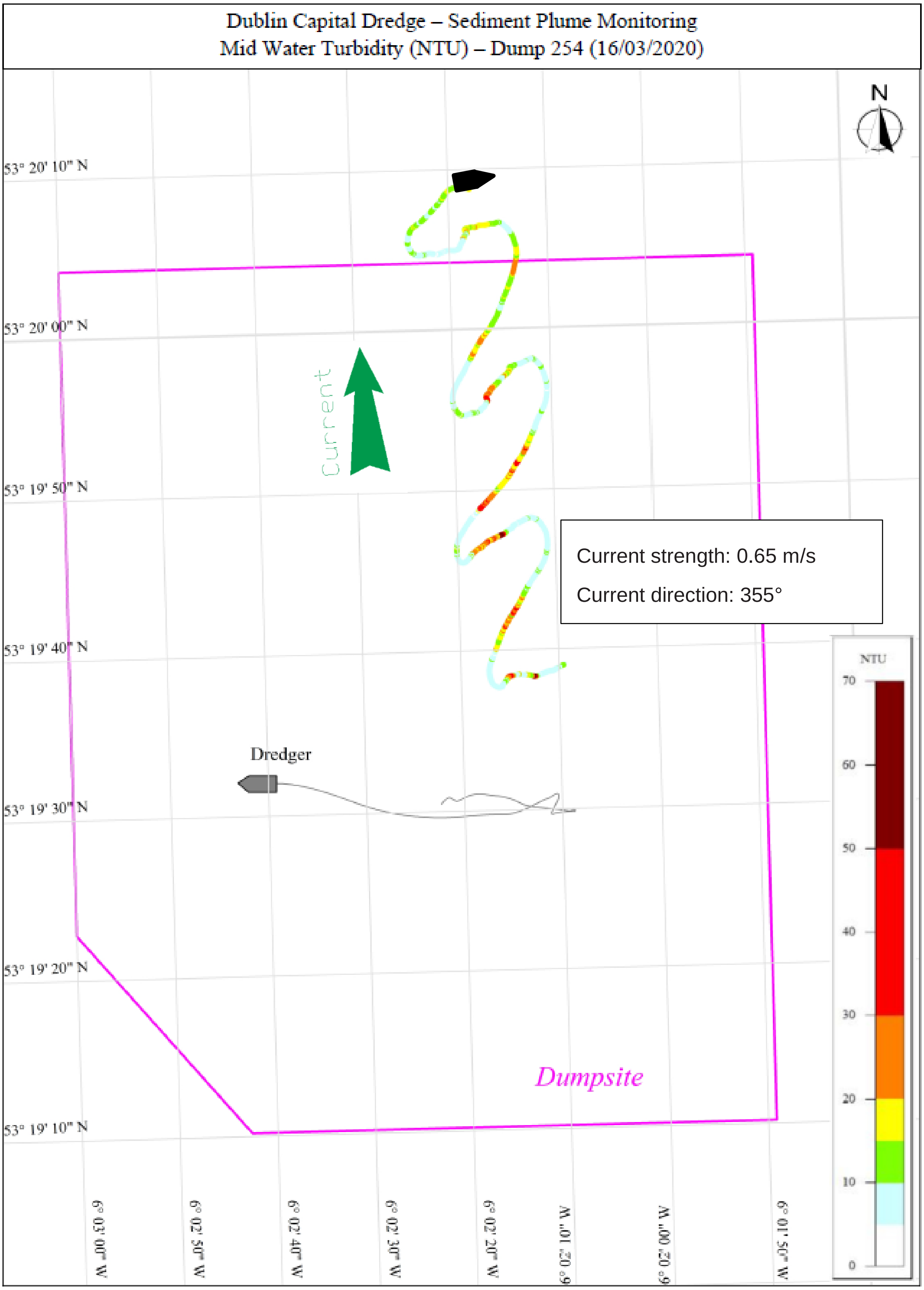


Figure 8.1: Dump 231 Survey track with mid water turbidity [NTU]



Current strength: 0.65 m/s

Current direction: 355°

Figure 8.2: Dump 254 Survey track with mid water turbidity [NTU]

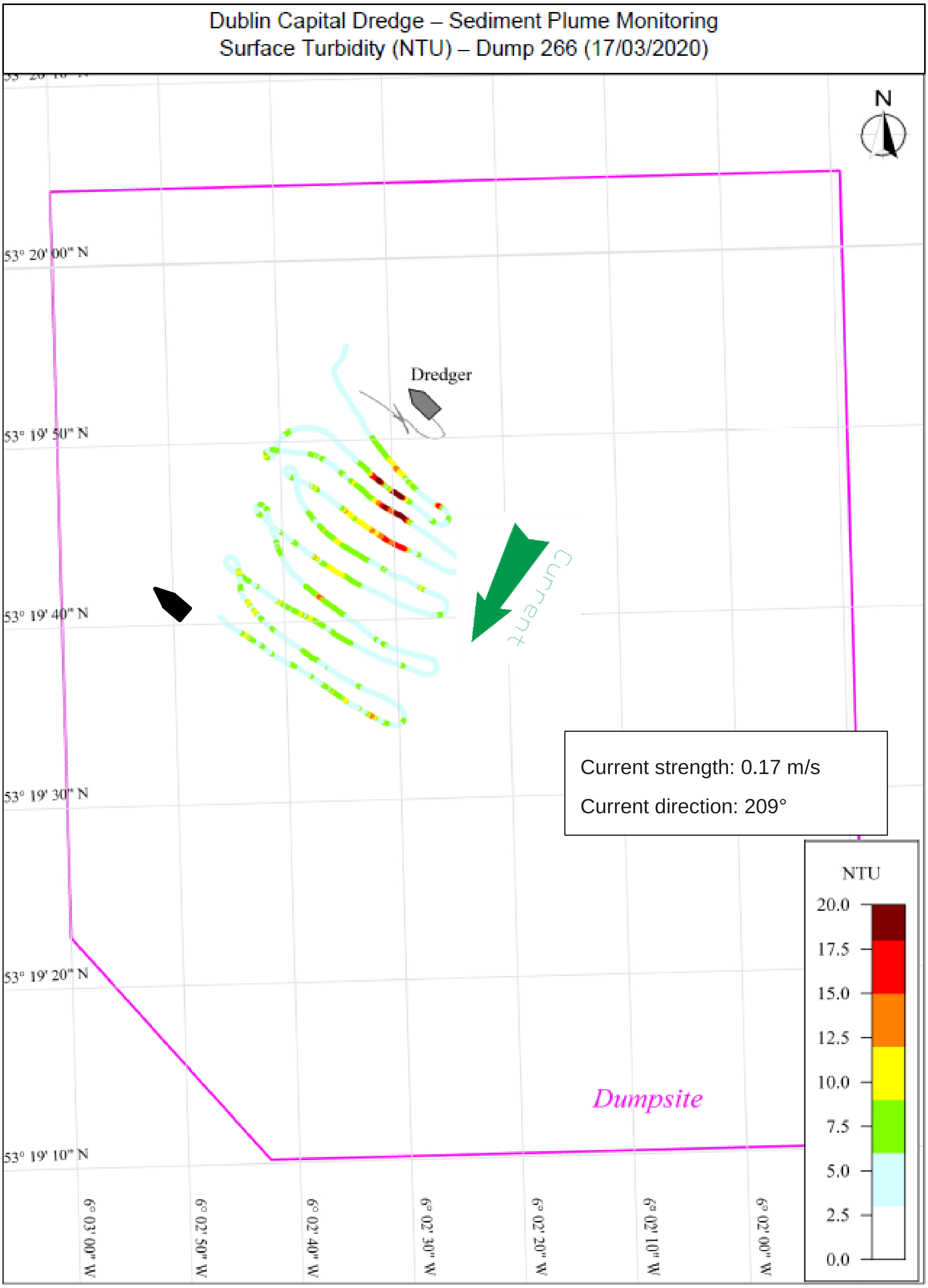
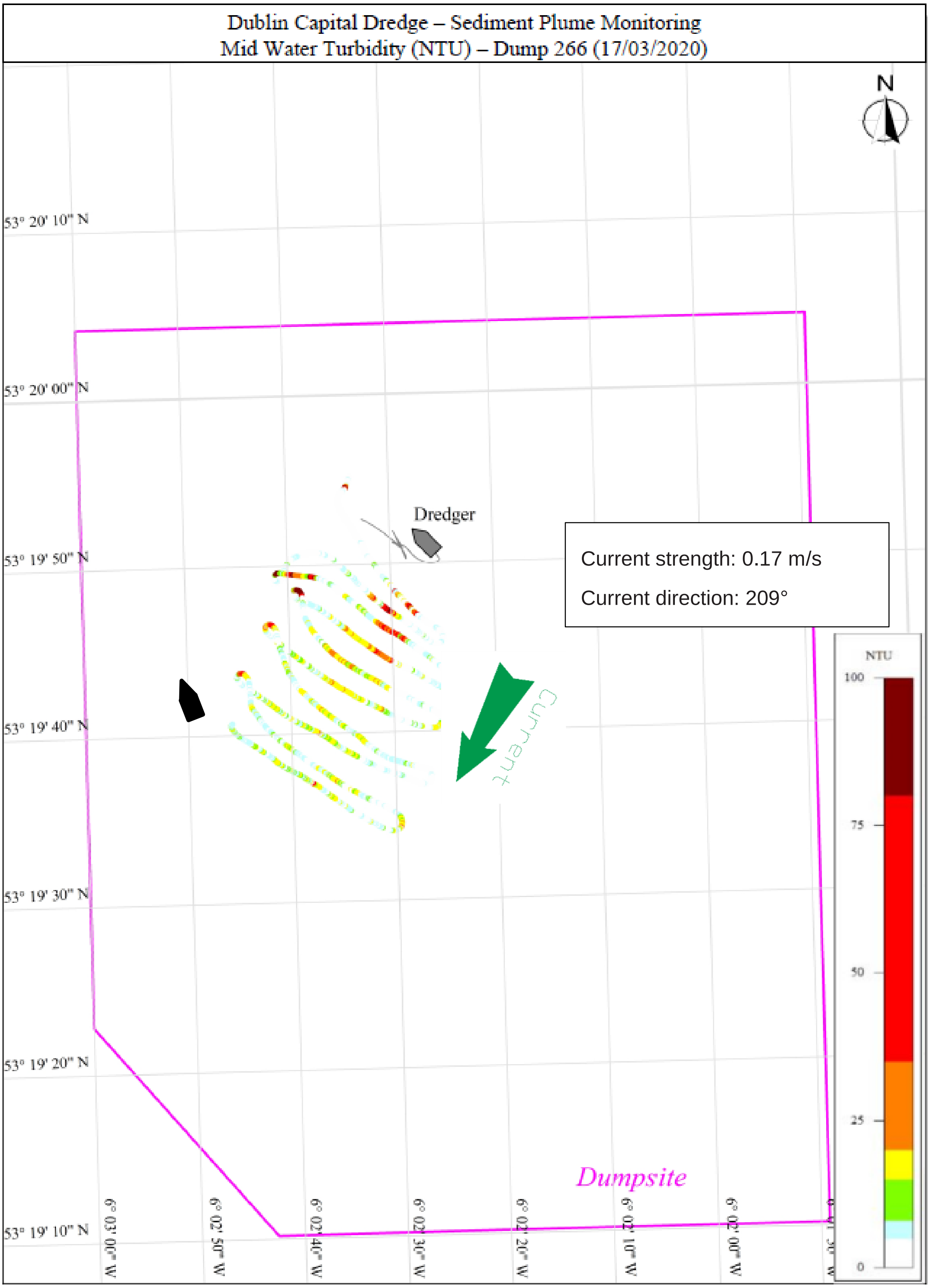


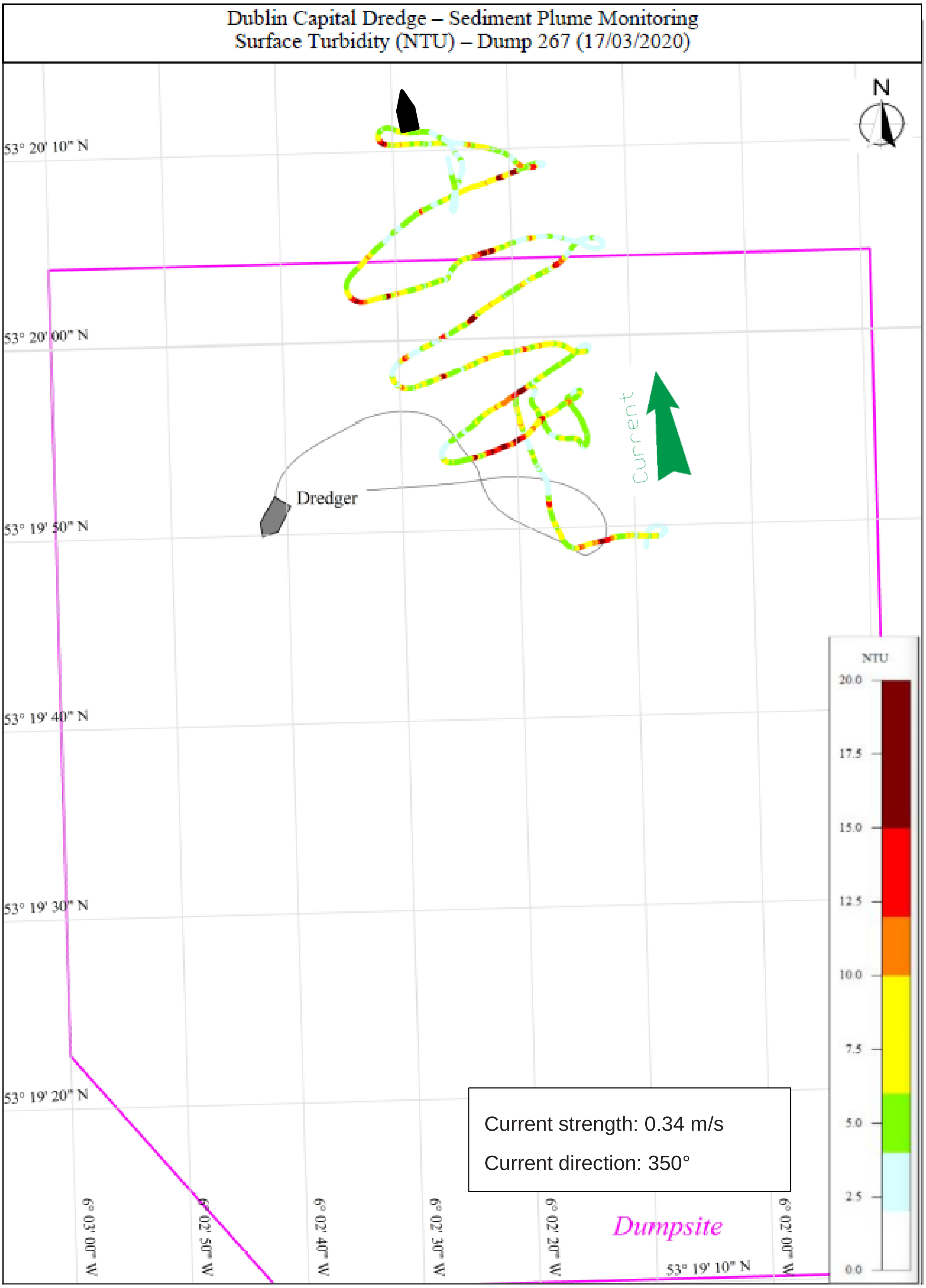
Figure 8.3: Dump 266 Survey track with surface turbidity [NTU]



Current strength: 0.17 m/s

Current direction: 209°

Figure 8.4: Dump 266 Survey track with mid water turbidity [NTU]



Dublin Capital Dredge – Sediment Plume Monitoring
Surface Turbidity (NTU) – Dump 267 (17/03/2020)

Current strength: 0.34 m/s

Current direction: 350°

Figure 8.5: Dump 267 Survey track with surface turbidity [NTU]

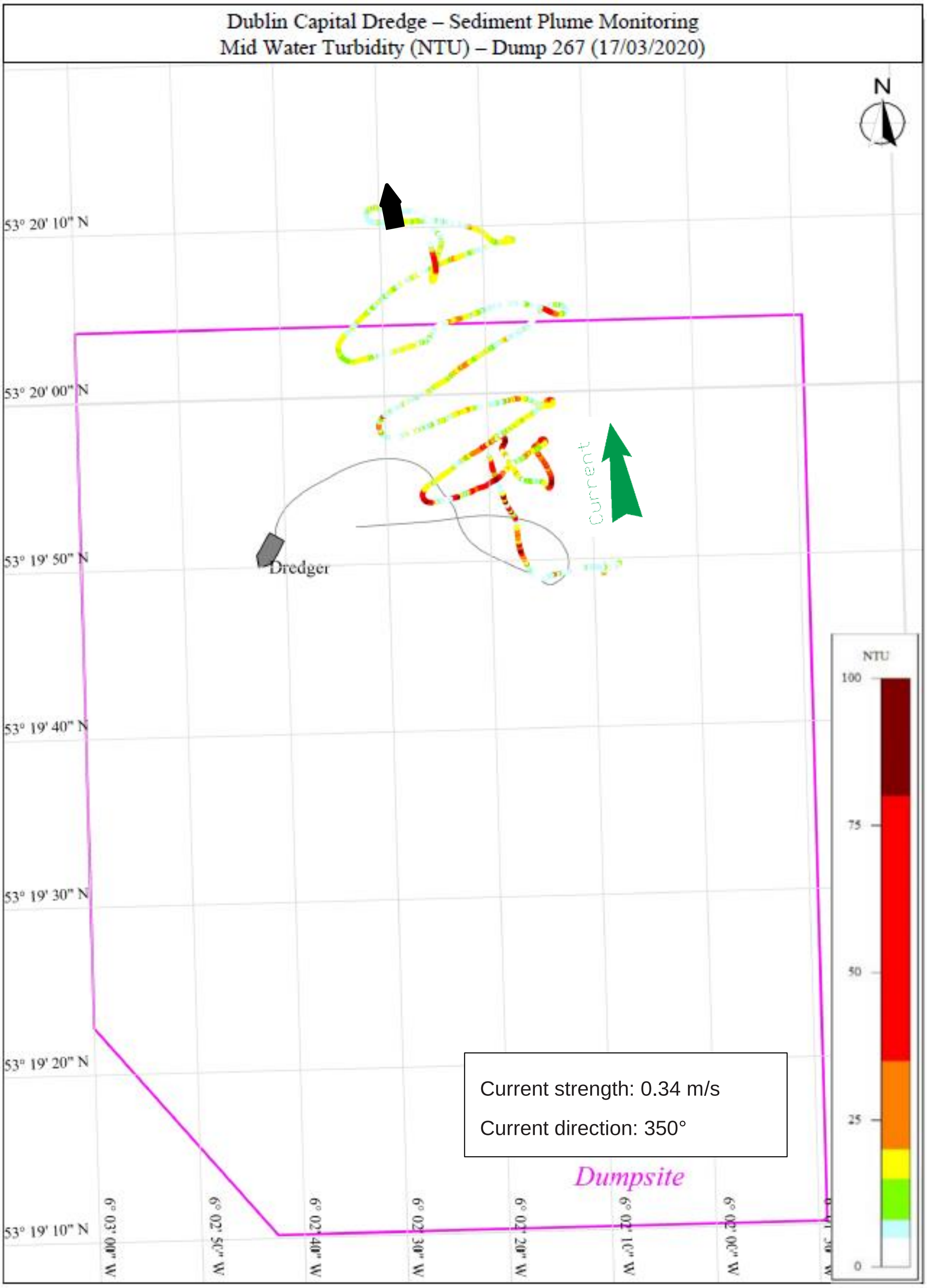
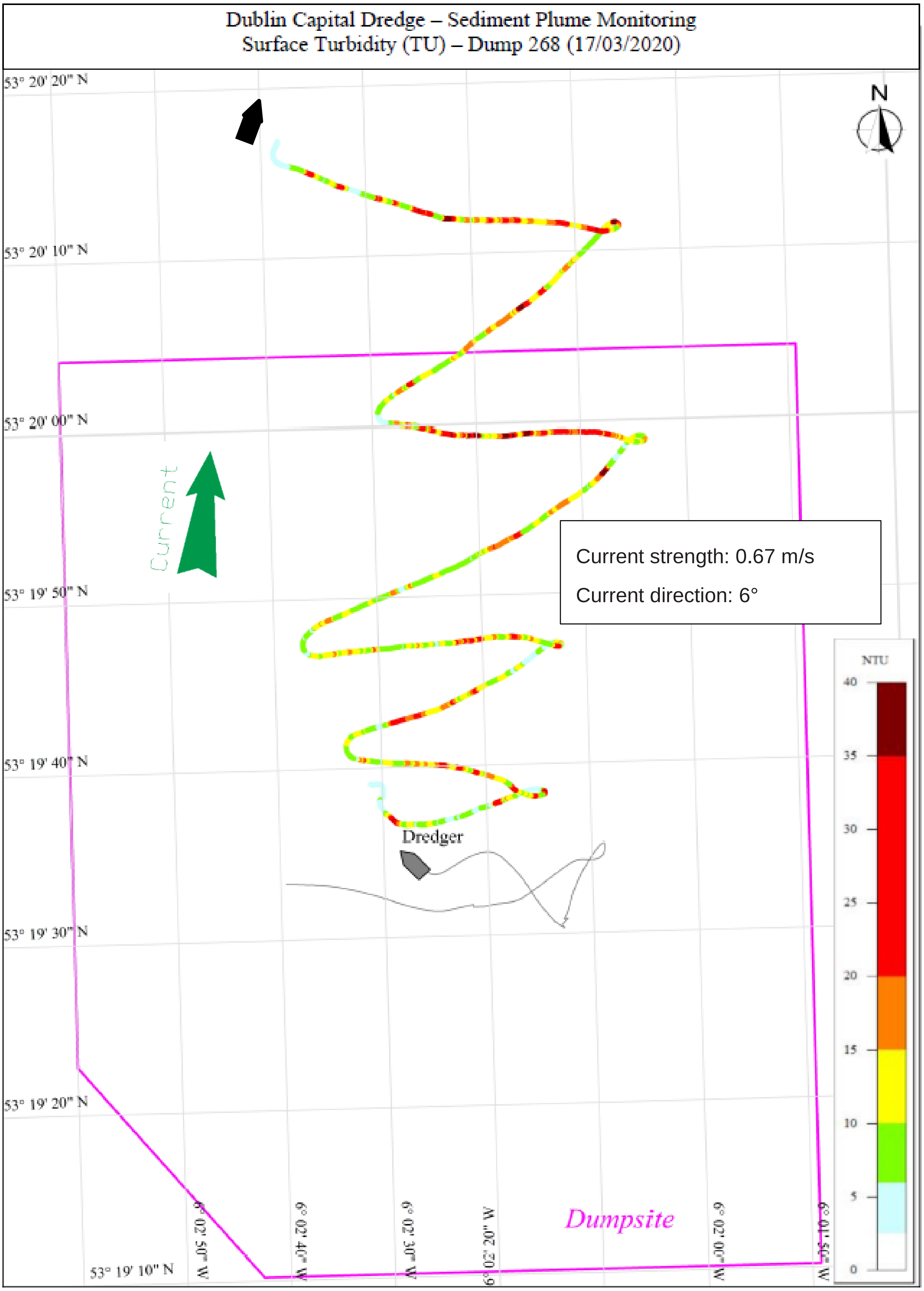


Figure 8.6: Dump 267 Survey track with mid water turbidity [NTU]



Current strength: 0.67 m/s

Current direction: 6°

Figure 8.7: Dump 268 Survey track with surface turbidity [NTU]

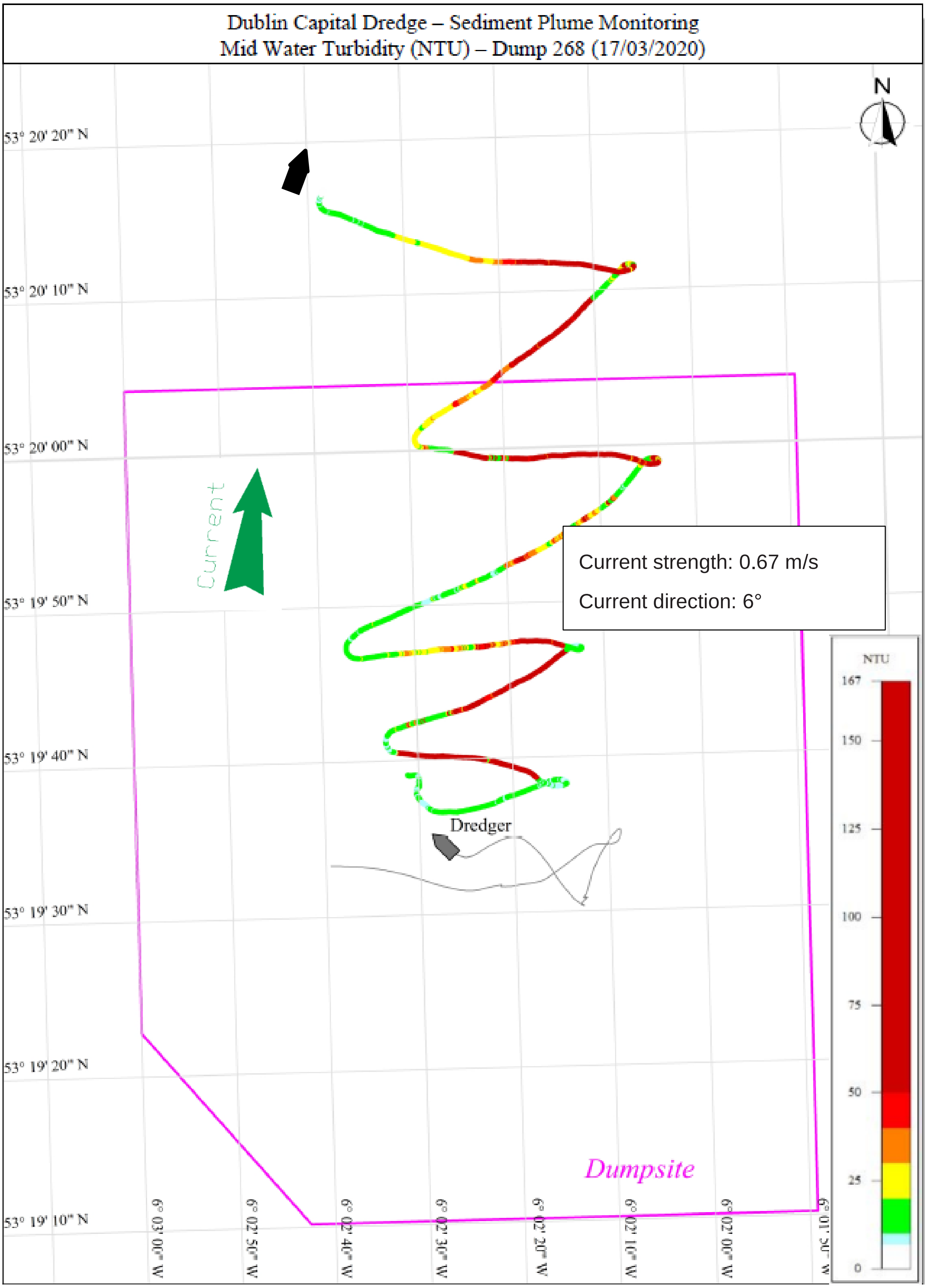


Figure 8.8: Dump 268 Survey track with mid water turbidity [NTU]

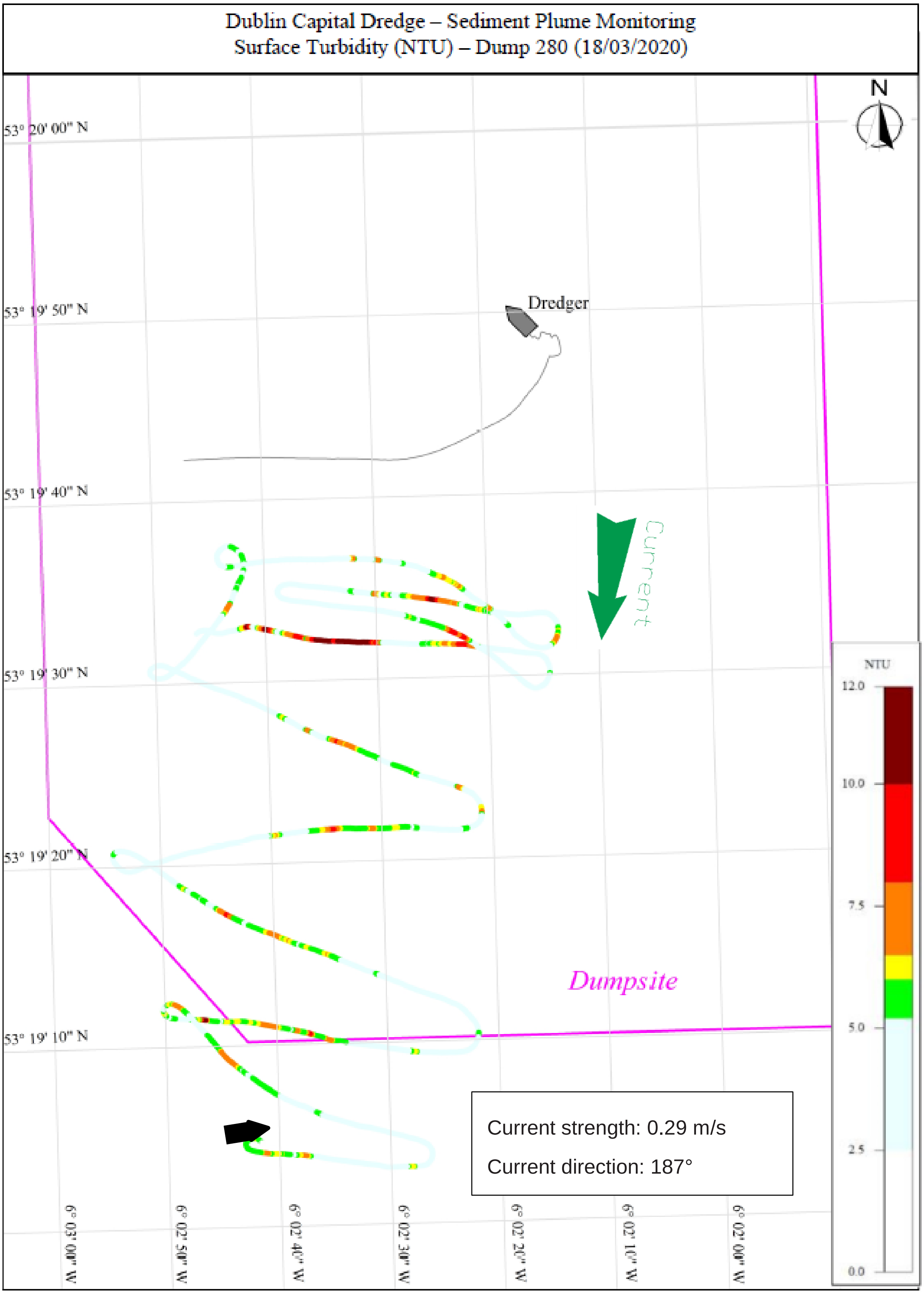


Figure 8.9: Dump 280 Survey track with surface turbidity [NTU]

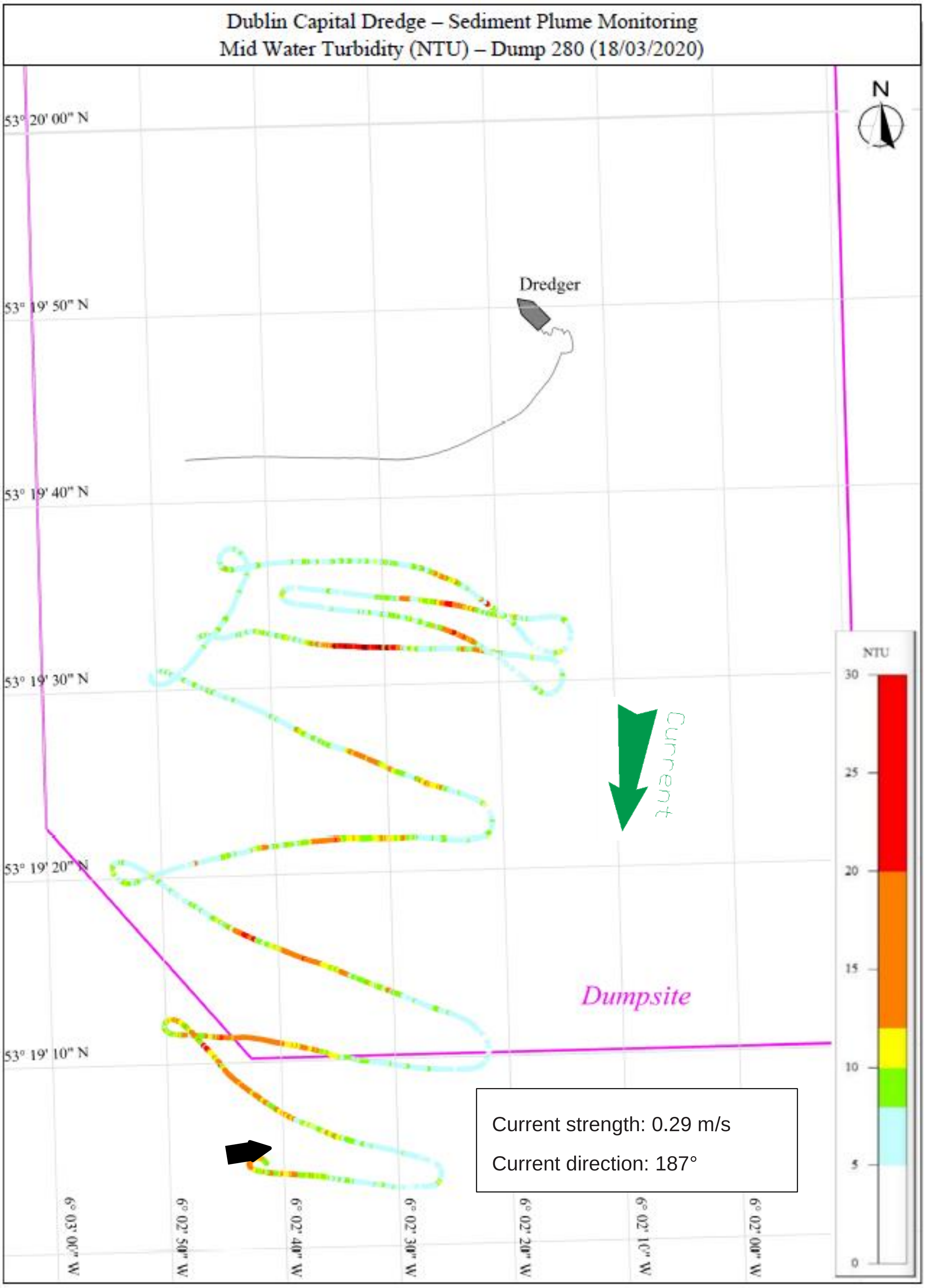
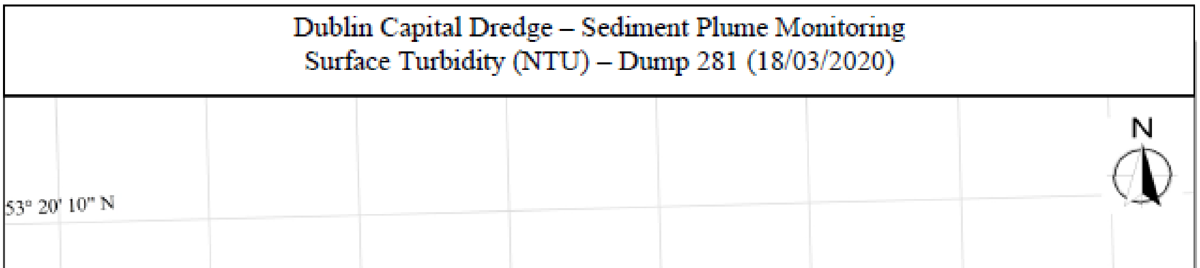


Figure 8.10: Dump 280 Survey track with mid water turbidity [NTU]



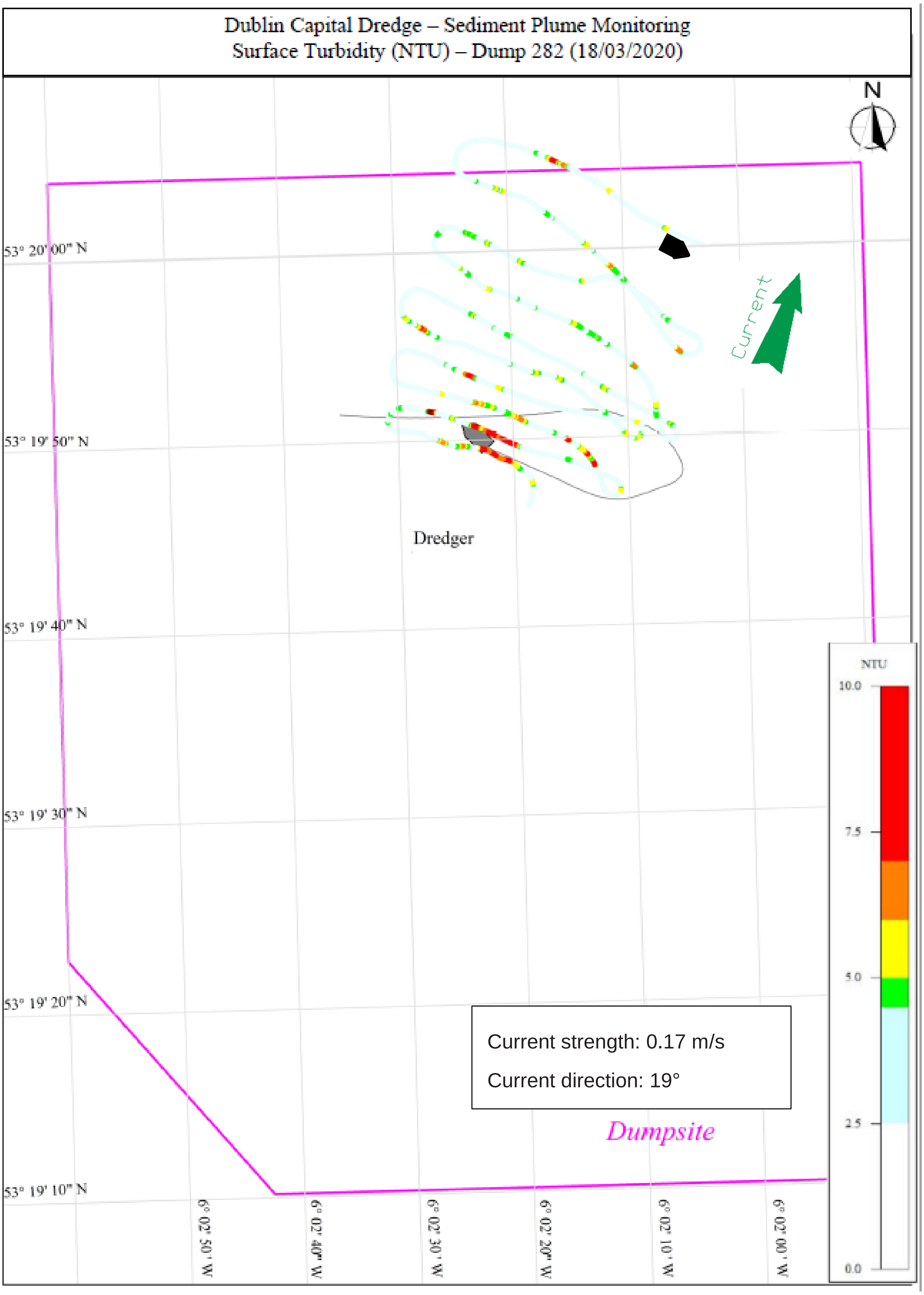
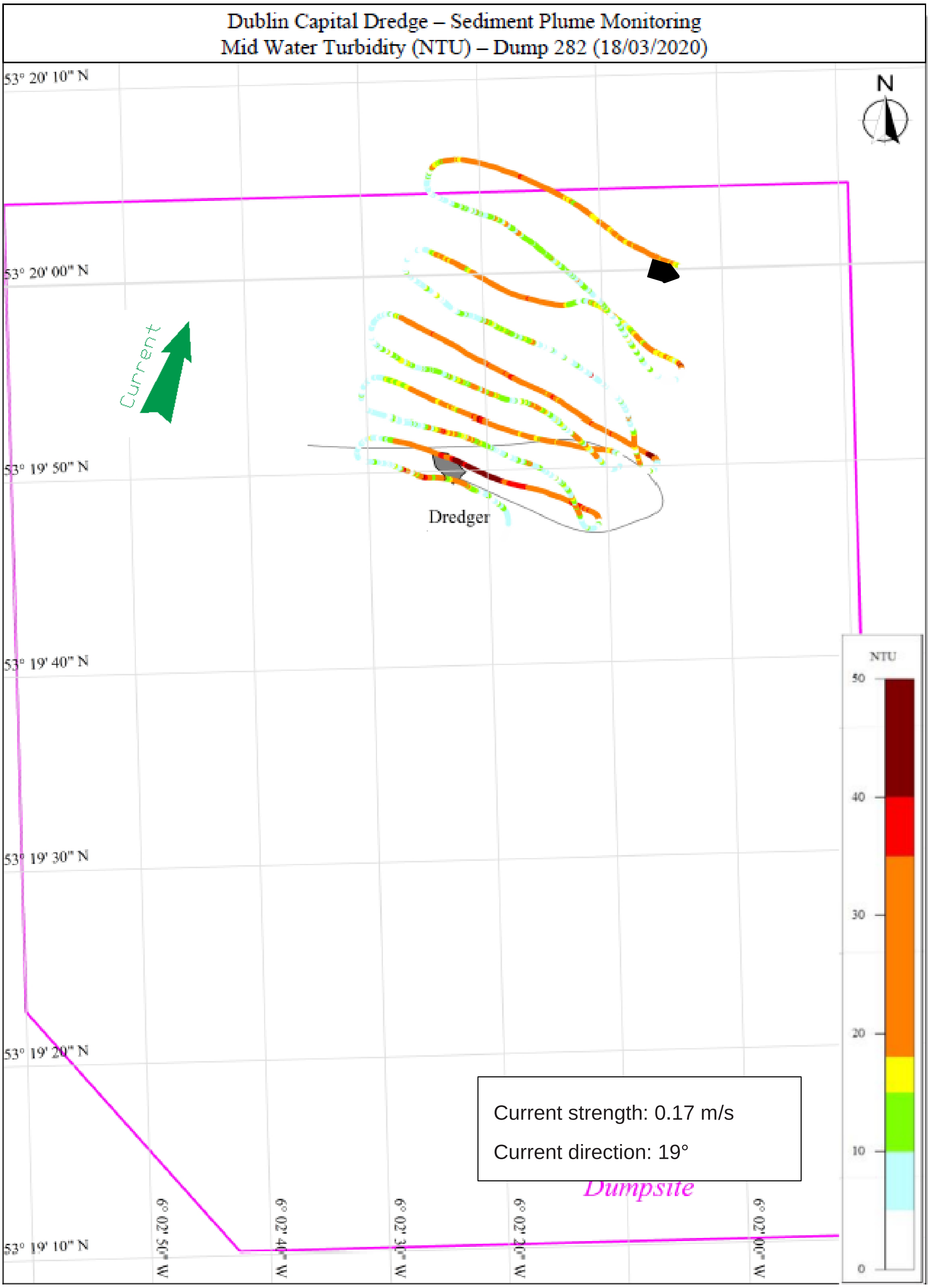


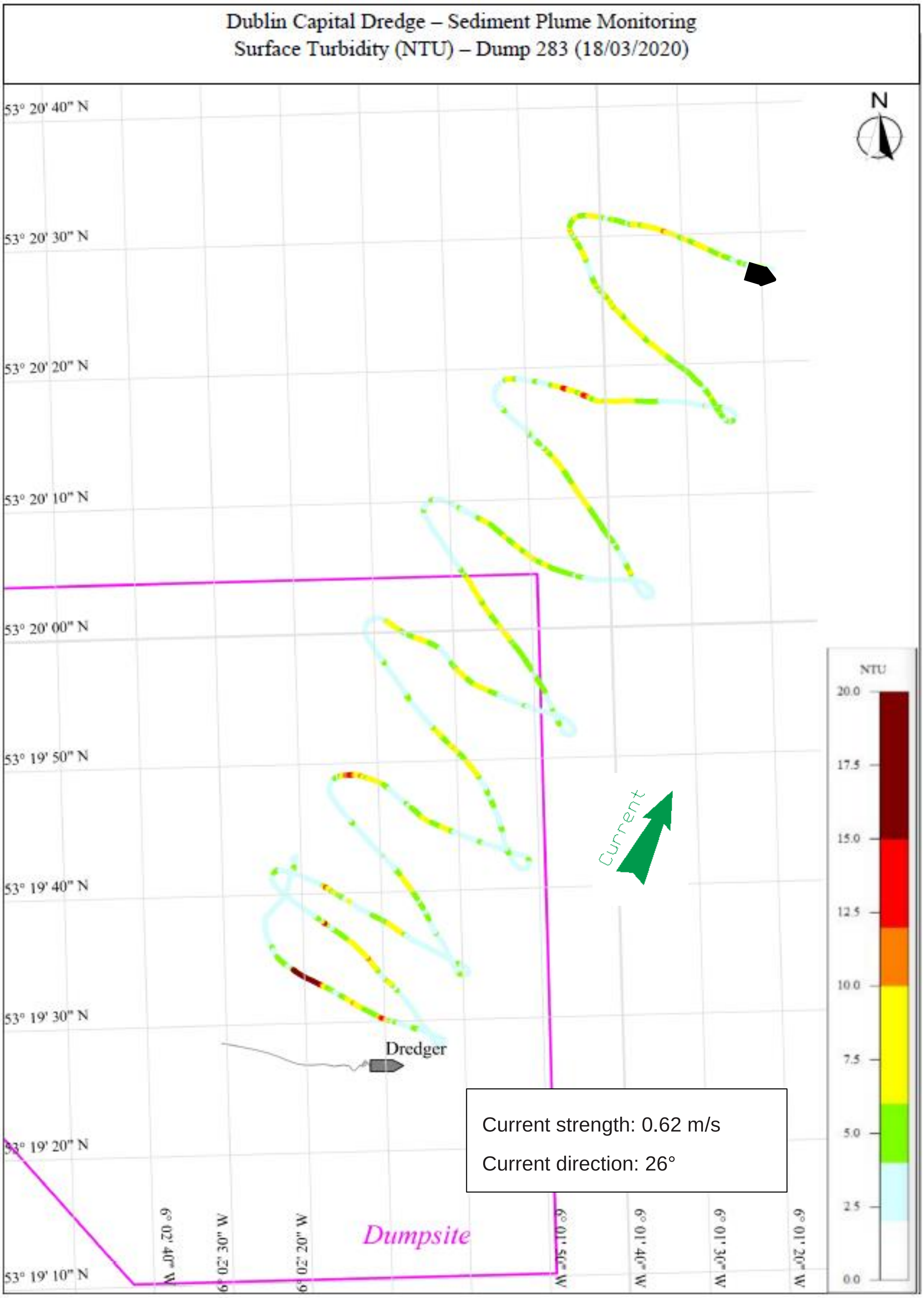
Figure 8.12: Dump 282 Survey track with surface turbidity [NTU]



Current strength: 0.17 m/s

Current direction: 19°

Figure 8.13: Dump 282 Survey track with mid water turbidity [NTU]


Dublin Capital Dredge – Sediment Plume Monitoring
Surface Turbidity (NTU) – Dump 283 (18/03/2020)

Current strength: 0.62 m/s

Current direction: 26°

Figure 8.14: Dump 283 Survey track with surface turbidity [NTU]

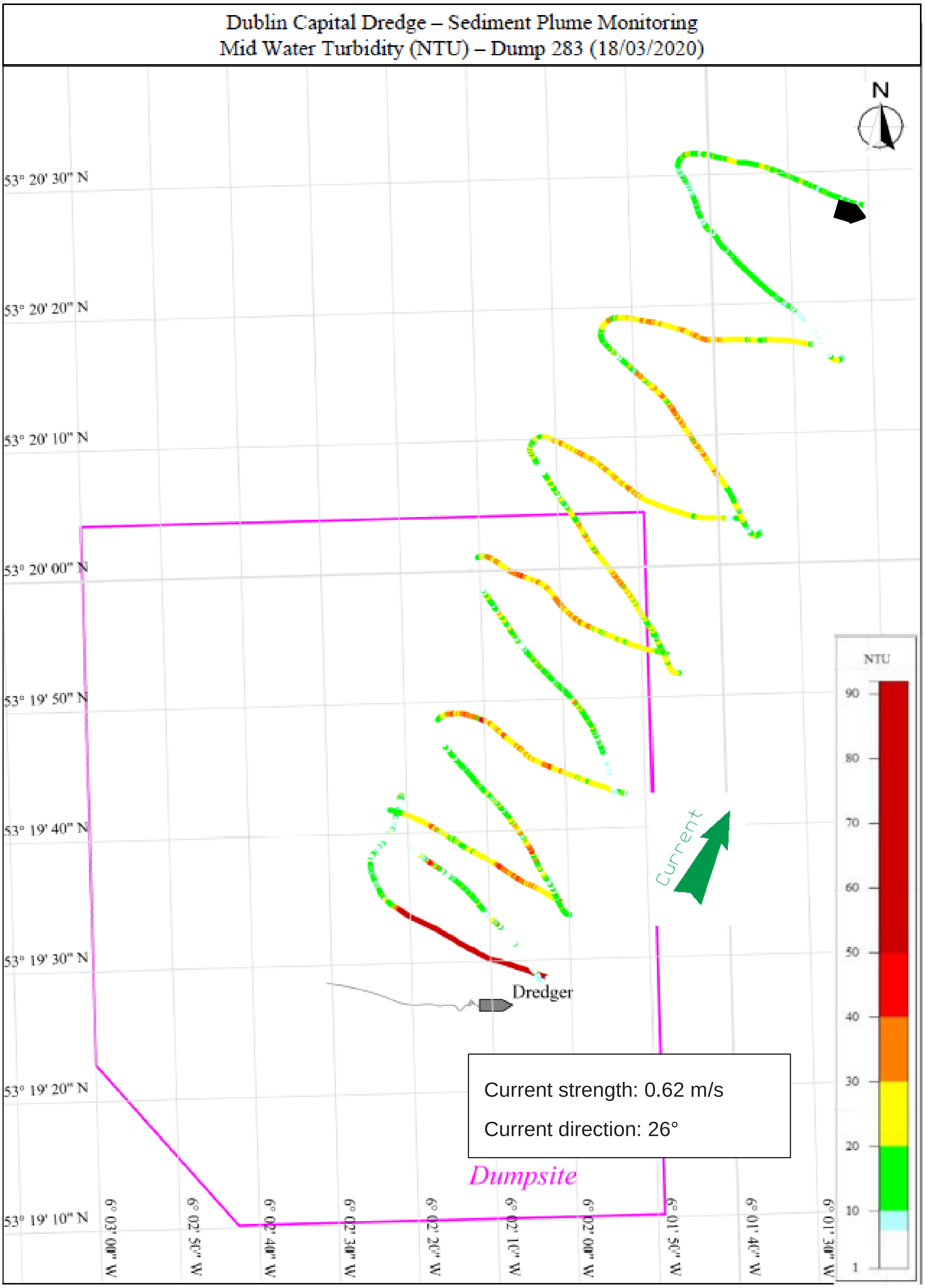


Figure 8.15: Dump 283 Survey track with mid water turbidity [NTU]

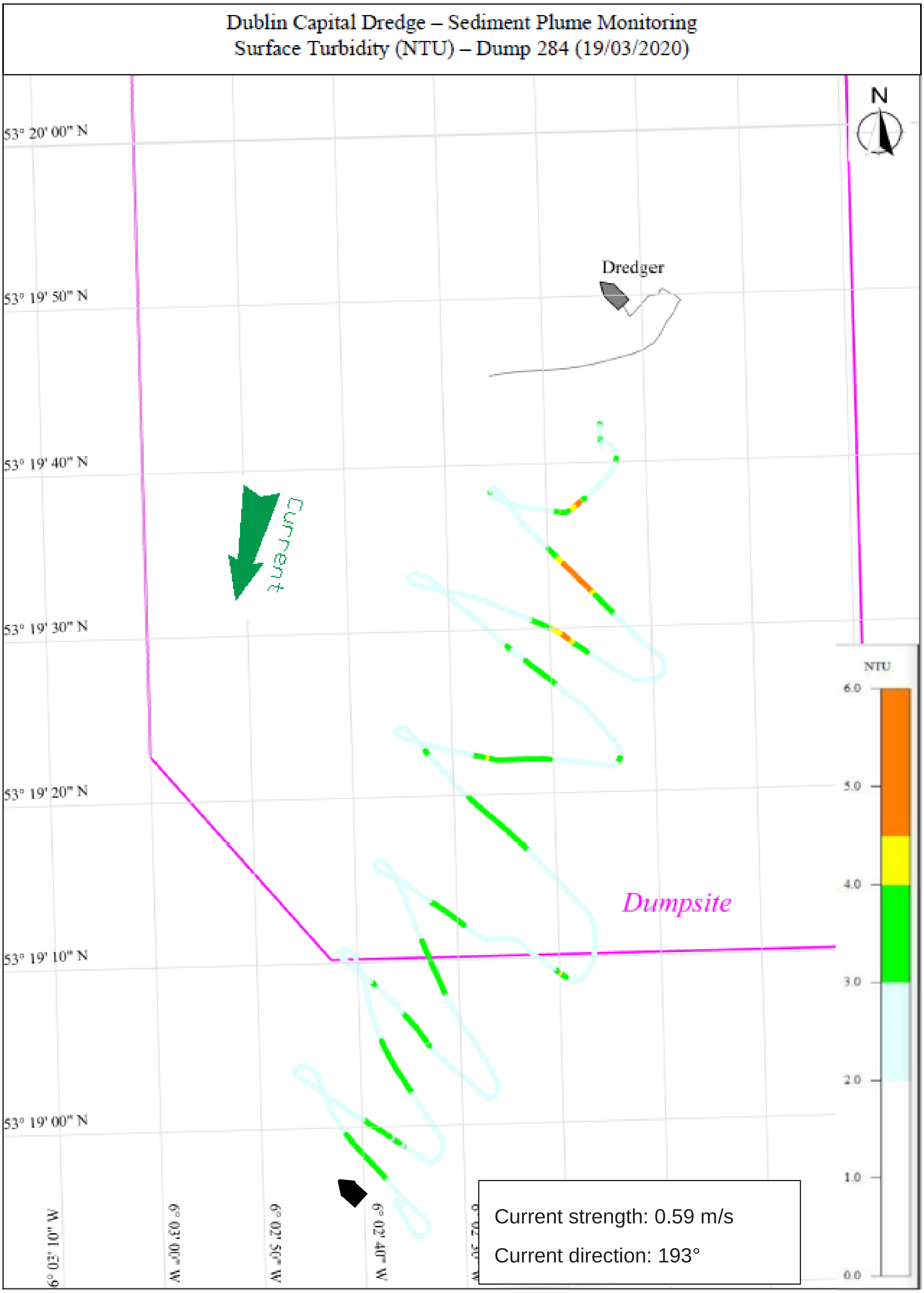


Figure 8.16: Dump 284 Survey track with surface turbidity [NTU]

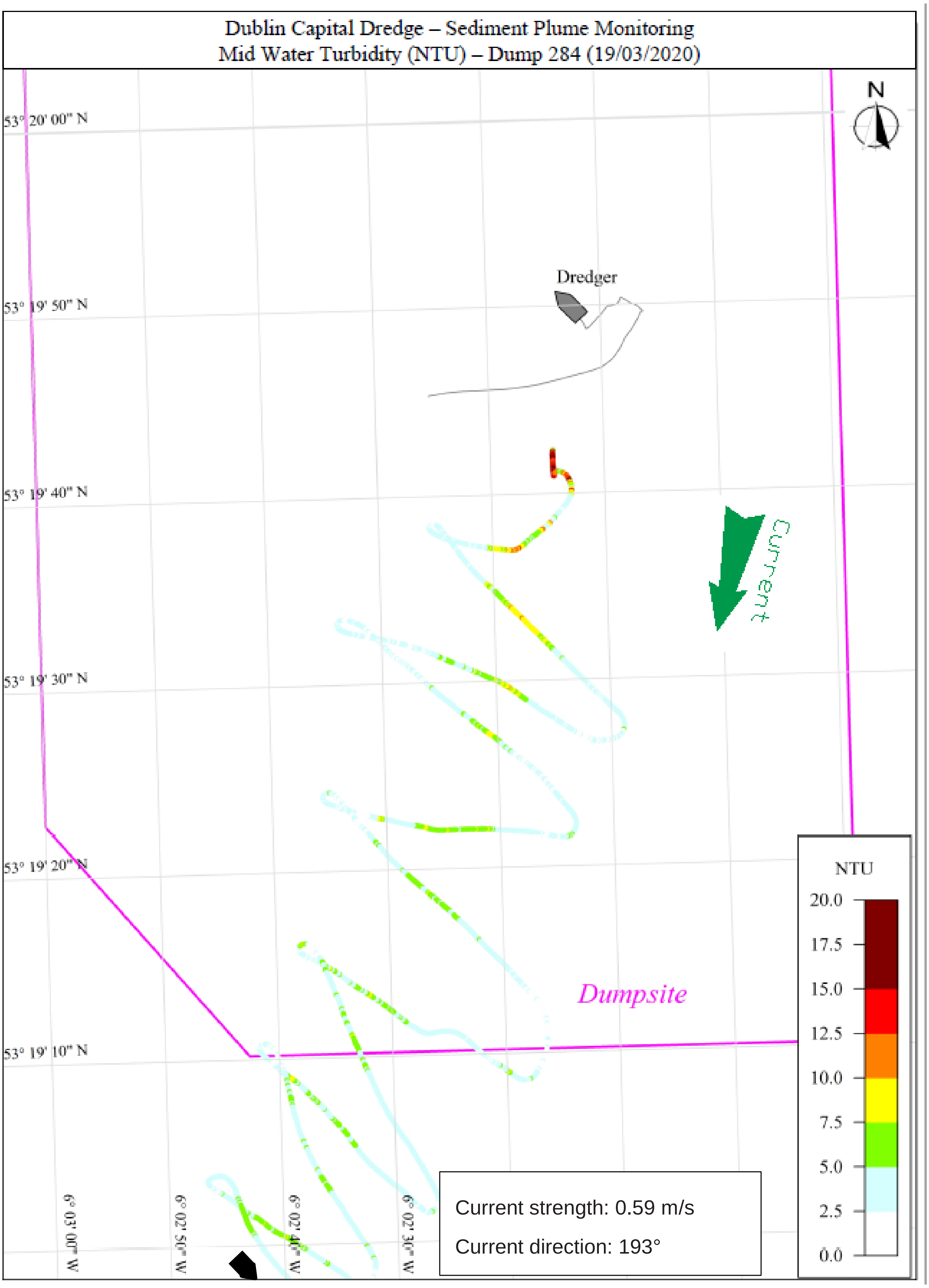


Figure 8.17: Dump 284 Survey track with mid water turbidity [NTU]

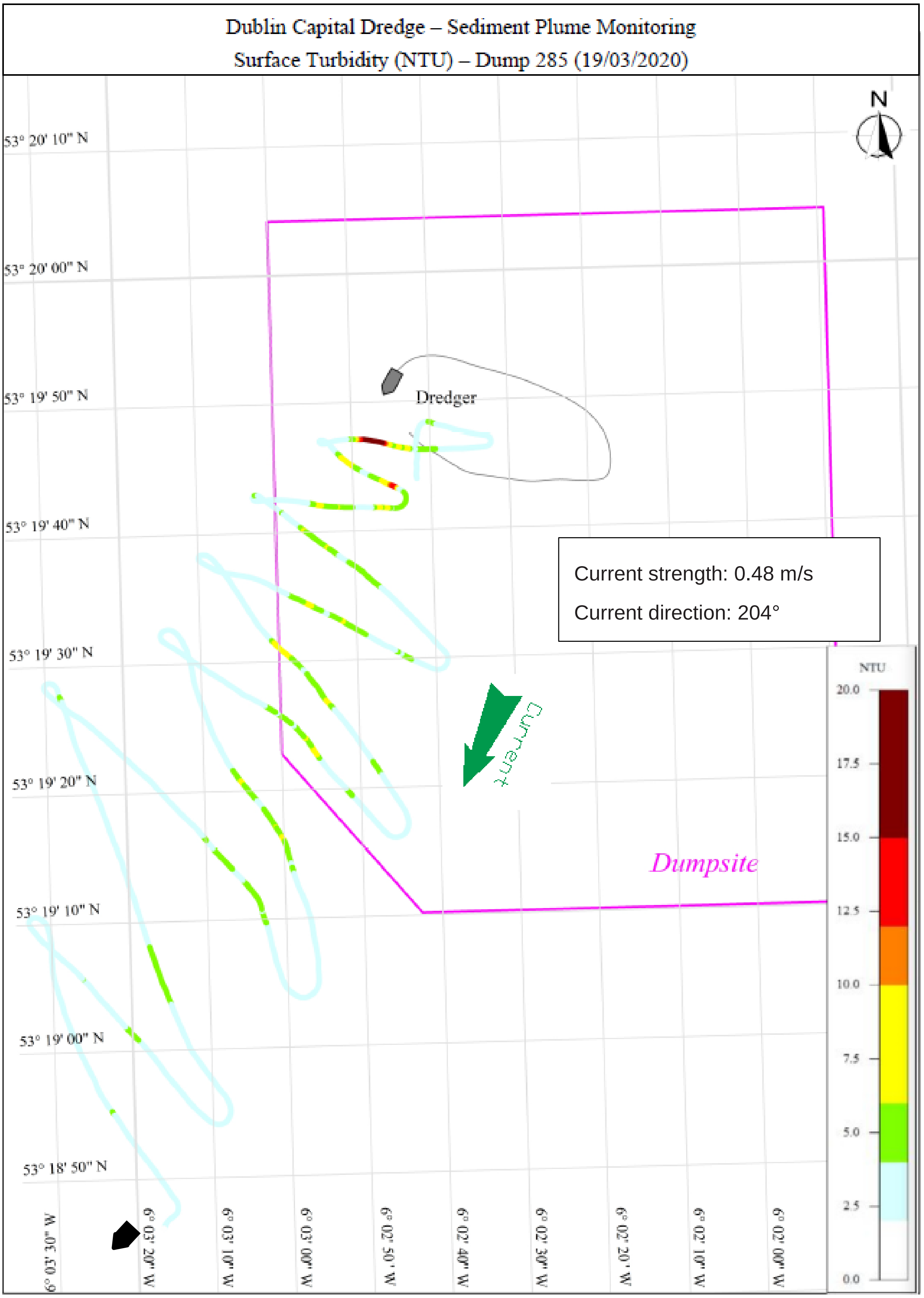


Figure 8.18: Dump 285 Survey track with surface turbidity [NTU]

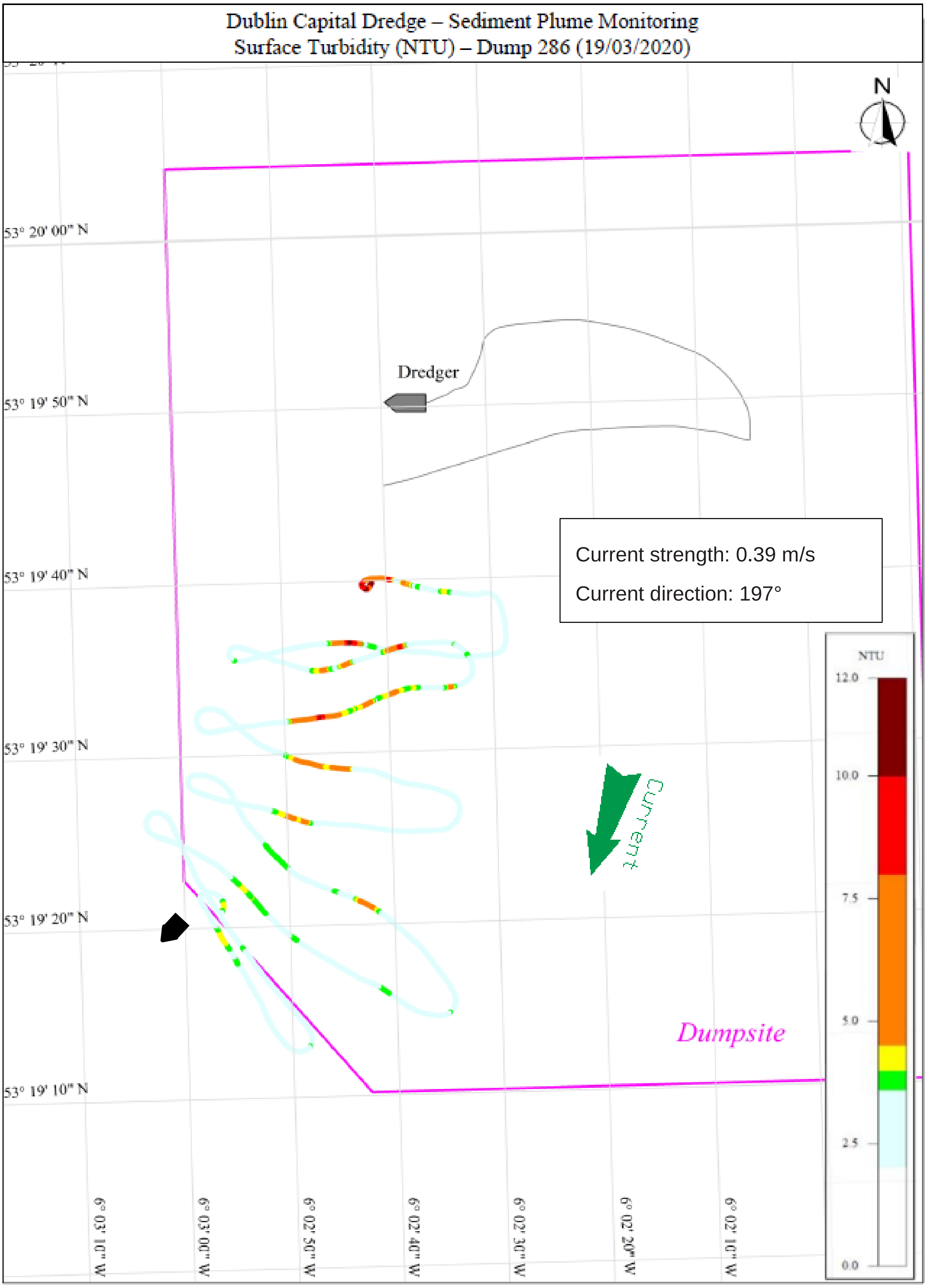


Figure 8.19: Dump 286 Survey track with surface turbidity [NTU]

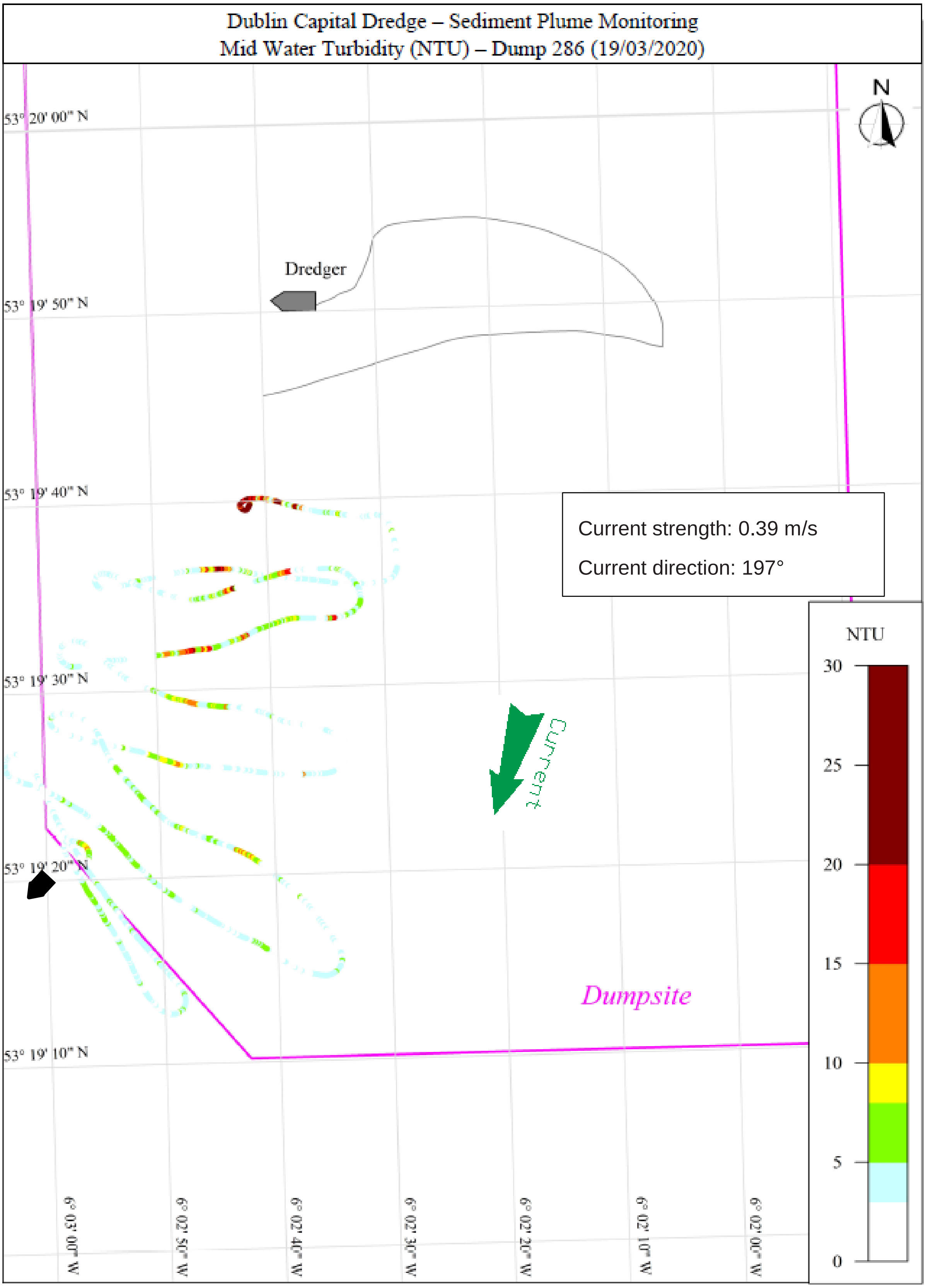


Figure 8.20: Dump 286 Survey track with mid water turbidity [NTU]

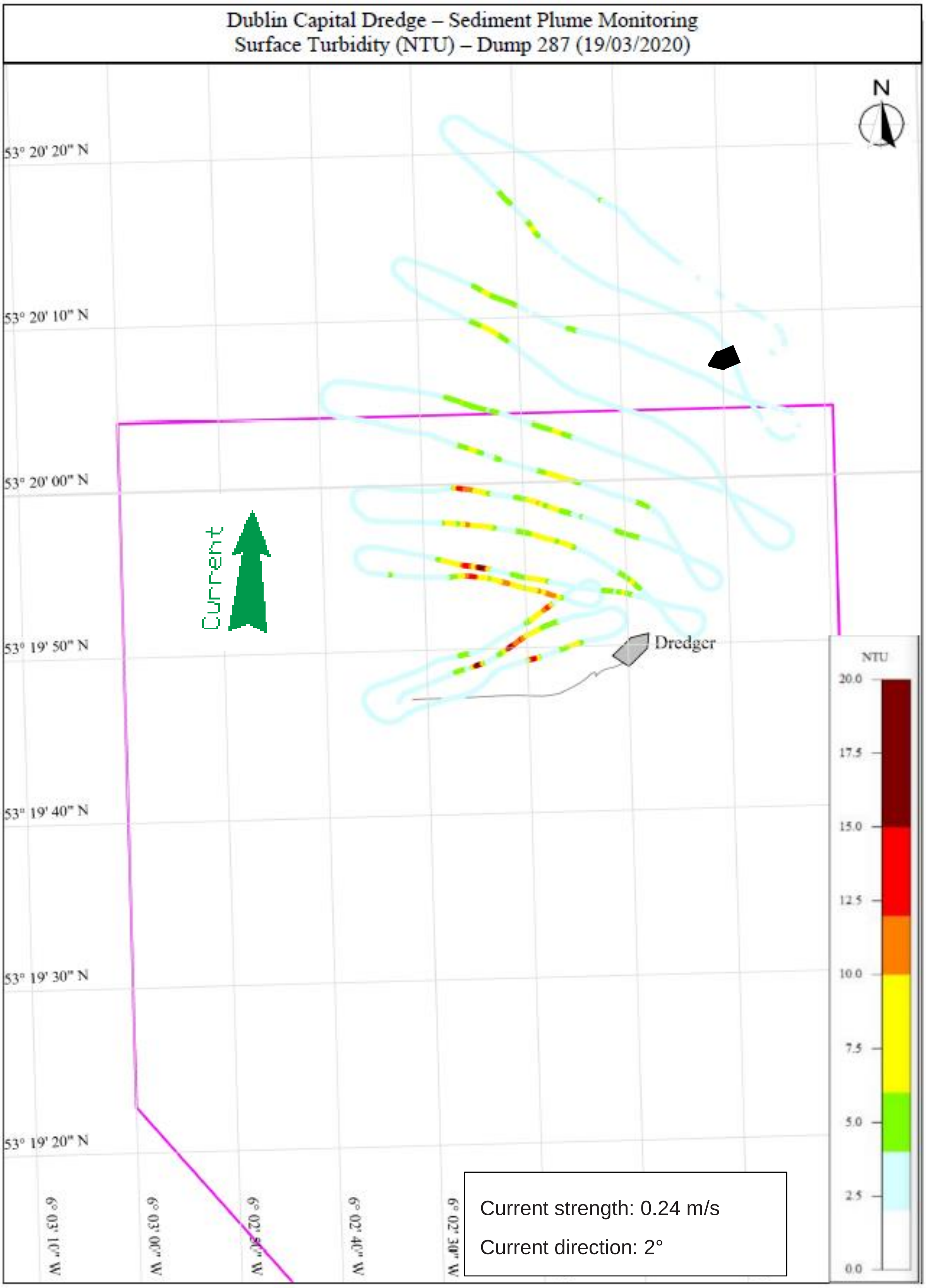


Figure 8.21: Dump 287 Survey track with surface turbidity [NTU]

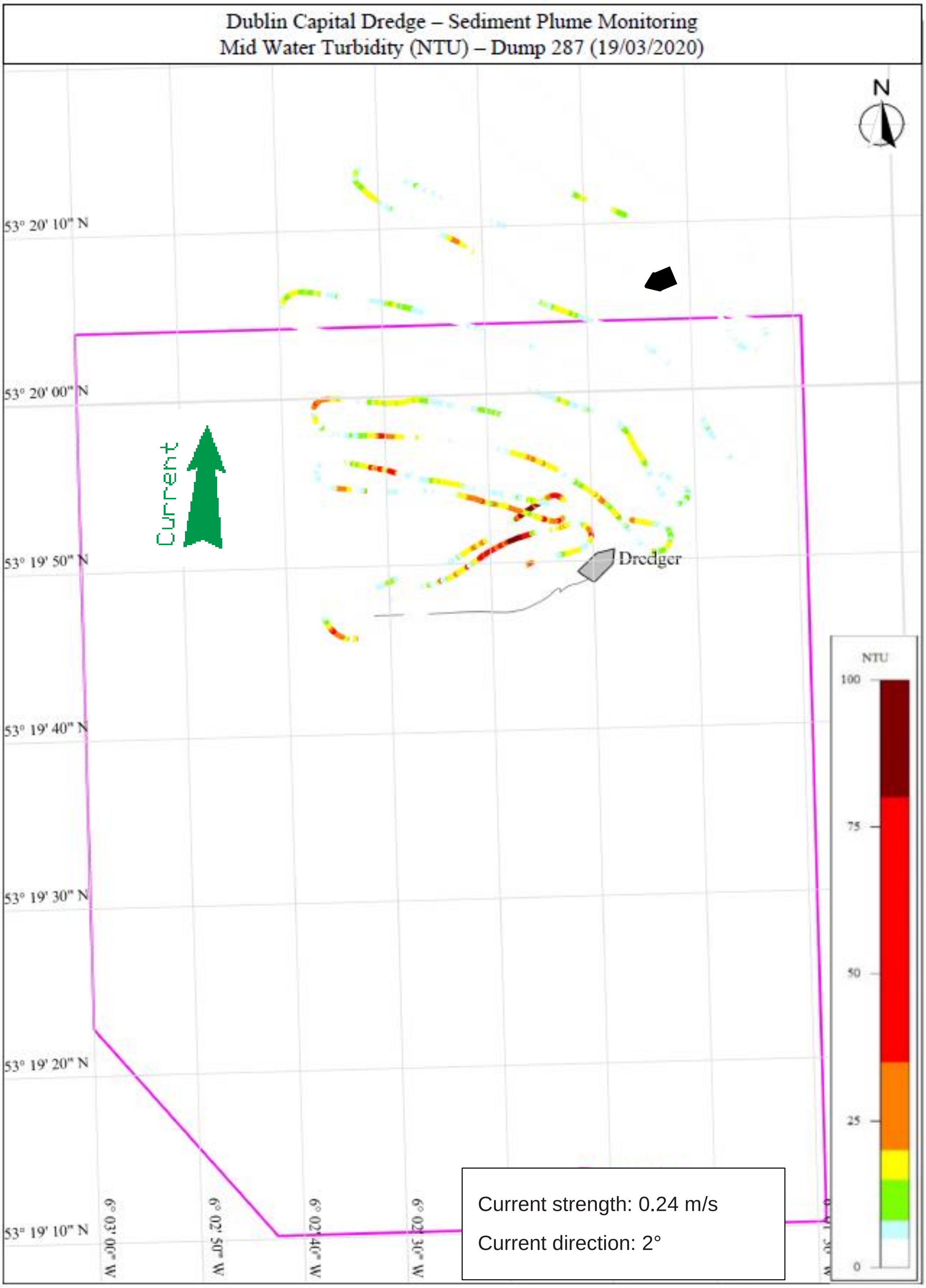


Figure 8.22: Dump 287 Survey track with mid water turbidity [NTU]

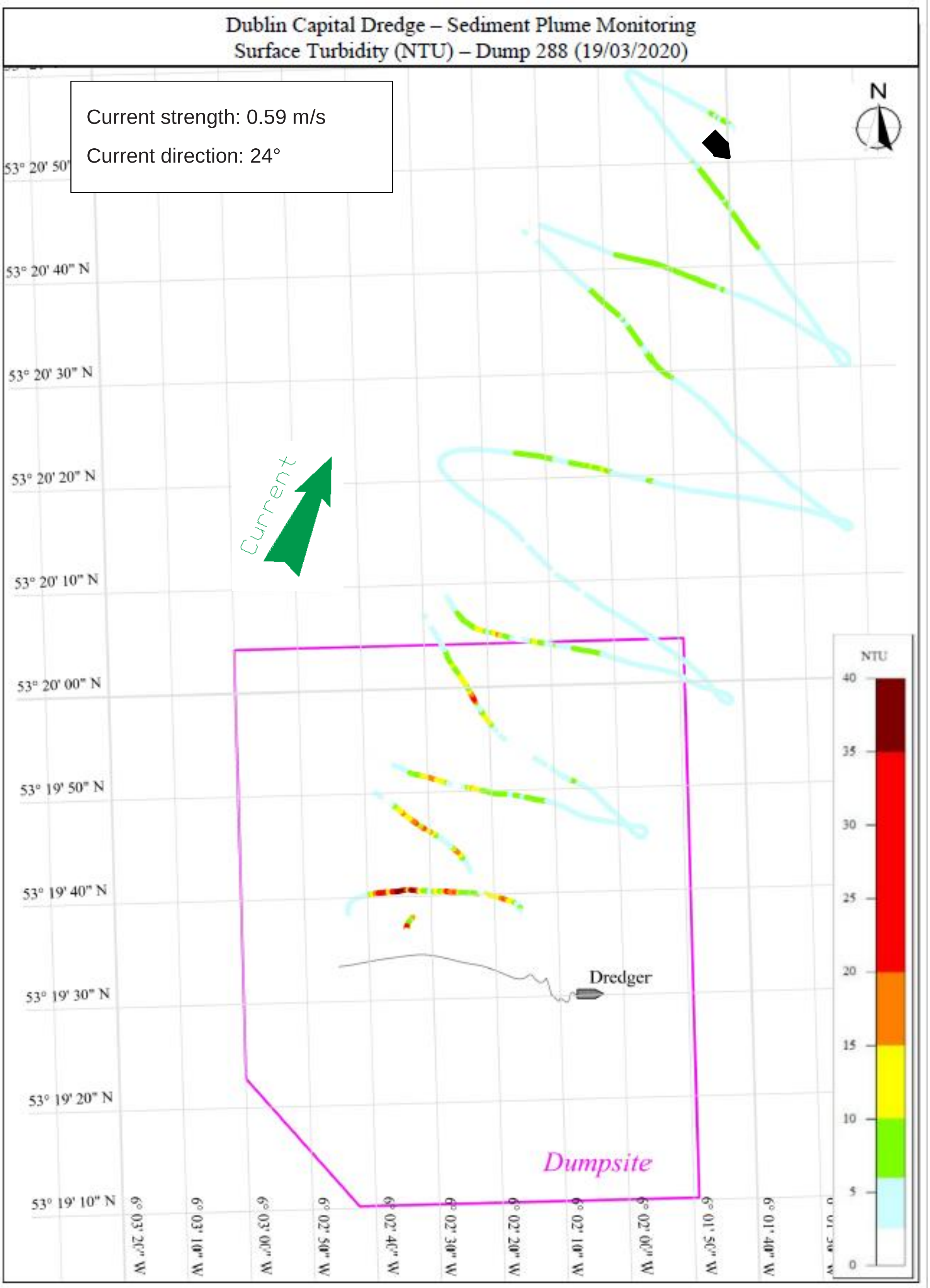


Figure 8.23: Dump 288 Survey track with surface turbidity [NTU]

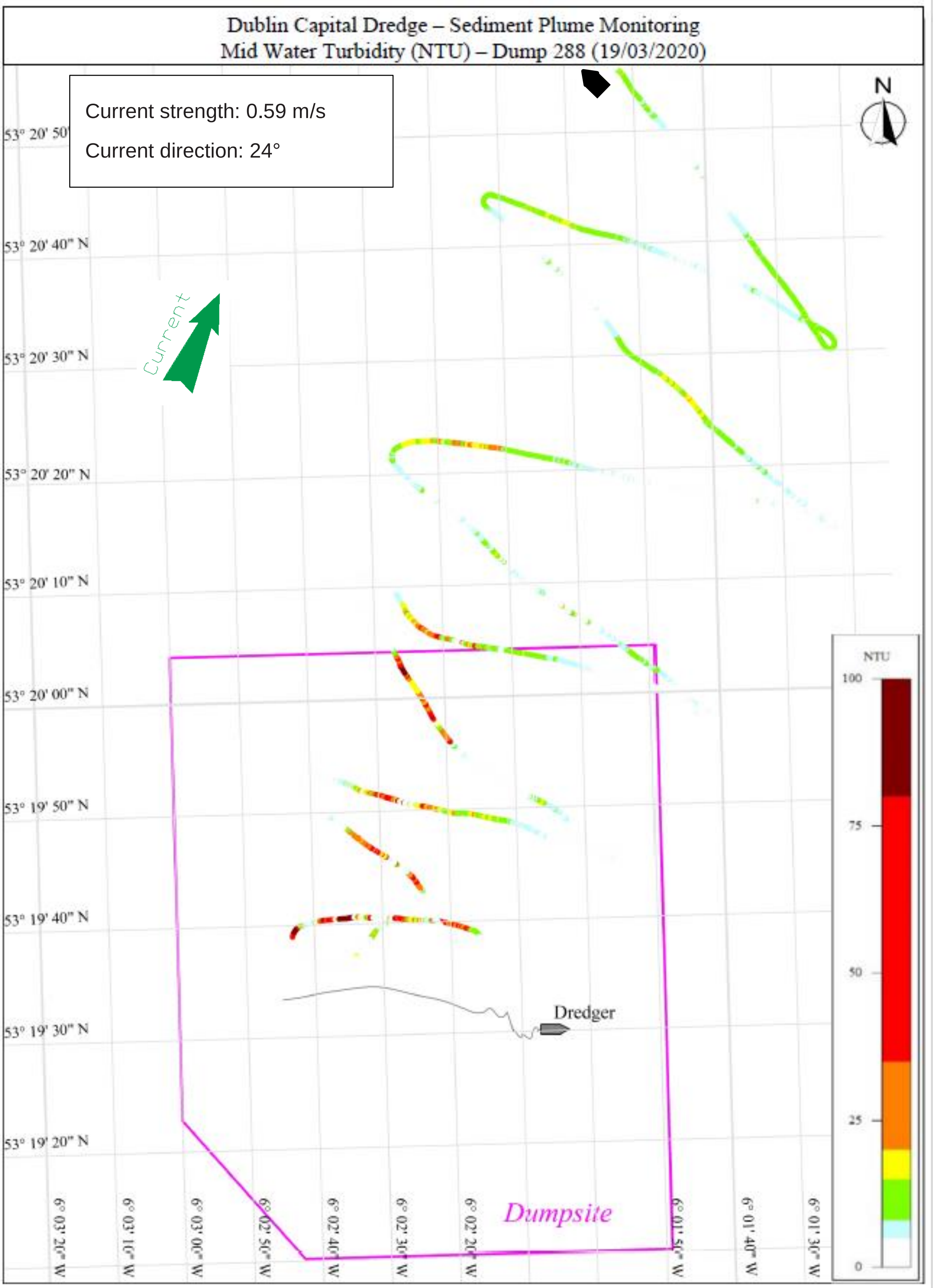


Figure 8.24: Dump 288 Survey track with mid water turbidity [NTU]

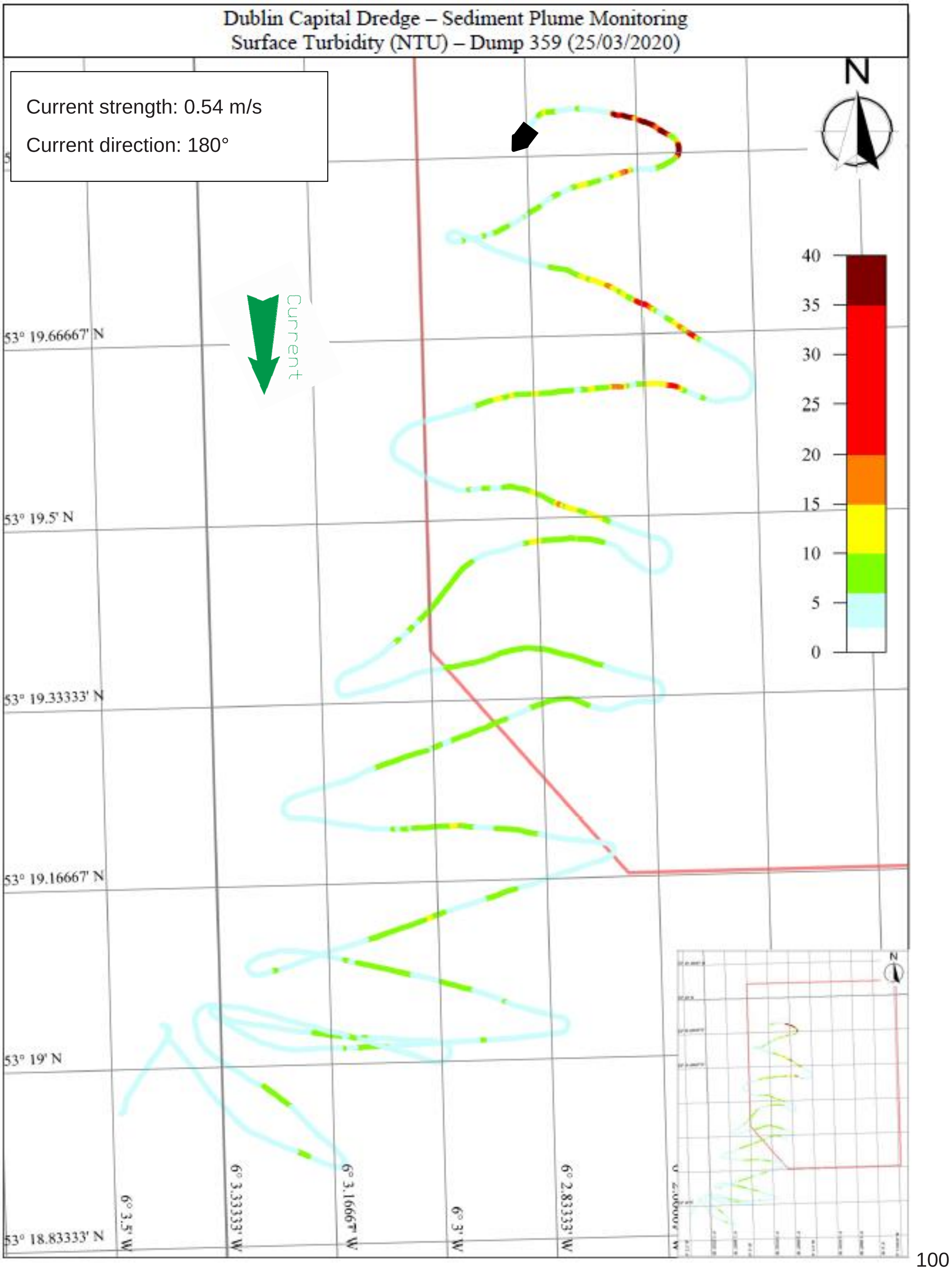


Figure 8.25: Dump 359 Survey track with surface turbidity [NTU]

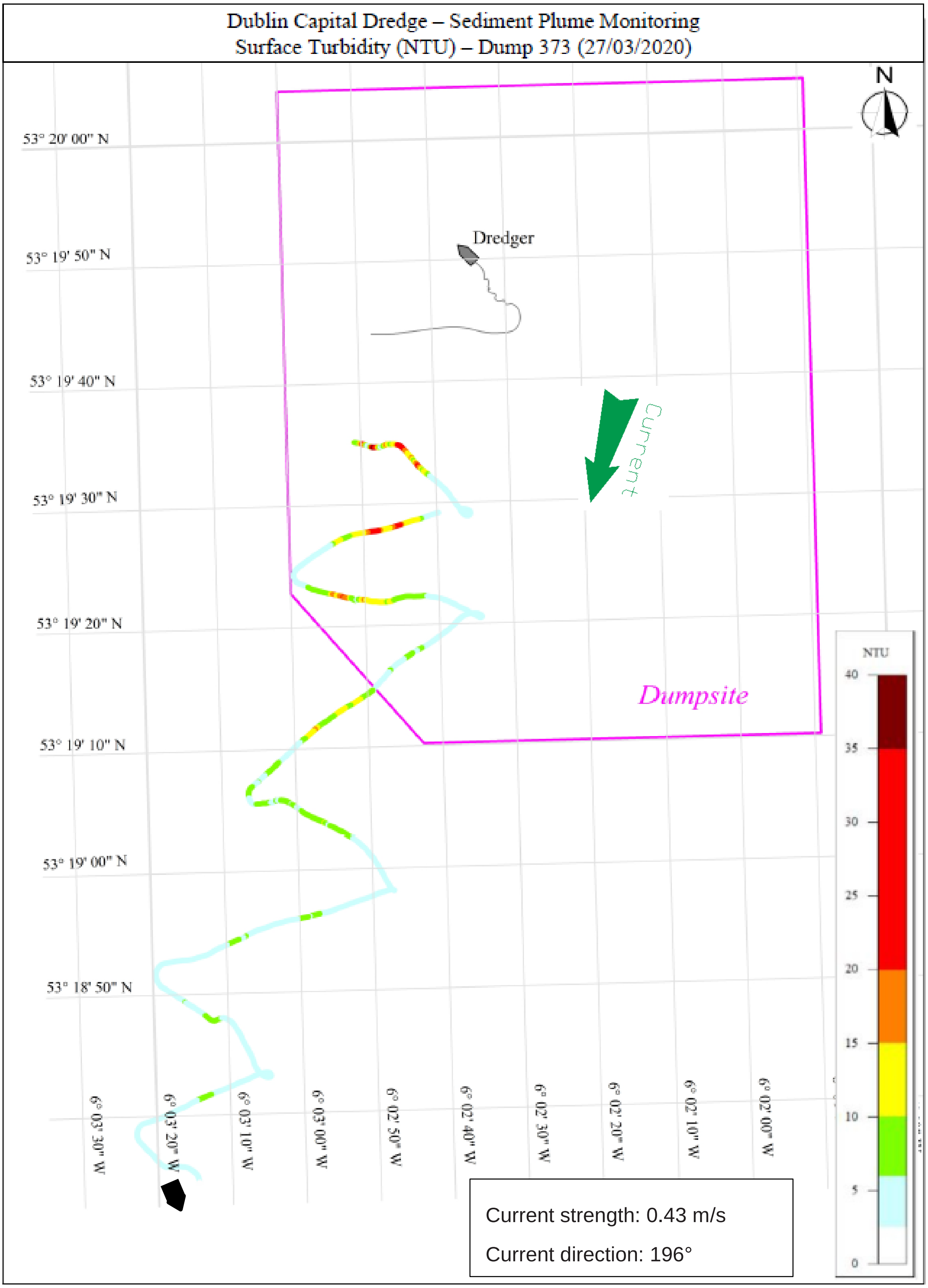


Figure 8.26: Dump 373 Survey track with surface turbidity [NTU]

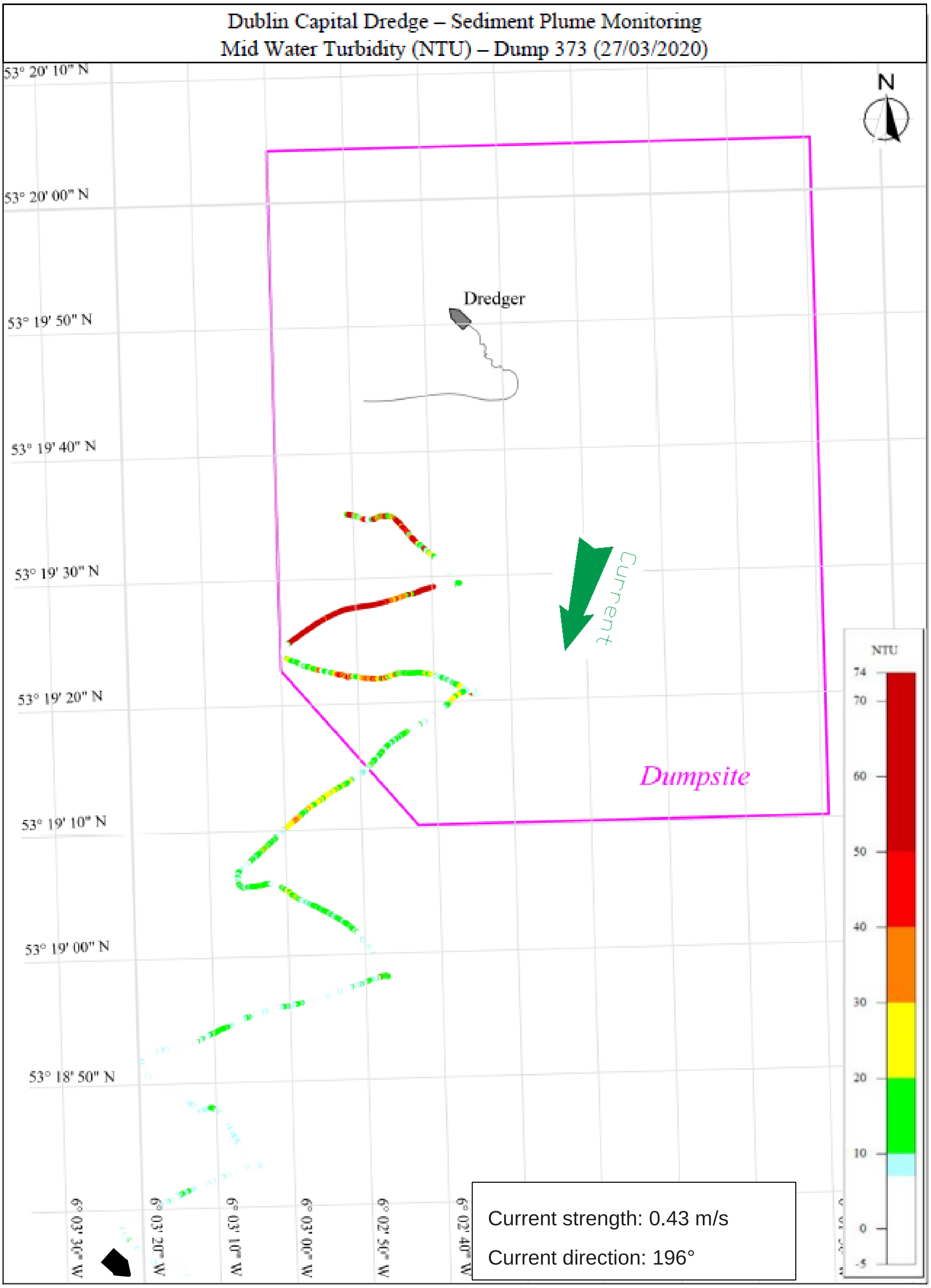


Figure 8.27: Dump 373 Survey track with mid water turbidity [NTU]

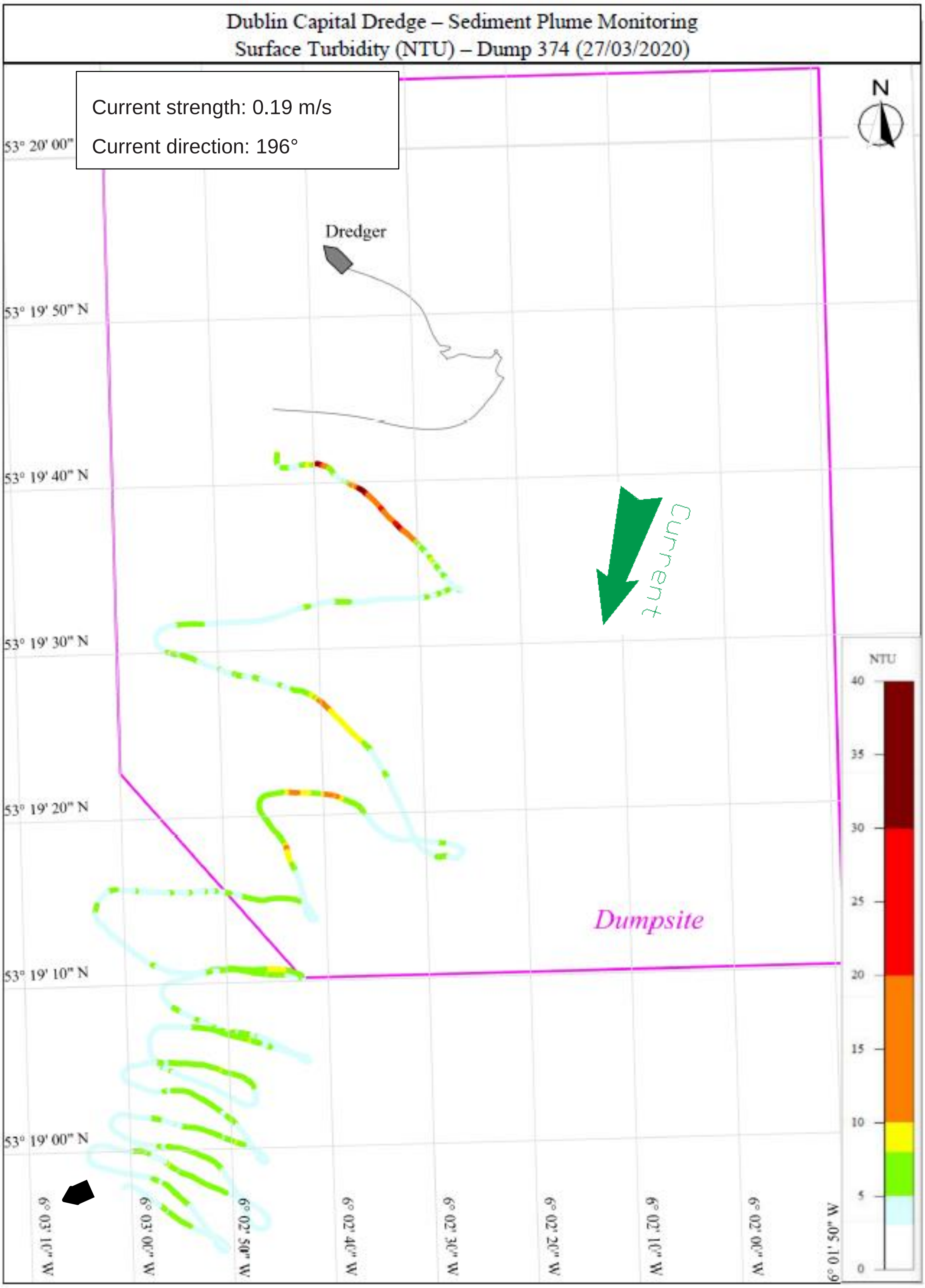


Figure 8.28: Dump 374 Survey track with surface turbidity [NTU]

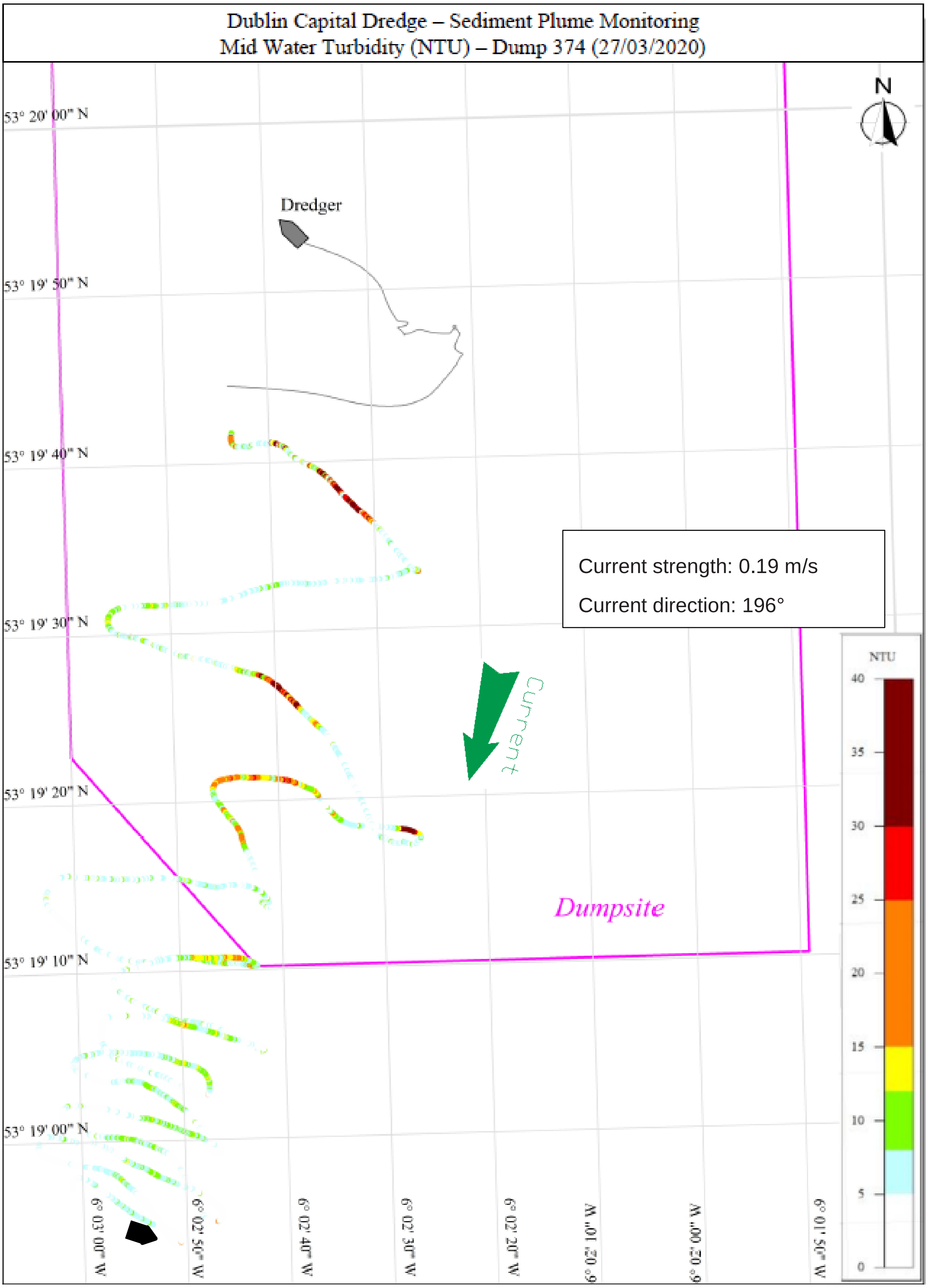


Figure 8.29: Dump 374 Survey track with mid water turbidity [NTU]

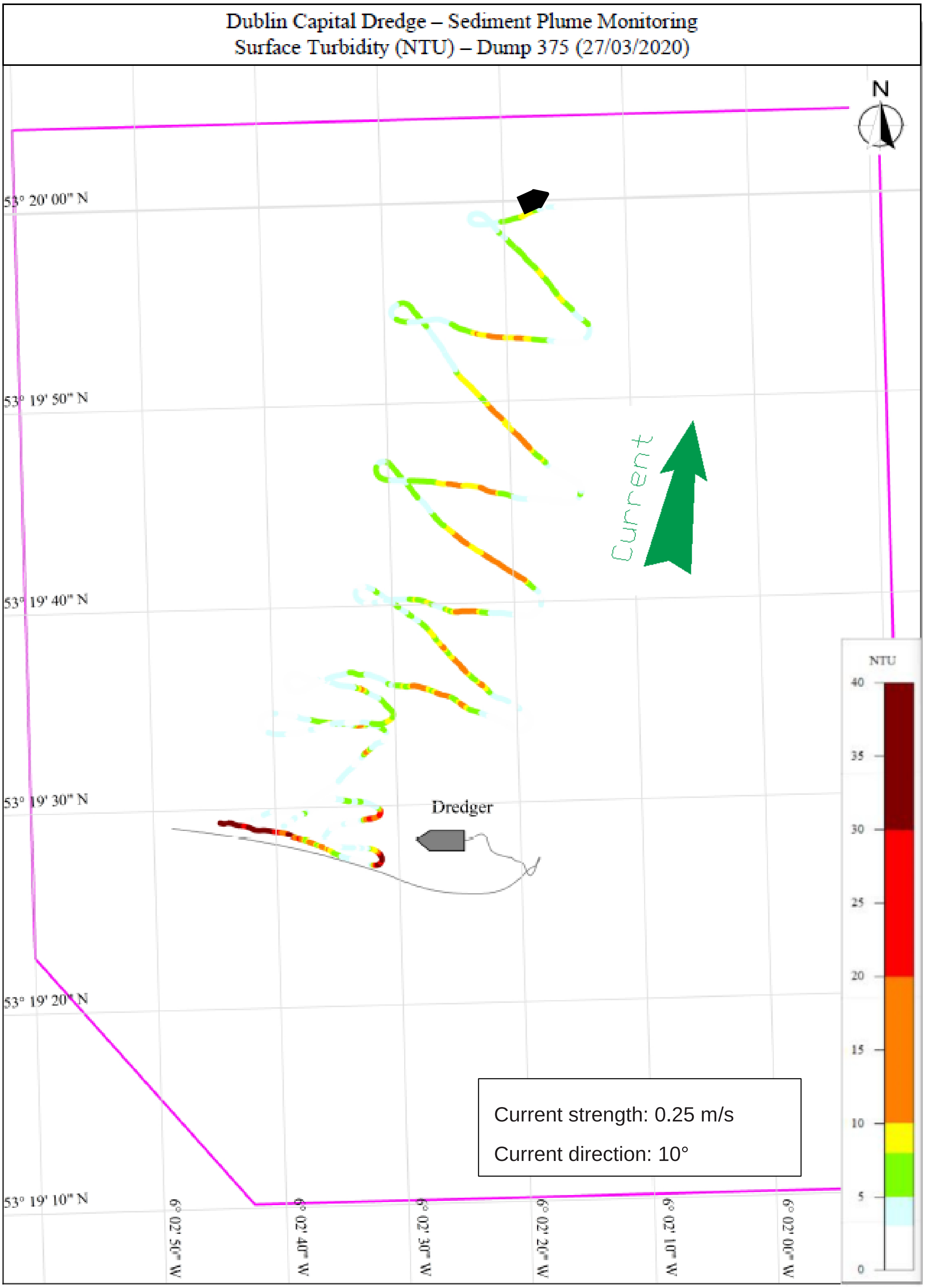


Figure 8.30: Dump 375 Survey track with surface turbidity [NTU]

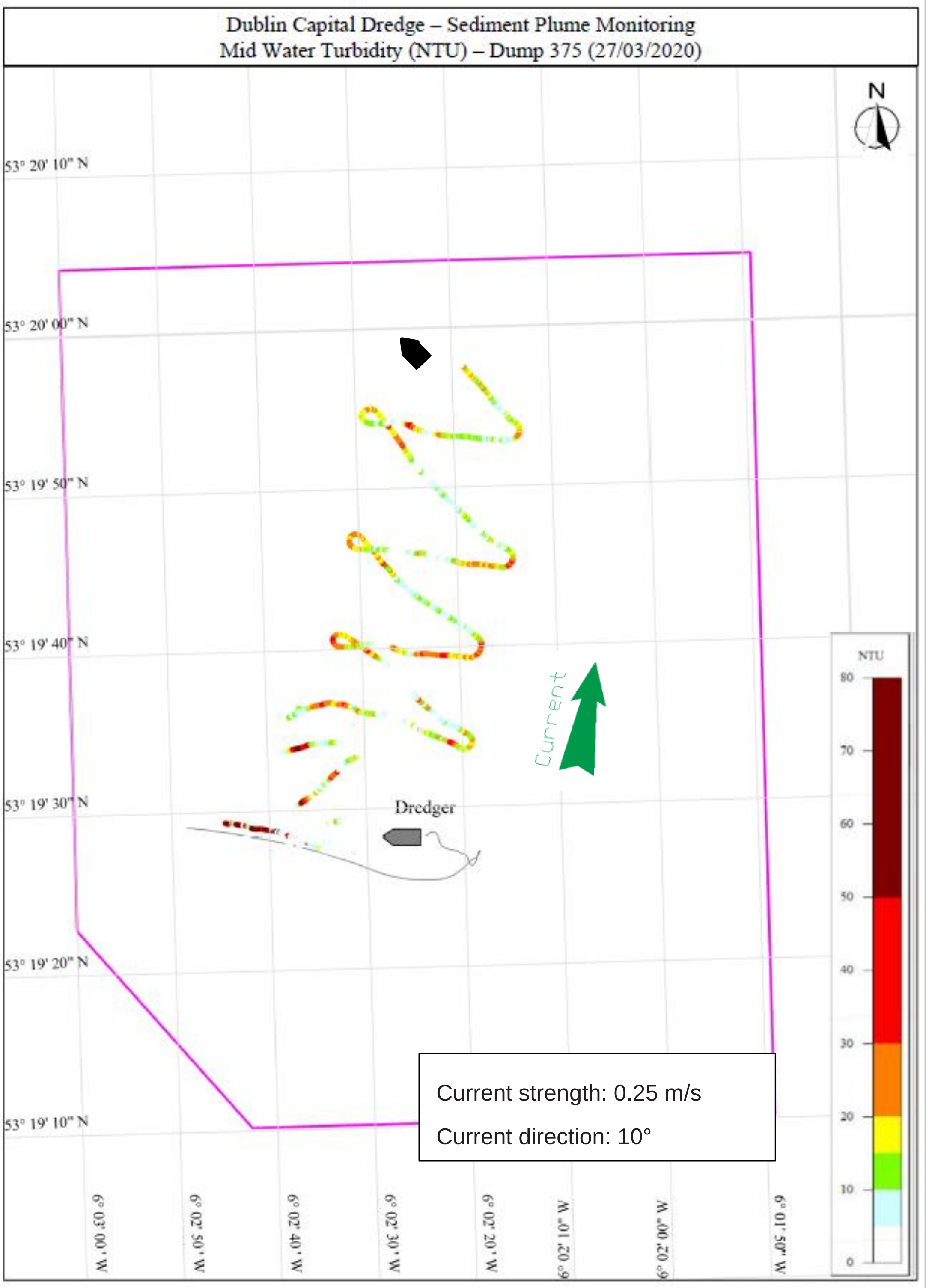


Figure 8.31: Dump 375 Survey track with mid water turbidity [NTU]

A.2 Comparison of Simulated and Recorded Data

In order to supplement the results presented in Section 6.1 and further validate the numerical modelling programme, RPS have produced 1D validation plots for all relevant dump events.

These plots illustrate the depth averaged simulated turbidity levels and actual turbidity levels recorded at the surface and mid-point of the water column as recorded by Hydromaster. It should be noted that each data in these plots have a unique spatial coordinate (i.e. as the survey vessel traversed the dump site) but this element has been omitted so data could be easily presented in one dimensional time series plots.

Table 8.1: Index of sediment plume validation plots for dump events 231 – 375

Date	Dump #	Figure No.
14/03/2020	**231**	Figure 8.32
16/03/2020	**254**	Figure 8.33
17/03/2020	**266**	Figure 8.34
	267	Figure 8.35
	268	Figure 8.36
18/03/2020	**280**	Figure 8.37
	281	Figure 8.38
	282	Figure 8.39
	283	Figure 8.40
27/03/2020	**373**	Figure 8.41
	374	Figure 8.42
	375	Figure 8.43

As demonstrated in Figure 8.32 to Figure 8.43, the computational models accurately simulate the temporal and spatial dispersion of sediment plumes during the dumping activities to a very high degree of accuracy.

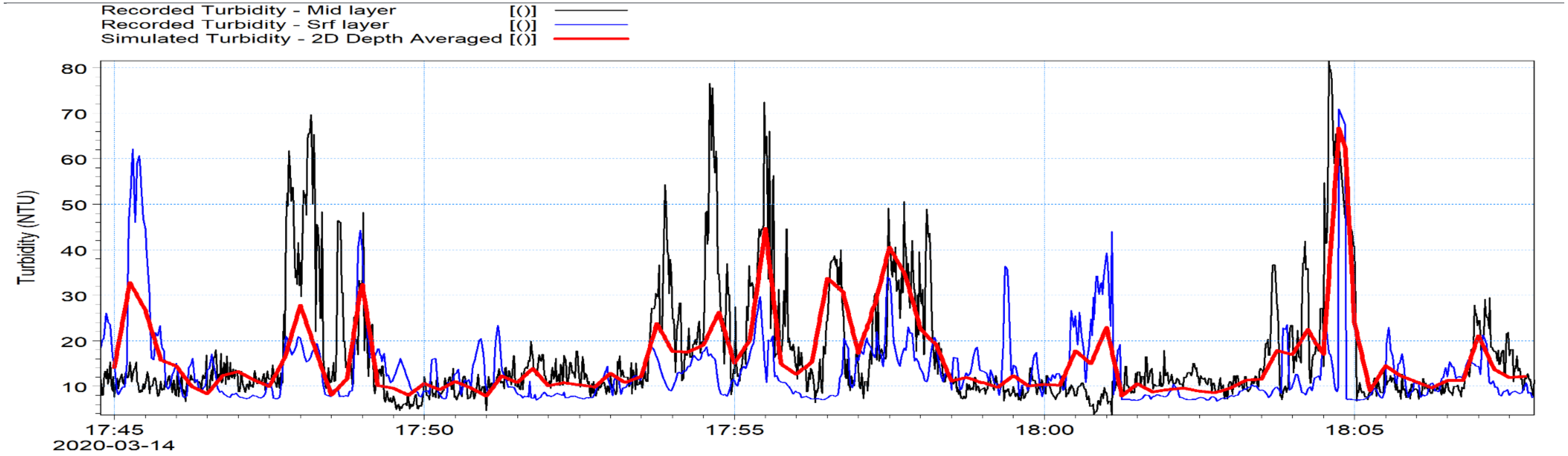


Figure 8.32: Comparison of recorded and simulated turbidity measurements across the dump site during Event 231

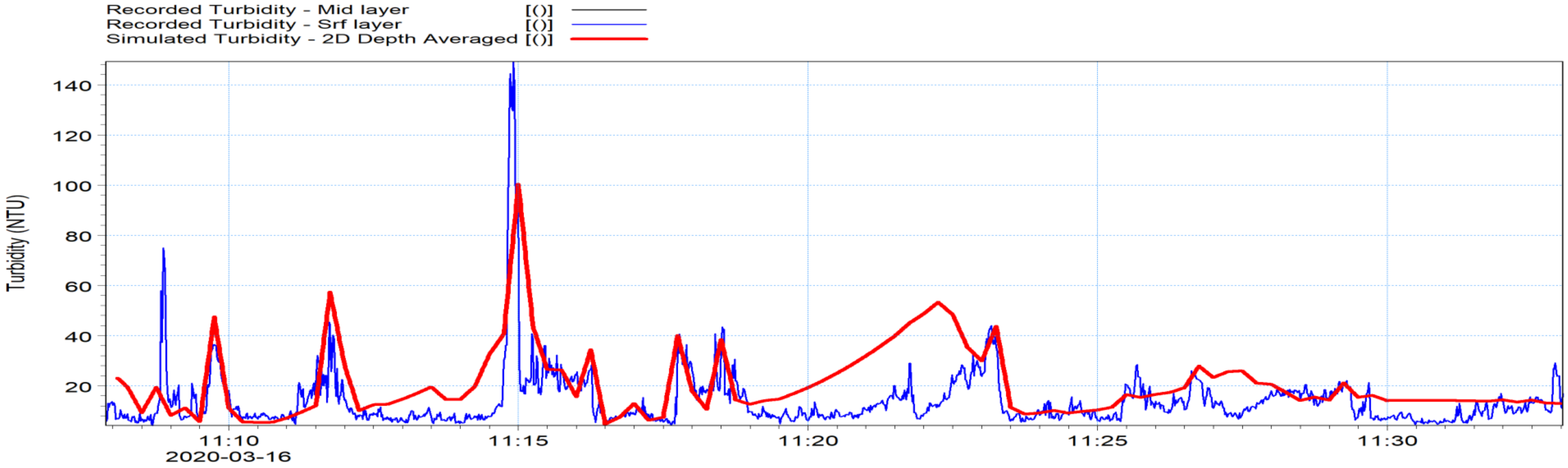


Figure 8.33: Comparison of recorded and simulated turbidity measurements across the dump site during Event 254

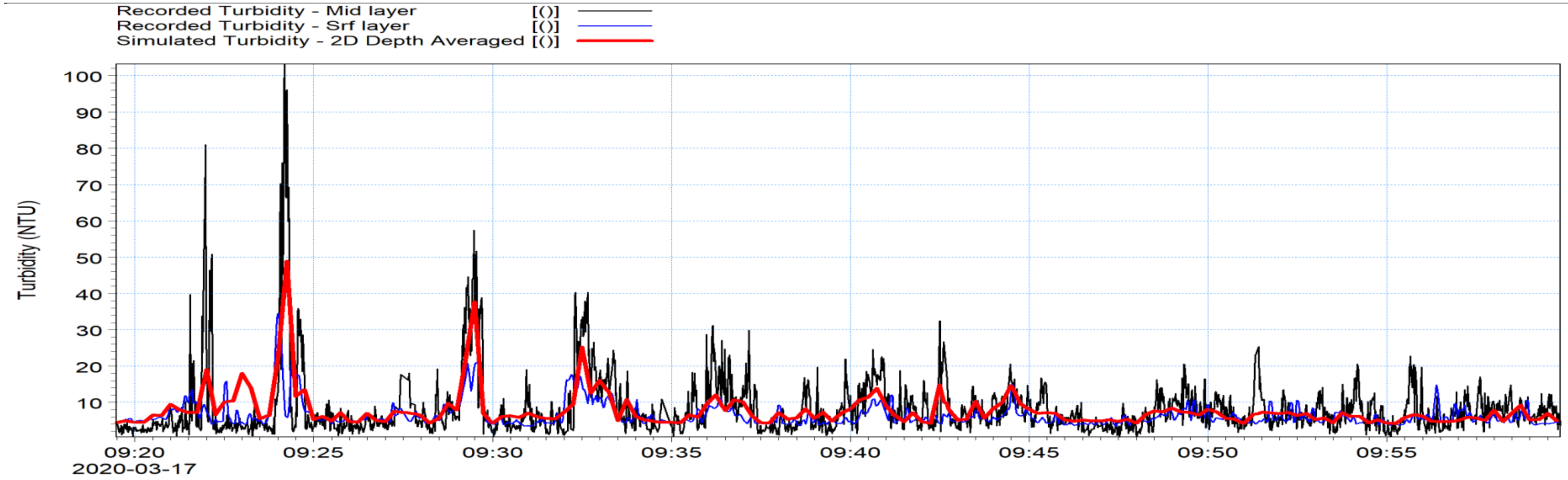


Figure 8.34: Comparison of recorded and simulated turbidity measurements across the dump site during Event 266

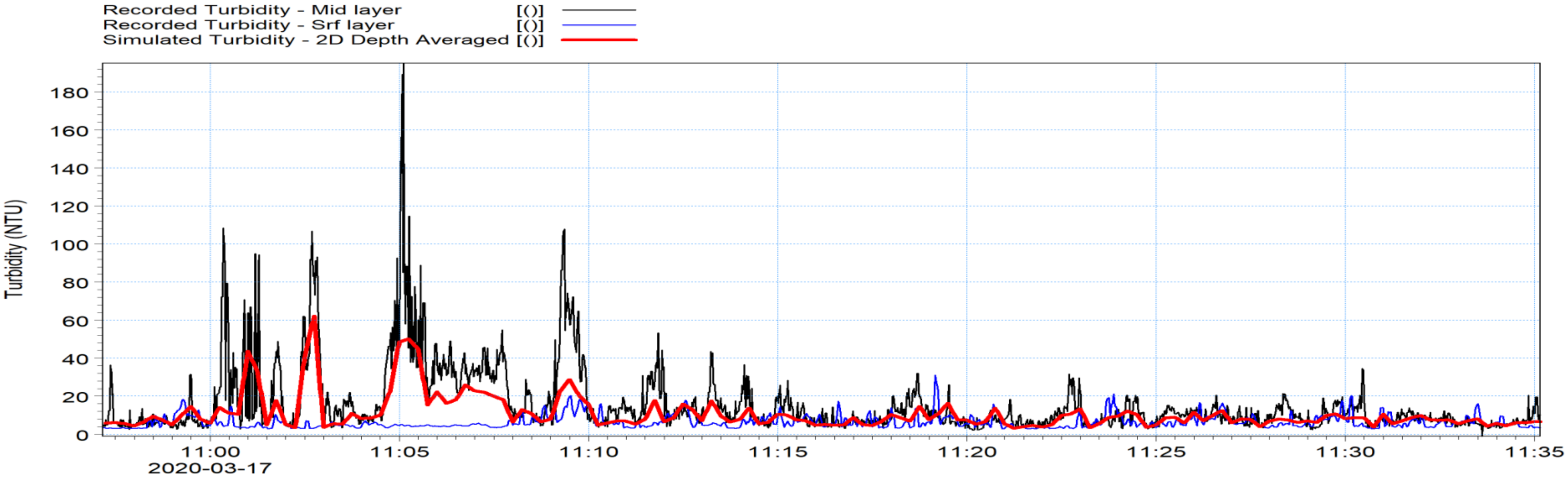


Figure 8.35: Comparison of recorded and simulated turbidity measurements across the dump site during Event 267

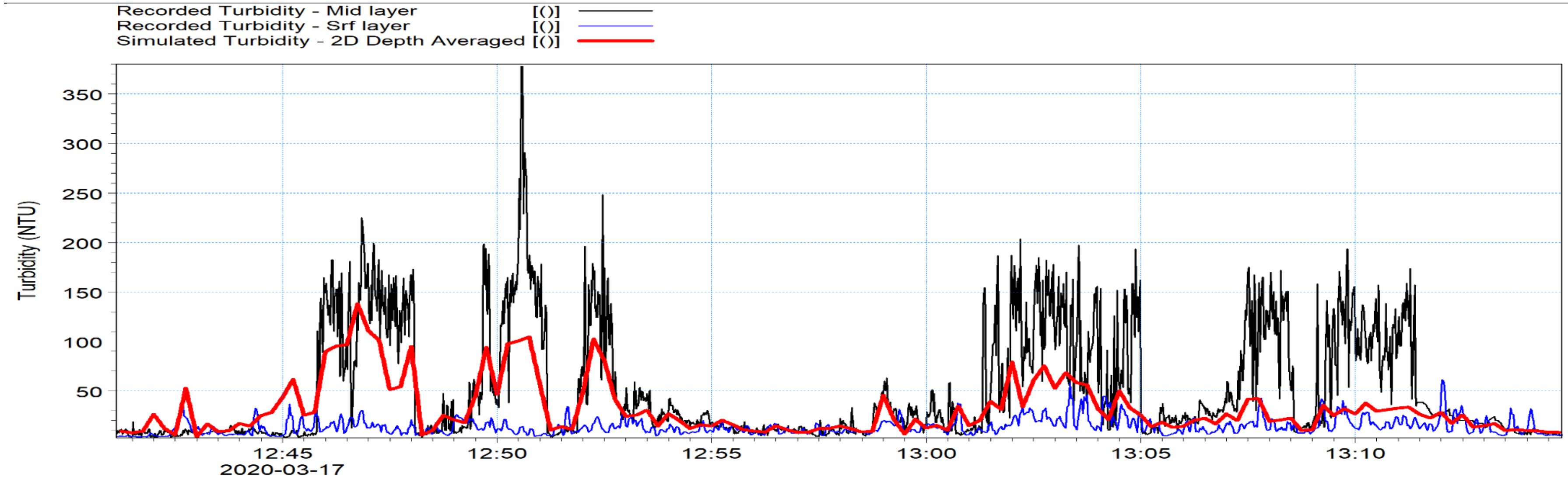


Figure 8.36: Comparison of recorded and simulated turbidity measurements across the dump site during Event 268

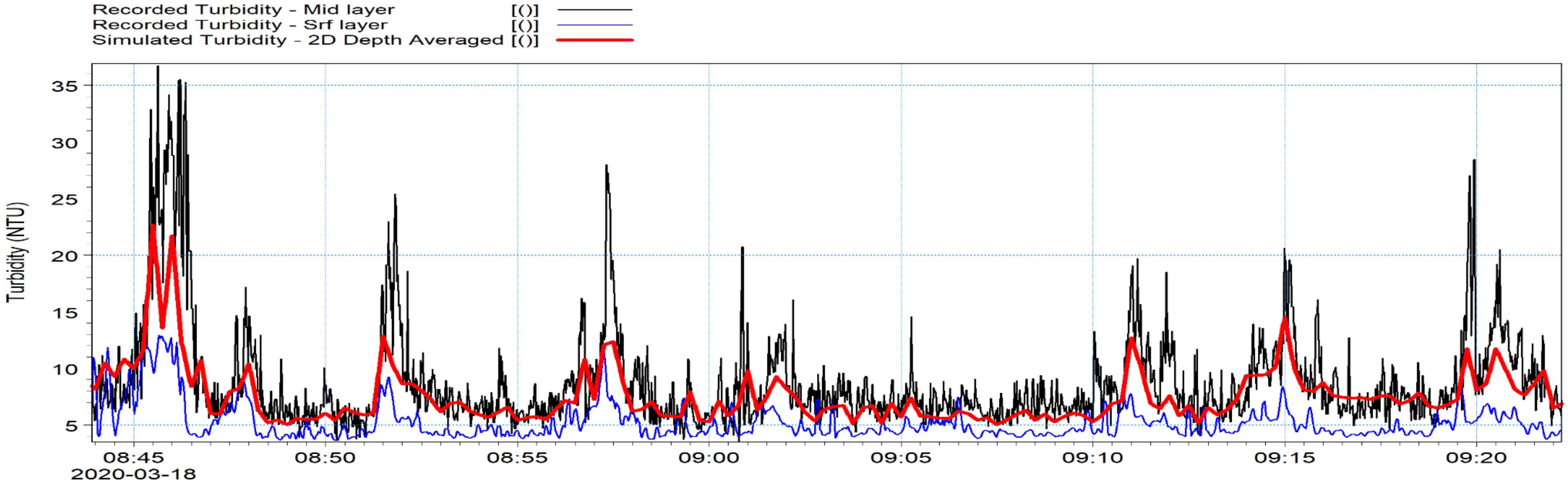


Figure 8.37: Comparison of recorded and simulated turbidity measurements across the dump site during Event 280

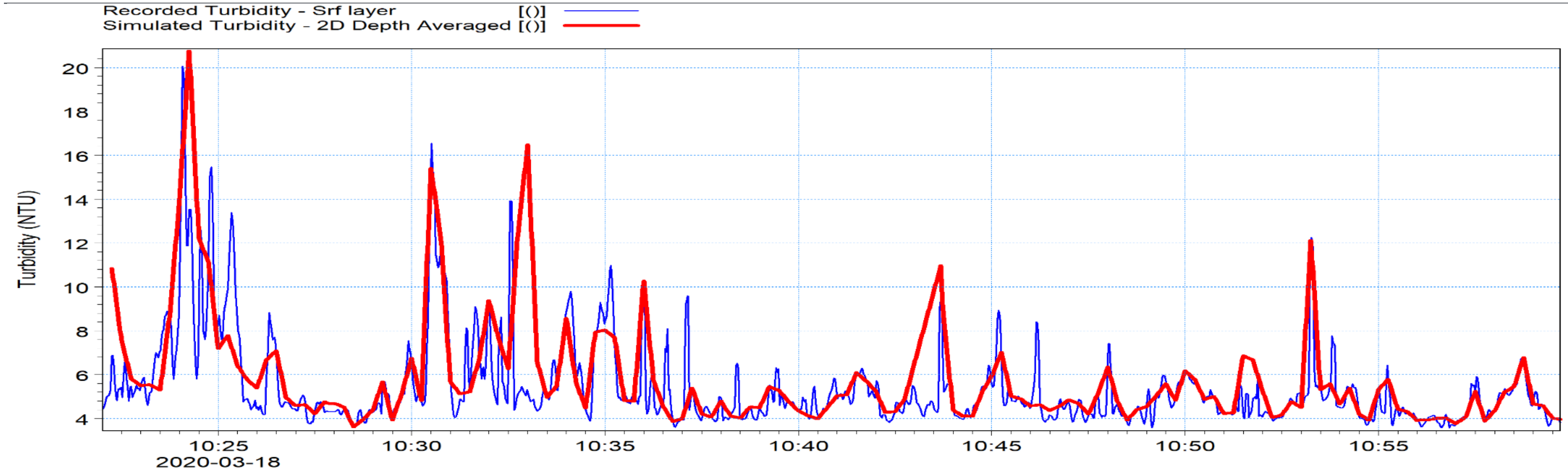


Figure 8.38: Comparison of recorded and simulated turbidity measurements across the dump site during Event 281

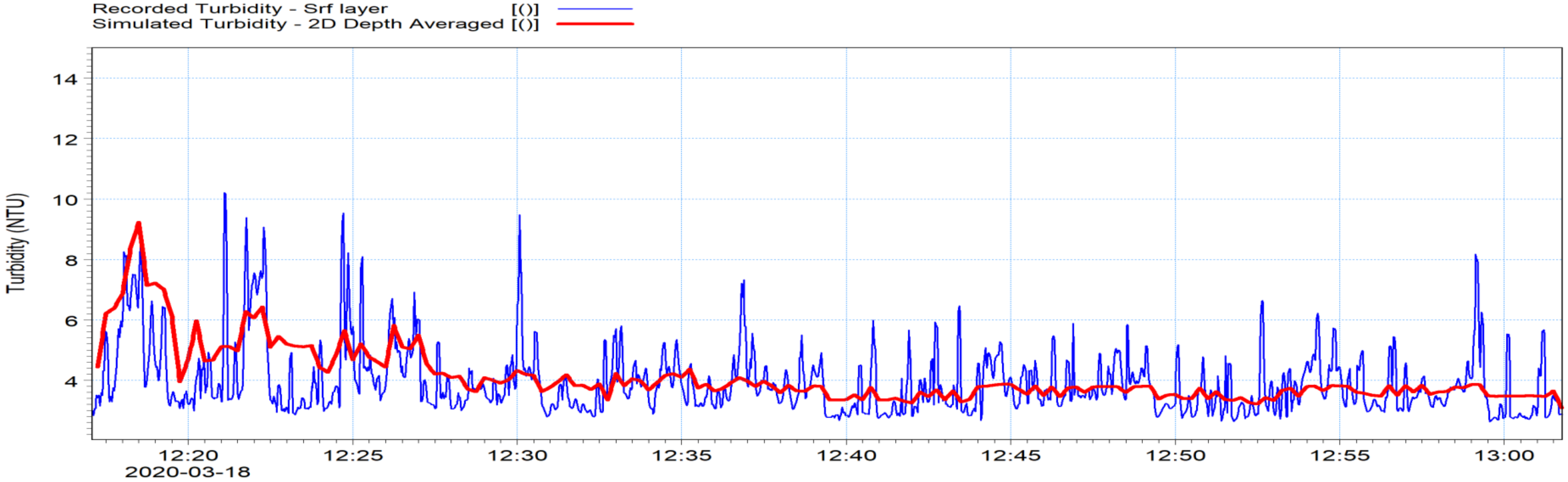


Figure 8.39: Comparison of recorded and simulated turbidity measurements across the dump site during Event 282

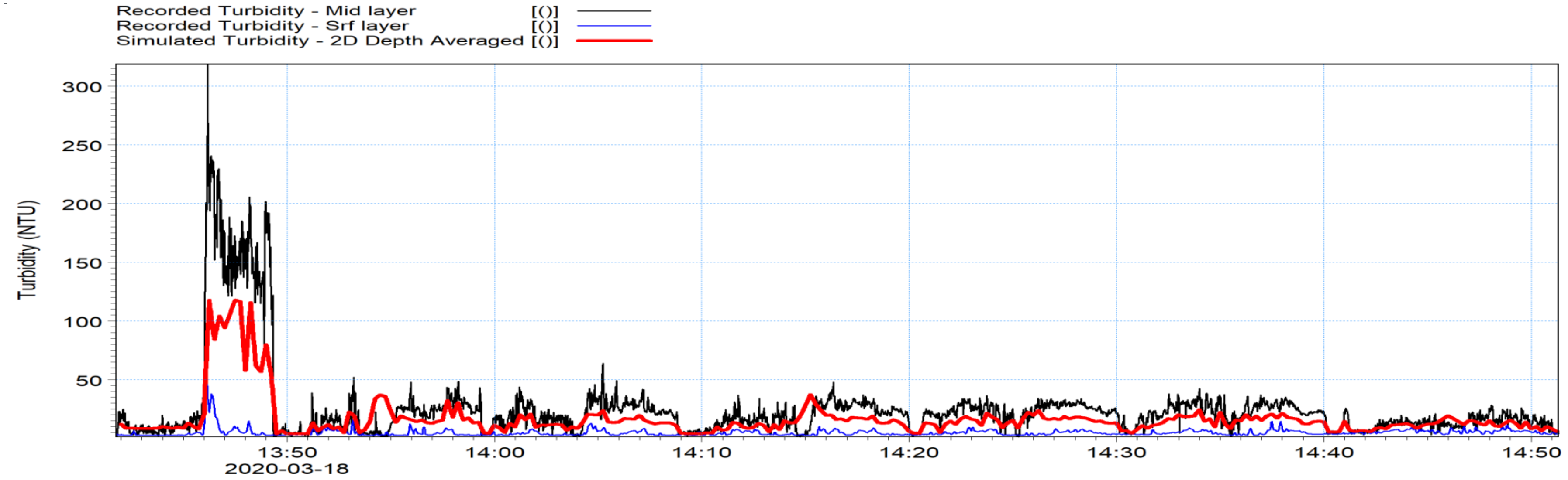


Figure 8.40: Comparison of recorded and simulated turbidity measurements across the dump site during Event 283

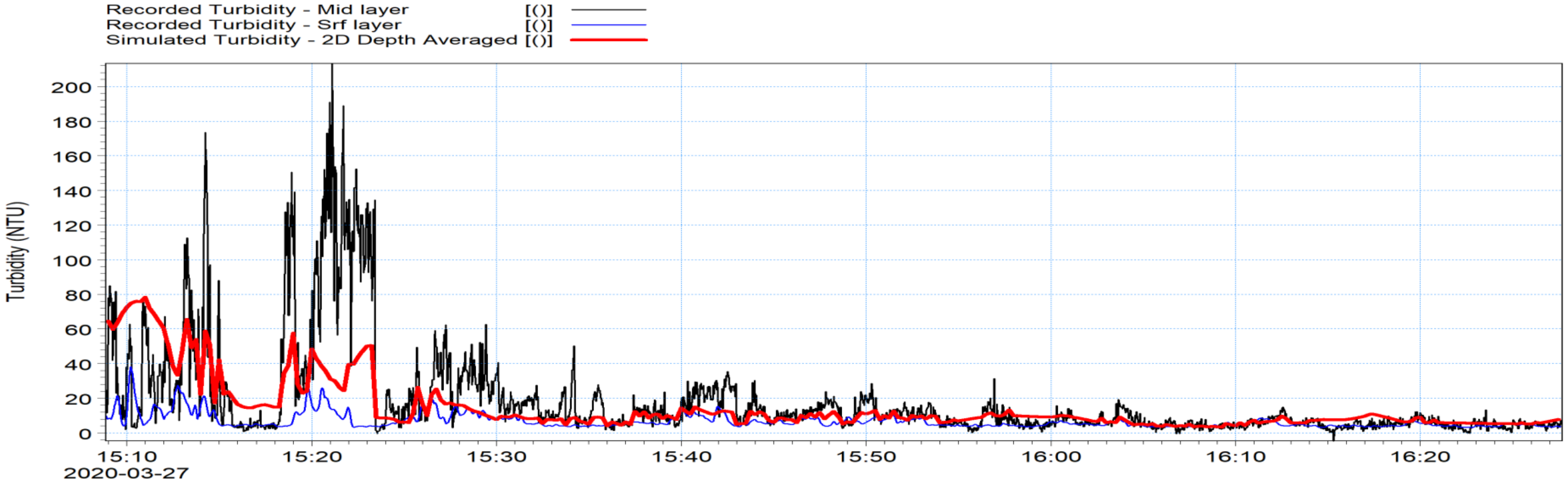


Figure 8.41: Comparison of recorded and simulated turbidity measurements across the dump site during Event 373

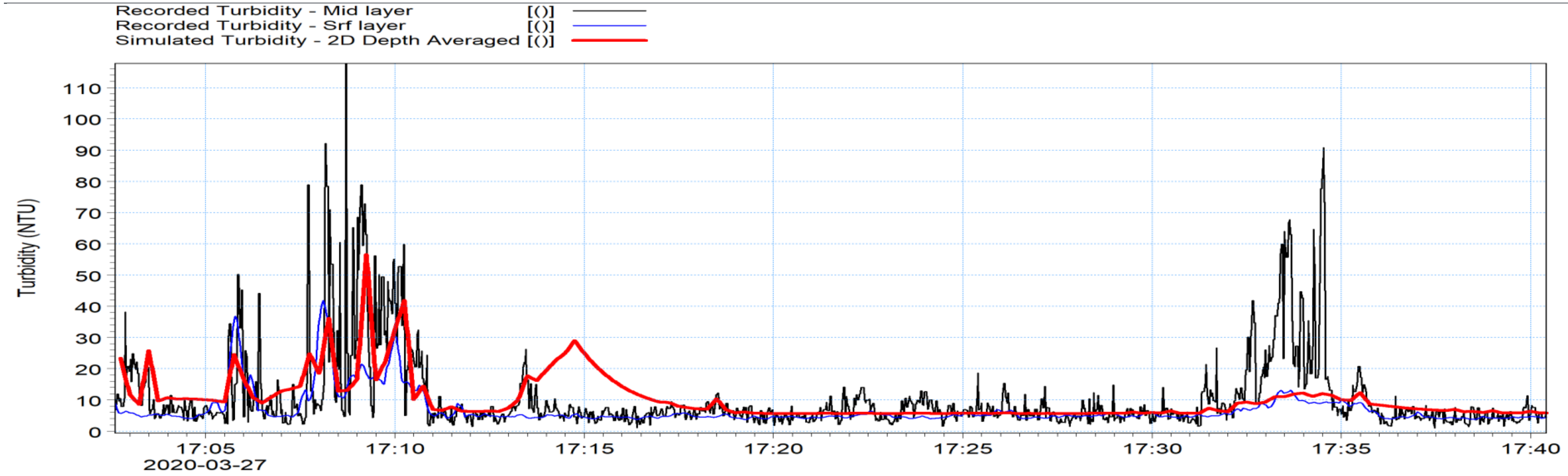


Figure 8.42: Comparison of recorded and simulated turbidity measurements across the dump site during Event 374

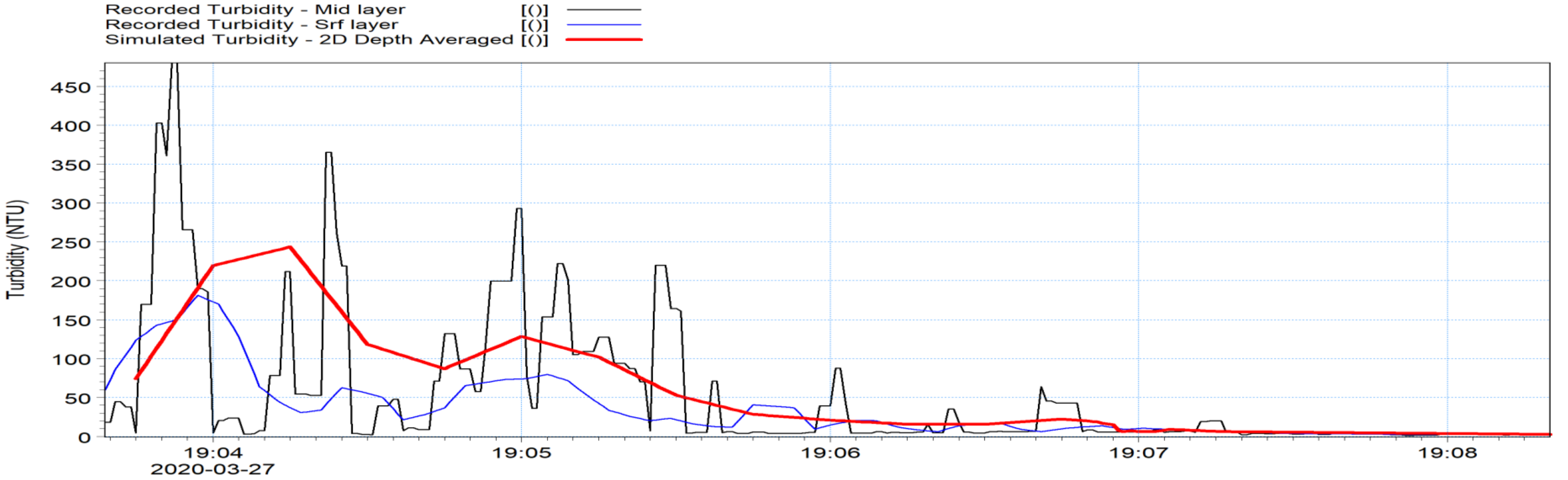


Figure 8.43: Comparison of recorded and simulated turbidity measurements across the dump site during Event 375

Appendix B: Subsea Noise Assessment

12.2 Underwater Noise

12.2.1 Introduction

This section provides an overview of the potential underwater noise impacts arising during the construction and operation phases of the 3FM Project on the surrounding marine environment. A detailed Project Description of the 3FM Project is presented in Chapter 5 of this EIAR. The assessment has been informed by focussed underwater noise surveys undertaken during the construction phase of the ABR Project. The key underwater noise impacts are generated from piling and dredging. The results from this Section have been used to inform the assessment of potential impact of underwater noise on marine life (Chapter 7, Biodiversity, Flora and Fauna).

12.2.2 Methodology

12.2.2.1 Fundamentals of Underwater Noise

Sound may be defined as the periodic disturbance in pressure from some equilibrium value and is measured as sound pressure. The unit of pressure is given in Pascals (Pa) or Newton per square metre (N/m^2). In order to avoid dealing with a very large range of numbers, e.g. from 0.00002 Pascals to 20,000 Pascals the logarithmic decibel scale is used. This simplifies the same range of numbers, by setting up a logarithmic scale based on a reference pressure.

For historical and scientific reasons, the reference pressure chosen for airborne noise is not the same as that chosen for underwater noise. The reference pressure for underwater noise is 1 µPa so underwater noise levels are referred to as dB re 1 µPa. The acoustic impedance of water is also greater than that of air. This means that there is no direct relationship between decibels in air and decibels in water.

decibels in air ≠ decibels in water

Underwater sound sources are treated somewhat differently to sound sources in air. Peak source levels for underwater noise sources are quoted in dB re 1 µPa at 1 metre. This is a ‘notional’ figure extrapolated from far field measurements as it is not practicable to measure sound levels directly at 1m from an active source such as a ship or a large marine pile. Measurements are taken in what is known as the far field and extrapolated back to a notional 1m from an idealised point source. It is usual to take measurements at several hundred metres or kilometres in deep water and extrapolate the measured levels to what has become known as a 1m source level. The actual sound pressure area in the near (Fresnel) field produces an undulating curve, but the extrapolated dashed line indicates a much higher notional source level (Figure 12.2.1).

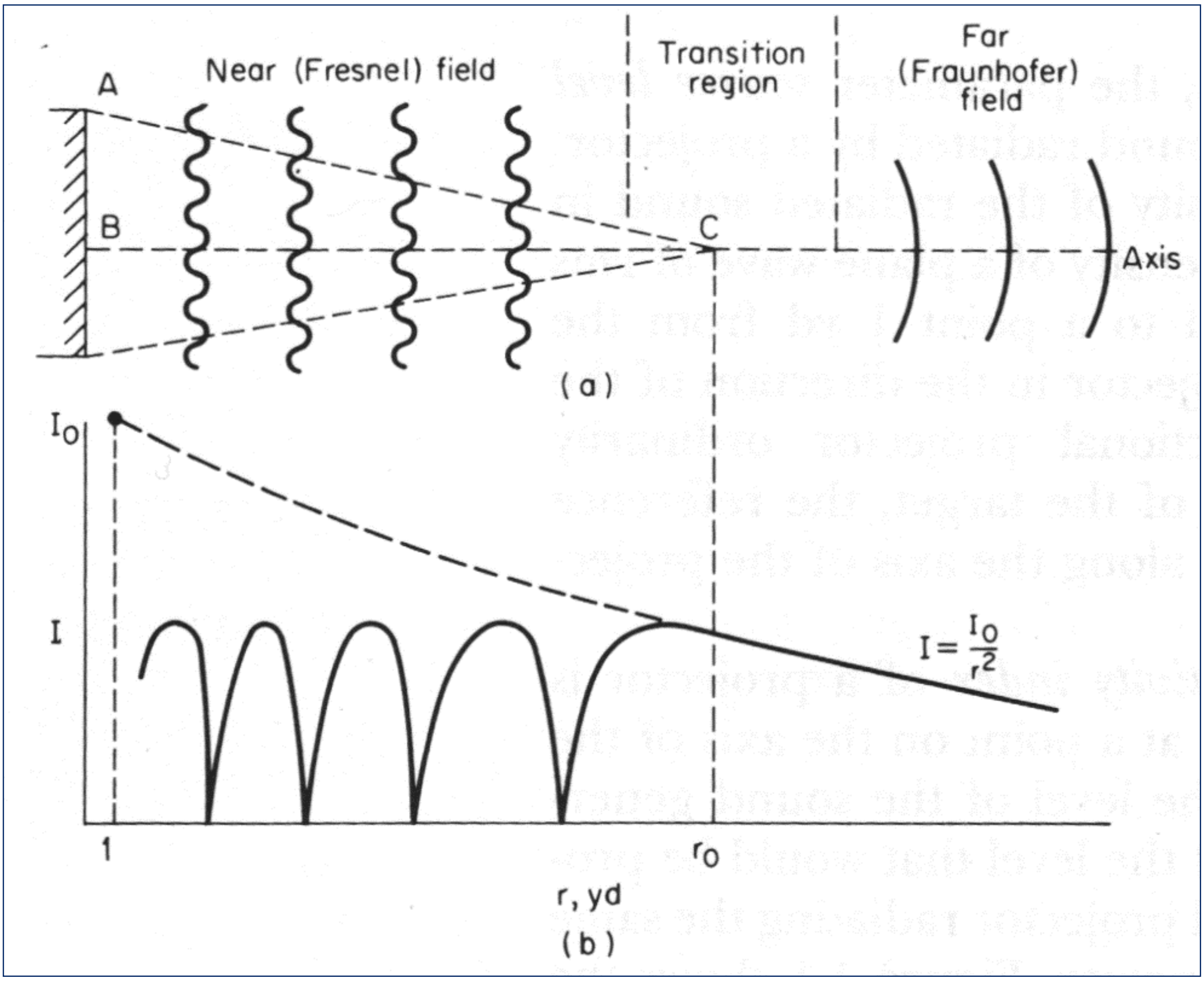


Figure 12.2.1 Underwater Noise Source Level Fields (Urich 1983, Fig. 4)

A table of typical underwater noise levels is set out below in Table 12.2.1.

Table 12.2.1 Typical Underwater Noise Levels - from Richardson et al. (1995)

Source	**SPL** **dB re: 1µPa @ 1m**	**Peak Frequency** **Hertz**	**Bandwidth** **Hertz**
Super Tanker - 337m long @ 18 knots	185	20-30	5-100
Dredging (Suction/Hopper dredge)	177	80-200	20-8,000
Tug vessel (while towing)	145-170	1,000	37-5,000
Fishing vessel (@ 7 knots)	151	250-1,000	250-1,000

This extrapolation leads to apparently high values for the source level and can lead to erroneous conclusions about the impact on marine mammals and fish for the following reasons:

- Far field source levels do not apply in the near field of the array where the sources do not add coherently; sound levels in the near field are, in fact, lower than would be expected from far field estimates.

- Source level calculations are generally based on theoretical point sources with sound propagating equally in all directions. This is not easily replicated in real world conditions.
- The majority of published data for underwater sources is based on deep water measurements. Sound propagation in shallow water is significantly more complex and, sound does not propagate as efficiently as it would in deep water.

Acoustic Metrics

This report utilises the standards and definitions set out by "ISO 18405:2017 Underwater Acoustics – Terminology". All times are reported as Coordinated Universal Time.

Peak Sound Pressure Level (L_P)

The peak sound pressure level is the level based on the maximum absolute instantaneous deviation from ambient pressure recorded over a given time interval.

$$L_P = 10 \cdot Log_{10}\left(\frac{Pa^2}{1 \cdot 10^{-12} Pa}\right)$$

Sound Exposure Level (SEL)

The Sound Exposure Level (SEL) is the time integral of the square pressure over a given time period. SEL values for short events are calculated for the duration of that event, e.g. $\text{SEL}_{\text{single impulse}}$.

$$SEL = 10 \cdot Log_{10}\left(\frac{\int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$$

For continuous sounds the SEL can be simply calculated from the SPL:

$$SEL = SPL + 10 \cdot Log_{10}(t_2 - t_1)$$

Cumulative Sound Exposure Level (SEL_{cum})

The Sound Exposure Level (SEL) is the time integral of the square pressure over a given time period. SEL_{cum} values are calculated over longer duration and can often be calculated simply by adjusting the SEL for a single event by the total number of events.

$$SEL_{cum} = SEL_{single\ event} + 10\log_{10}(\text{number of events})$$

In this way we might also calculate a "typical" SEL, by using the SEL from a longer exposure to calculate and equivalent single exposure leading to the same cumulative exposure:

$$SEL_{typical} = SEL_{cum\ over\ n\ events} - 10\log_{10}(\text{n})$$

Sound pressure Level (SPL or RMS level)

SPL is the root mean square of the amplitude of a continuous pressure signal in a specified frequency band, for a specified averaging time. SPL is thus equal to the L_{eq} over the same period.

$$SPL = 10 \cdot Log_{10}\left(\frac{\frac{1}{t_2 - t_1} \cdot \int_{t_1}^{t_2} p(t)^2 dt}{1 \cdot 10^{-12} Pa}\right)$$

This is functionally equivalent to the deprecated:

$$SPL = 20 \cdot Log_{10}\left(\frac{RMS}{1 \cdot 10^{-6}Pa}\right)$$

Hearing Sensitivity

The frequency, or pitch, of the sound is the rate at which pressure oscillations occur and is measured in Hertz (Hz). When sound is measured in a way which approximates to how a human would perceive it using an A-weighting filter on a sound level meter, the resulting level is described in values of dBA. However, the hearing faculties of marine mammals and fish are not the same as humans, with marine mammals hearing over a wider range of frequencies, fish over a typically smaller range of frequencies and both with different sensitivities. It is therefore important to understand how an animal's hearing varies over the entire frequency range in order to assess the effects of sound on marine life.

Consequently, use can be made of frequency weighting scales to determine the level of the sound in comparison with the auditory response of the animal concerned. A comparison between the typical hearing response curves for fish, humans and marine mammals is shown in Figure 12.2.2. It is worth noting that hearing thresholds are sometimes shown as audiograms with sound level on the y axis rather than sensitivity, resulting in the graph shape being the inverse of the graph shown. It is also worth noting that some fish are sensitive to particle velocity rather than pressure, although paucity of data relating to particle velocity levels for anthropogenic noise sources means that it is often not possible to quantify this effect.

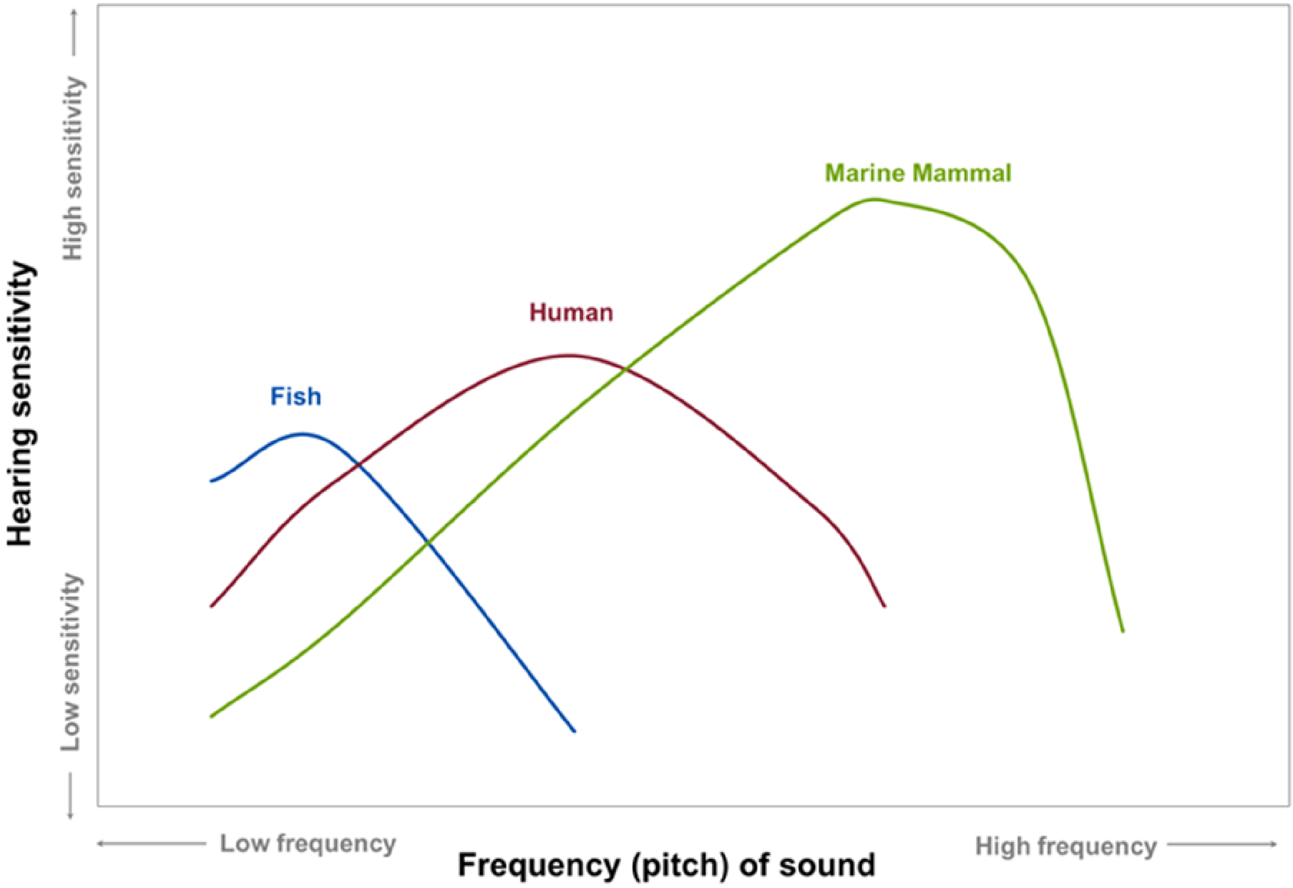


Figure 12.2.2 Comparison between hearing thresholds of different marine animals and humans.

Underwater Sound Propagation

Increasing the distance from the noise source usually results in the level of noise getting lower, due primarily to the spreading of the sound energy with distance, analogous to the way in which the ripples in a pond spread after a stone has been thrown in.

The way that the noise spreads will depend upon several factors such as water column depth, pressure, temperature gradients, salinity, as well as water surface and seabed conditions. Thus, even for a given locality, there are temporal variations to the way that sound will propagate. However, in simple terms, the sound energy may spread out in a spherical pattern (close to the source) or a cylindrical pattern (much further from the source), although other factors mean that decay in sound energy may be somewhere between these two simplistic cases.

In acoustically shallow waters in particular, the propagation mechanism is coloured by multiple interactions with the seabed and the water surface (Lurton, 2002; Etter, 2013; Urick, 1983; Brekhovskikh and Lysanov 2003, Kinsler et al., 1999). Whereas in deeper waters, the sound will propagate further without encountering the surface or bottom of the sea, in shallower waters the sound may be reflected from either or both boundaries (potentially more than once).

At the sea surface, the majority of sound is reflected back into the water due to the difference in acoustic impedance (i.e. sound speed and density) between air and water. However, scattering of sound at the surface of the sea is an important factor with respect to the propagation of sound from a source. In an ideal case (i.e. for a perfectly smooth sea surface), the majority of sound wave energy will be reflected back into the sea (but with the phase reversed, due to the pressure-release nature of the surface). However, for rough waters, much of the sound energy is scattered (Eckart, 1953; Fortuin, 1970; Marsh, Schulkin, and Kneale, 1961; Urick and Hoover, 1956). Scattering can also occur due to bubbles near the surface such as those generated by wind or fish or due to suspended solids in the water such as particulates and marine life. Scattering is more pronounced for higher frequencies than for low frequencies and is dependent on the sea state (i.e. wave height). However, the various factors affecting this mechanism are complex.

Because surface scattering results in differences in reflected sound, its effect will be more important at longer ranges from the source sound and in acoustically shallow water (i.e. where there are multiple reflections between the source and receiver). The degree of scattering will depend upon the water surface smoothness/wind speed, water depth, frequency of the sound, temperature gradient, grazing angle and range from source. Depending upon variations in the aforementioned factors, significant scattering could occur at sea state 3 or more for higher frequencies (e.g. 15 kHz or more). It should be noted that variations in propagation due to scattering will vary temporally (primarily due to different sea-states/wind speeds at different times) and that more sheltered areas (which are more likely to experience calmer waters) could experience surface scattering to a lesser extent, and less frequently, than less sheltered areas which are likely to encounter rougher waters. However, over shorter ranges (e.g. a few hundred meters or less) the sound will experience fewer reflections and so the effect of scattering should not be significant. Consequently, taking into account the sheltered location of Dublin Port and likely distances over which injury will occur, this effect is unlikely to significantly affect the injury ranges presented in this report, although it is possible that disturbance ranges could vary depending on local and seasonal conditions.

When sound waves encounter the seabed, the amount of sound reflected will depend on the geo-acoustic properties of the seabed (e.g. grain size, porosity, density, sound speed, absorption coefficient and roughness) as well as the grazing angle and frequency of the sound (Cole, 1965; Hamilton, 1970; Mackenzie, 1960; McKinney and Anderson, 1964; Etter, 2013; Lurton, 2002; Urick, 1983). Thus, seabed comprising primarily of mud or other acoustically soft sediment will reflect less sound than acoustically harder seabed such as rock or sand. Propagation will also depend on the profile of the seabed (e.g. the depth of the sediment layer and how the geo-acoustic properties vary with depth below the sea floor). The effect is less pronounced at low frequencies (a few kilohertz and below) and so might not be a significant factor to take into account with respect to piling noise (where most of the acoustic energy is at frequencies of a few hundred hertz). A scattering effect (similar to that which occurs at the surface) also occurs at the seabed (Essen, 1994; Greaves and Stephen, 2003; McKinney and Anderson, 1964; Kuo, 1992), particularly on rough substrates (e.g. pebbles).

Another phenomenon is the waveguide effect which means that shallow water columns do not allow the propagation of low frequency sound (Urick, 1983; Etter, 2013). The cut-off frequency of the lowest mode in a channel can be calculated based on the water depth and knowledge of the sediment geo-acoustic properties. Any sound below this frequency will not propagate far due to energy losses through multiple reflections. The cut-off frequency as a function of water depth is shown in Figure 12.2.3 for medium silt. Thus, for a water depth of 7-10 m CD (i.e. the dredged depth range in Dublin Port's navigation channel) the cut-off frequency would be approximately 182-260 Hz.

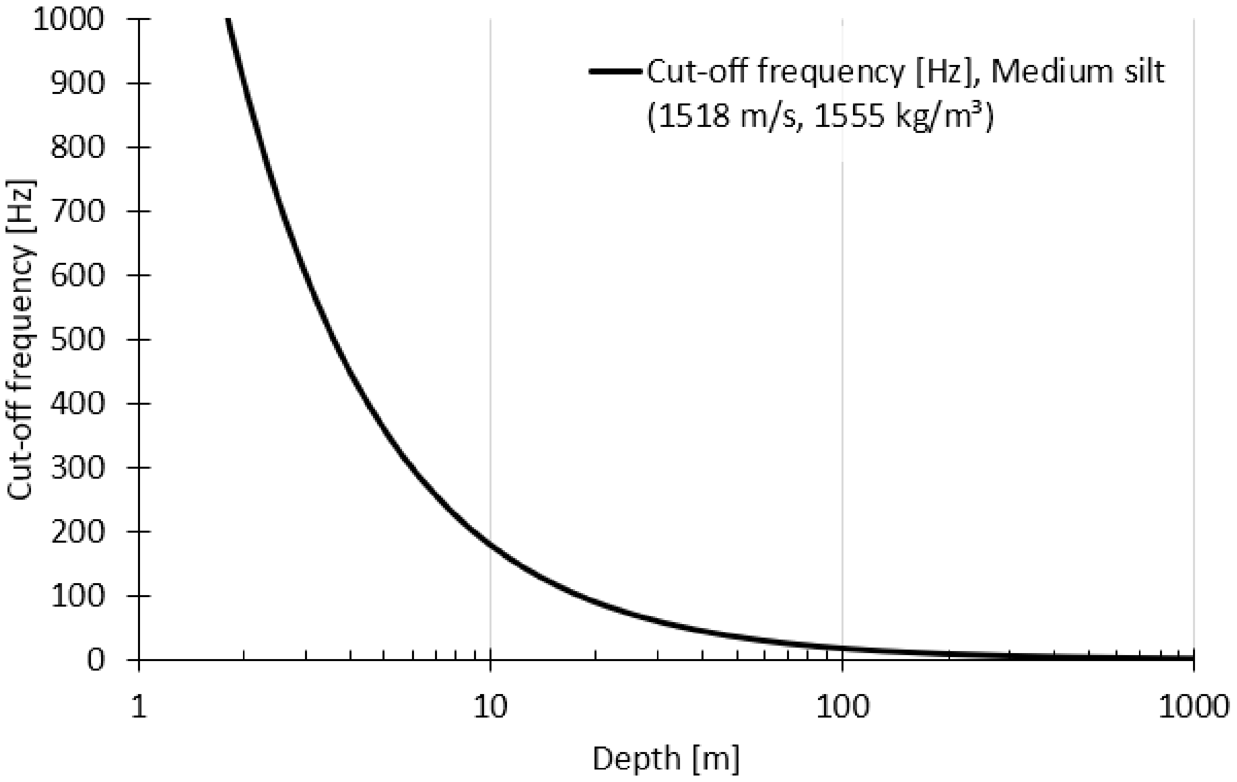


Figure 12.2.3 Shallow water cut-off frequency in "Medium silt" sediments

Activities giving rise to underwater noise

As outlined above the activities giving rise to underwater noise levels during the construction phase are piling and dredging. During the operational phase underwater noise will arise from vessel traffic and annual maintenance dredging.

The piling activity required to strengthen the quay walls at the proposed Ro-Ro Terminal (Area K) and the Maritime Village will have a similar underwater noise profile to that carried out previously under the ABR Project, i.e. the construction of a combi-wall using vibro-piling, impact piling and sheet piling.

The open-piled wharf proposed to form the Lo-Lo Terminal (Area N) requires tubular piles, similar to the king piles used for the ABR Project.

Smaller diameter piles will be required at the finger berth marina, while two larger diameter locating piles will be required to secure the proposed ramp at the Ro-Ro Terminal (Area K).

Further piling is required to support the SPAR Bridge and the suspended deck linking the bridge to the site of Poolbeg Marina.

A combi-wall of tubular king piles and sheet piles will be installed around the south end of the turning circle.

At the tern colony platform with smaller tubular piles will be installed.

A schedule of the pile sizes is provided in Table 12.2.6.

Two types of dredging activity are proposed, Backhoe Dredging and Trailing Suction Hopper Dredging (TSHD). The process has a similar underwater noise profile to work carried out previously at Dublin Port.

12.2.2.2 Assessment Criteria

Noise Sources

In order to determine the potential spatial range of injury and disturbance, assessment criteria have been developed based on a review of available evidence including national and international guidance and scientific literature. The following sections summarise the relevant criteria and describe the evidence base used to derive them.

Underwater noise has the potential to affect marine life in different ways depending on its noise level and characteristics. Assessment criteria generally separate sound into two distinct types, as follows:

- Impulsive sounds which are typically transient, brief (less than one second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay (ANSI 1986; NIOSH 1998; ANSI 2005). This category includes sound sources such as seismic surveys, impact piling and underwater explosions; and
- Non-impulsive (continuous) sounds which can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent and typically do not have a high peak sound pressure with rapid rise/decay time that impulsive sounds do (ANSI 1995; NIOSH 1998). This category includes sound sources such as continuous vibro-piling, running machinery, sonar and vessels.

The acoustic assessment criteria for marine mammals and fish in this report has followed the latest international guidance (based on the best available scientific information), that are widely accepted for assessments in the UK, Europe and worldwide.

Injury and Disturbance to Marine mammals

Richardson et al. (Richardson and Thomson 1995) defined four zones of noise influence which vary with distance from the source and level as follows:

- Injury/hearing loss;
- Responsiveness;
- Masking; and
- Audibility.

For this study, it is the zones of injury and responsiveness (i.e., behavioural effects) that are of interest; there is insufficient evidence to properly evaluate masking.

The zone of injury in this study is classified as the distance over which a marine mammal can suffer a Permanent Threshold Shift (PTS) leading to non-reversible auditory injury. Injury thresholds are based on marine mammal hearing-weighted SELs. The hearing weighting function is designed to represent the bandwidth for each group within which acoustic exposures can have auditory effects.

The categories include:

- Low-frequency (LF) cetaceans (i.e. marine mammal species such as baleen whales with an estimated functional hearing range between 7 Hz and 35 kHz);
- Mid-frequency (MF) cetaceans (i.e. marine mammal species such as dolphins, toothed whales, beaked whales and bottlenose whales with an estimated functional hearing range between 150 Hz and 160 kHz);
- Very High-frequency (VHF) cetaceans (i.e. marine mammal species such as true porpoises, with an estimated functional hearing range between 275 Hz and 160 kHz);
- Phocid pinnipeds (PW) (i.e. true seals with an estimated functional hearing range between 50 Hz and 86 kHz); and
- Otariid pinnipeds (OW) (i.e. sea lions and fur seals with an estimated functional hearing range between 60 Hz and 39 kHz).

These weightings have therefore been used in this study and are shown in Figure 12.2.4. It should be noted that not all of the above categories of marine mammal will be present within the Study Area (as defined in Chapter 7, Section 7.4 Marine Mammals) but criteria are presented in this report for completeness.

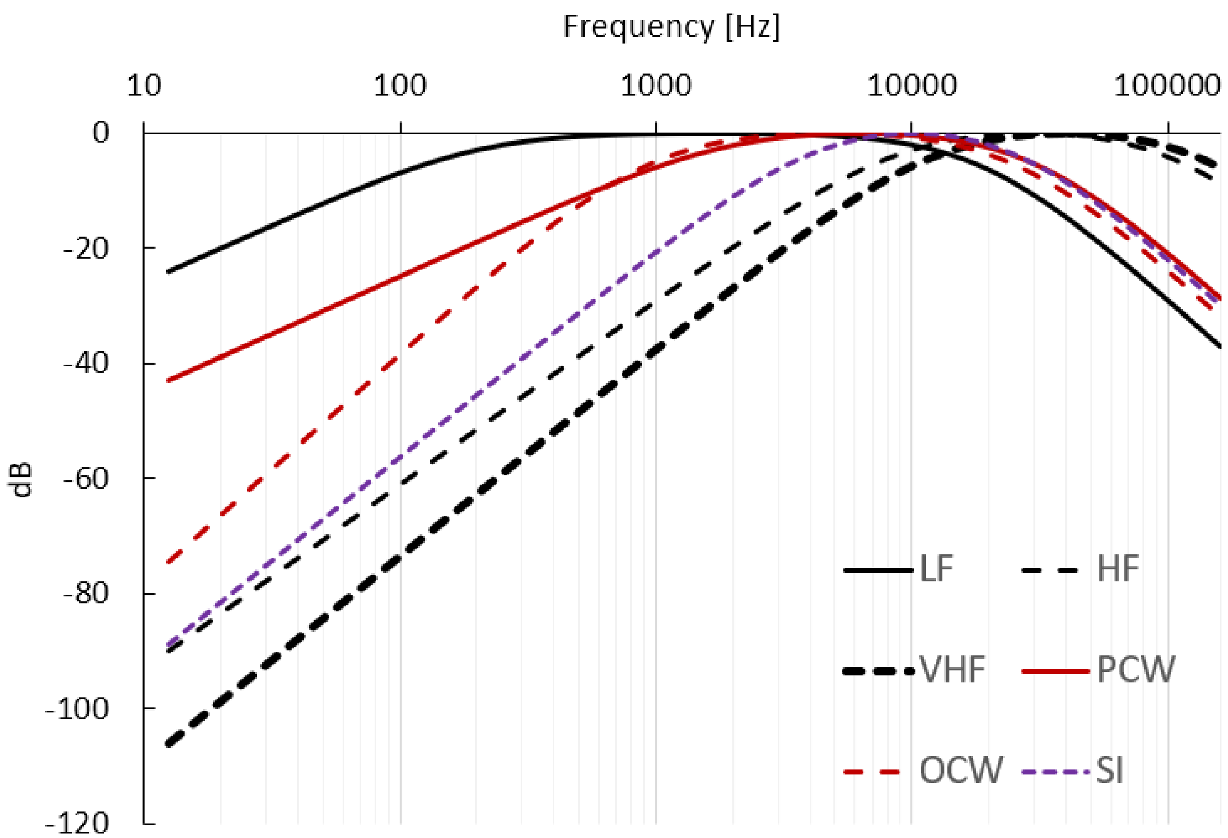


Figure 12.2.4 Marine Mammal Hearing Thresholds (from Southall et al. (2019))

The criteria for impulsive and non-impulsive sound have been adopted for this study given the nature of the sound source used during construction activities. The relevant criteria proposed by Southall *et al*. (2019) are as summarised in Table 12.2.2.

These updated marine mammal injury criteria were published in March 2019 (Southall *et al*., 2019). This paper utilised the same hearing weighting curves and thresholds as presented in the preceding regulations document NMFS (2018) (and prior to that Southall *et al.* (2007)) with the main difference being the naming of the hearing groups and introduction of additional thresholds for animals not covered by NMFS (2018).

For avoidance of doubt, the naming convention used in this report is based upon those set out in Southall *et al*. (2019). Consequently, this assessment utilises criteria which are applicable to both NMFS (2018) and Southall *et al*. (2019).

Table 12.2.2 Summary of PTS and TTS onset acoustic thresholds (Southall et al., 2019; Tables 6 and 7).

Hearing Group	Parameter	Impulsive		Non-impulsive	
		PTS	TTS	PTS	TTS
Low frequency (LF) cetaceans	Peak, dB re 1 µPa (unweighted)	219	213	-	-
	SEL, dB re 1 µPa^{2}s (LF weighted)	183	168	199	179
High frequency (HF) cetaceans	Peak, dB re 1 µPa (unweighted)	230	224	-	-
	SEL, dB re 1 µPa^{2}s (MF weighted)	185	170	198	178
Very high frequency (VHF) cetaceans	Peak, dB re 1 µPa (unweighted)	202	196	-	-
	SEL, dB re 1 µPa^{2}s (HF weighted)	155	140	173	153
Phocid carnivores in water (PCW)	Peak, dB re 1 µPa (unweighted)	218	212	-	-
	SEL, dB re 1 µPa^{2}s (PW weighted)	185	170	201	181
Other marine carnivores in water (OCW)	Peak, dB re 1 µPa (unweighted)	232	226	-	-
	SEL, dB re 1 µPa^{2}s (OW weighted)	203	188	219	199

Under current legislation in Ireland[1], it is an offence to disturb or injure a marine mammal whether this occurs via introduced sound or another anthropogenic source. The induction of temporary or permanent tissue damage and a Temporary Threshold Shift (TTS) in hearing sensitivity, which can have negative effects on the ability to use natural sounds (e.g. to communicate, navigate, locate prey) for a period of minutes, hours or days may constitute such an injury. It is therefore considered that anthropogenic sound sources with the potential to induce TTS in a receiving marine mammal contain the potential for both disturbance and poses a risk to the fecundity of the animal and thus to a part of the local population. Permanent Threshold Shift (PTS) is a permanent hearing injury and is thus a serious impact even with no prolonged or repeated exposure.

The NMFS (2018) and Southall et al. (2007 & 2019) guidelines define TTS as a 6 dB shift in the hearing threshold. Although animals are able to recover fully from TTS, particularly as they move away from a source,

---

[1] The EC Directive on the conservation of natural habitats and of wild flora and fauna (the Habitats Directive, Council Directive 92/43/EEC) transposed into national law by the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011).

hearing loss may become permanent if TTS occurs over a sustained period of time (and exceeds the PTS threshold), and if hearing does not return to pre-impact levels. Thus, the distinction between TTS and PTS depends on whether there is complete recovery of the individual's hearing or not.

This assessment considers the potential for a permanent injury to occur by considering the anthropogenic noise in relation to the energy thresholds that could lead to TTS. The impact from peak pressure (L_P) levels has also been considered, but the ranges are much smaller than for SEL (even for a single blow) and are therefore not included further in the assessment. Thus, as per the NPWS guidance (Department of Arts, heritage and the Gealtacht, 2014), this assessment considers whether there is the potential for injury to occur. Note that the NPWS guidance specifically refers to now deprecated thresholds for marine mammals (Brandon L. Southall, 2007), and that the ones used here represent an updated and more conservative assessment than would be the case using the older methodology.

The most likely response of a marine mammal to noise levels that could induce TTS is to flee from the ensonified area (Southall et al., 2007) and subsequently the onset of TTS can be referred to as the fleeing response. This is therefore a behavioural response that overlaps with disturbance ranges and animals exposed to these noise levels are likely to actively avoid hearing damage by moving away from the area.

Beyond the area in which injury may occur, the effect on marine mammal behaviour is the most important measure of impact. Significant (i.e. non-trivial) disturbance may occur when there is a risk of animals incurring sustained or chronic disruption of behaviour or when animals are displaced from an area, with subsequent redistribution being significantly different from that occurring due to natural variation.

To consider the possibility of significant disturbance resulting from the 3FM Project, it is therefore necessary to consider the likelihood that the sound could cause non-trivial disturbance, the likelihood that the sensitive receptors will be exposed to that sound and whether the number of animals exposed are likely to be significant at the population level. Assessing this is a very difficult task due to the complex and variable nature of sound propagation, the variability of documented animal responses to similar levels of sound, and the availability of population estimates, and regional density estimates for all marine mammal species.

The (NMFS, 2005) guidance sets the marine mammal level B harassment threshold for continuous noise at 120 dB re 1 µPa (rms). Considering the paucity and high-level variation of data relating to onset of behavioural effects due to continuous sound, it is recommended that any ranges predicted using this number are viewed as probabilistic and potentially over-precautionary.

Southall et al. (2007) presents a summary of observed behavioural responses due to multiple pulsed sound, although the data are primarily based on responses to seismic exploration activities (rather than for piling). Although these datasets contain much relevant data for low-frequency cetaceans, there are no strong data for mid-frequency or high-frequency cetaceans. Low frequency cetaceans, other than bow-head whales, were typically observed to respond significantly at a received level of 140 to 160 dB re 1 µPa (rms). Behavioural changes at these levels during multiple pulses may have included visible startle response, extended cessation or modification of vocal behaviour, brief cessation of reproductive behaviour or brief/minor separation of females and dependent offspring. The data available for mid-frequency cetaceans indicate that some significant response was observed at a sound pressure level of 120 to 130 dB re 1µPa (rms), although the majority of cetaceans in this category did not display behaviours of this severity until exposed to a level of 170 to 180 dB re 1µPa (rms). Furthermore, other mid-frequency cetaceans within the same study were observed to have no behavioural response even when exposed to a level of 170 to 180 dB re 1µPa (rms).

A more recent study is described in Graham et al. (2017). Empirical evidence from piling at the Beatrice offshore wind farm was used to derive a dose-response curve for harbour porpoise. The unweighted single pulse SEL contours were plotted in 5 dB increments and applied the dose-response curve to estimate the number of animals that would be disturbed by piling within each stepped contour. The study shows a 100% probability of disturbance at an (un-weighted) SEL of 180 dB re 1µPa^{2}s, 50% at 155 dB re 1µPa^{2}s and dropping to approximately 0% at an SEL of 120 dB re 1µPa^{2}s.

According to Southall et al. (2007) there is a general paucity of data relating to the effects of sound on pinnipeds in particular. One study using ringed, bearded and spotted seals (Harris et al., 2001) found onset of a significant response at a received sound pressure level of 160 to 170 dB re 1 µPa (rms), although larger numbers of animals showed no response at noise levels of up to 180 dB re 1 µPa (rms). It is only at much higher sound pressure levels in the range of 190 to 200 dB re 1 µPa (rms) that significant numbers of seals were found to exhibit a significant response. For non-pulsed sound, one study elicited a significant response on a single harbour seal at a received level of 100 to 110 dB re 1 µPa (rms), although other studies found no response or non-significant reactions occurred at much higher received levels of up to 140 dB re 1 µPa (rms). No data are available for higher noise levels and the low number of animals observed in the various studies means that it is difficult to make any firm conclusions from these studies.

Southall et al. (2007) also notes that, due to the uncertainty over whether high-frequency cetaceans may perceive certain sounds and due to paucity of data, it was not possible to present any data on responses of high frequency-cetaceans. However, Lucke et al. (2008) showed a single harbour porpoise consistently showed aversive behavioural reactions to pulsed sound at received sound pressure levels above 174 dB re 1 µPa (peak-to-peak) or a SEL of 145 dB re 1 µPa^{2}s, equivalent to an estimated[2] rms sound pressure level of 166 dB re 1 µPa.

Clearly, there is much intra-category and perhaps intra-species variability in behavioural response. As such, a conservative approach should be taken to ensure that the most sensitive cetaceans remain protected.

The High Energy Seismic Survey workshop on the effects of seismic (i.e. pulsed) sound on marine mammals ("Summary of Recommendations Made by the Expert Panel at the HESS Workshop on the Effects of Seismic Sound on Marine Mammals" 1997) concluded that mild behavioural disturbance would most likely occur at rms sound levels greater than 140 dB re 1 µPa (rms). This workshop drew on studies by Richardson (1995) but recognised that there was some degree of variability in reactions between different studies and mammal groups. Consequently, for the purposes of this study, a precautionary level of 140 dB re 1 µPa (rms) is used to indicate the onset of low-level/trivial marine mammal disturbance effects for all mammal groups for impulsive sound.

This assessment adopts a conservative approach and uses the NMFS (2005b) Level B harassment threshold of 160 dB re 1 µPa (rms) for impulsive sound. Level B Harassment is defined as having the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioural patterns, including,

---

[2] Based on an analysis of the time history graph in Lucke et al. (2007) the T90 period is estimated to be approximately 8 ms, resulting in a correction of 21 dB applied to the SEL to derive the rms_{T90} sound pressure level. However, the T90 was not directly reported in the paper.

but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild. This is similar to the JNCC (2010) description of non-trivial disturbance and has therefore been used as the basis for onset of behavioural change in this assessment.

It is important to understand that exposure to sound levels in excess of the behavioural change threshold stated above does not necessarily imply that the sound will result in significant disturbance. As noted previously, it is also necessary to assess the likelihood that the sensitive receptors will be exposed to that sound and whether the numbers exposed are likely to be significant at the population level.

Change in Assessment Criteria

There have been two changes in assessment criteria that will result in risk ranges being much larger that for previous assessments:

1. Change from using DAHG[3] PTS limits from 2014:
   198 dB SEL for porpoises and 186 dB SEL for seals. These are now 155 dB SEL for porpoises and 185 for seals, a decrease of 43 dB and 1 dB respectively.
2. Change from using PTS (hearing injury) to using TTS (temporary hearing impact) as limit, further lowering the thresholds from 155 to 140 dB SEL (porpoises), 185 to 170 dB SEL (seals), a decrease of 15 dB for both groups.

These two factors, reflecting an update in scientific consensus and the DAHG guidance setting TTS as the limit for injury (Department of Arts, heritage and the Gealtacht, 2014), mean that the assessment limits have decreased by 58 dB and 16 dB for porpoises and seals respectively, leading to large increases in risk ranges.

Injury and Disturbance to Fish

Adult fish not in the immediate vicinity of the noise generating activity are generally able to vacate the area and avoid physical injury. However, larvae and eggs are not highly mobile and are therefore more likely to incur injuries from the sound energy in the immediate vicinity of the sound source, including damage to their hearing, kidneys, hearts and swim bladders. Such effects are unlikely to happen outside of the immediate vicinity of even the highest energy sound sources.

For fish, the most relevant criteria for injury are considered to be those contained in the Sound Exposure Guidelines for Fishes and Sea Turtles (Popper *et al*., 2014). Sea Turtles are not included in this assessment. Popper *et al*. (2014) guidelines do not group by species but instead broadly group fish into the following categories based on their anatomy and the available information on hearing of other fish species with comparable anatomies:

- Group 1: Fishes with no swim bladder or other gas chamber (e.g. elasmobranchs, flatfishes and lampreys). These species are less susceptible to barotrauma and are only sensitive to particle motion, not sound

---

[3] Department of Arts, Heritage and the Gaeltacht: Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters, January 2014

pressure. Basking shark Cetorhinus maximus, which does not have a swim bladder, falls into this hearing group;

- Group 2: Fishes with swim bladders but the swim bladder does not play a role in hearing (e.g. salmonids). These species are susceptible to barotrauma, although hearing only involves particle motion, not sound pressure;
- Group 3: Fishes with swim bladders that are close, but not connected, to the ear (e.g. gadoids and eels). These fishes are sensitive to both particle motion and sound pressure and show a more extended frequency range than Groups 1 and 2, extending to about 500 Hz;
- Group 4: Fishes that have special structures mechanically linking the swim bladder to the ear (e.g. clupeids such as herring Clupea harengus, sprat Sprattus spp. and shads (Alosinae)). These fishes are sensitive primarily to sound pressure, although they also detect particle motion. These species have a wider frequency range, extending to several kilohertz and generally show higher sensitivity to sound pressure than fishes in Groups 1, 2 and 3; and
- Fish eggs and larvae: separated due to greater vulnerability and reduced mobility. Very few peer-reviewed studies report on the response of eggs and larvae to anthropogenic sound.

The guidelines set out criteria for injury due to different sources of noise. Those relevant to the Project are considered to be those for injury due to impulsive piling. The criteria include a range of indices including SEL, rms and peak sound pressure levels. Where insufficient data exist to determine a quantitative guideline value, the risk is categorised in relative terms as “high”, “moderate” or “low” at three distances from the source: “near” (i.e. in the tens of metres), “intermediate” (i.e. in the hundreds of metres) or “far” (i.e. in the thousands of metres). It should be noted that these qualitative criteria cannot differentiate between exposures to different noise levels and therefore all sources of noise, no matter how noisy, would theoretically elicit the same assessment result. However, because the qualitative risks are generally qualified as “low”, with the exception of a moderate risk at “near” range (i.e. within tens of metres) for some types of animal and impairment effects, this is not considered to be a significant issue with respect to determining the potential effect of noise on fish.

The criteria used in this noise assessment for impulsive piling are given in Table 12.2.3. In the table, both peak and SEL criteria are unweighted.

We will use the lowest thresholds to cover all fishes. Note that Lamprey have higher thresholds (no swim bladder) than do salmon (with swim bladder, but not for hearing).

To simplify the terminology used in the results section we have abbreviated “Potential Mortality”/”Recoverable injury” to PM/RI. Note that in plots and maps PM corresponds to “PTS” and RI to “TTS”.

Table 12.2.3 Criteria for onset of injury to fish and sea turtles due to impulsive piling (Popper et al., 2014).

Type of animal	**Parameter**	**Mortality and potential mortal injury (PM/PTS)**	**Recoverable injury (RI/TTS)**
Fish: no swim bladder (particle motion detection)	SEL, dB re 1 µPa^{2}s	>219	>216
	Peak, dB re 1 µPa	>213	>213
Fish: where swim bladder is not involved in hearing (particle motion detection)	SEL, dB re 1 µPa^{2}s	210	203
	Peak, dB re 1 µPa	>207	>207
Fish: where swim bladder is involved in hearing (primarily pressure detection)	SEL, dB re 1 µPa^{2}s	207	203
	Peak, dB re 1 µPa	>207	>207
Eggs and larvae	SEL, dB re 1 µPa^{2}s	>210	(*Near*) Moderate (*Intermediate*) Low (*Far*) Low
	Peak, dB re 1 µPa	>207	

The criteria used in this noise assessment for non-impulsive sound are given in Table 12.2.4.

Table 12.2.4 Criteria for onset of injury to fish due to non-impulsive sound (Popper et al., 2014)

Type of animal	**Mortality and potential mortal injury**	**Recoverable injury**
Fish: no swim bladder (particle motion detection)	(*Near*) Low (*Intermediate*) Low (*Far*) Low	(*Near*) Low (*Intermediate*) Low (*Far*) Low
Fish: where swim bladder is not involved in hearing (particle motion detection)	(*Near*) Low (*Intermediate*) Low (*Far*) Low	(*Near*) Low (*Intermediate*) Low (*Far*) Low
Fish: where swim bladder is involved in hearing (primarily pressure detection)	(*Near*) Low (*Intermediate*) Low (*Far*) Low	170 dB re 1 µPa (rms) for 48 hours Taken here to be 219 dB SEL over 24 hours
Eggs and larvae	(*Near*) Low (*Intermediate*) Low (*Far*) Low	(*Near*) Low (*Intermediate*) Low (*Far*) Low

Behavioural reaction of fish to sound has been found to vary between species based on their hearing sensitivity. Typically, fish sense sound via particle motion in the inner ear which is detected from sound-induced motions in the fish's body. The detection of sound pressure is restricted to those fish which have air filled swim bladders; however, particle motion (induced by sound) can be detected by fish without swim bladders[4].

Highly sensitive species such as herring have elaborate specialisations of their auditory apparatus, known as an otic bulla – a gas filled sphere, connected to the swim bladder, which enhances hearing ability. The gas filled swim bladder in species such as cod and salmon may be involved in their hearing capabilities, so although there is no direct link to the inner ear, these species are able to detect lower sound frequencies and as such are considered to be of medium sensitivity to noise. Flat fish and elasmobranchs have no swim bladders and as such are considered to be relatively less sensitive to sound pressure.

The most recent criteria for disturbance are considered to be those contained in Popper *et al*. (2014) which set out criteria for disturbance due to different sources of noise. The risk of behavioural effects is categorised in relative terms as "high", "moderate" or "low" at three distances from the source, as shown in Table 12.2.5.

Table 12.2.5 Criteria for onset of behavioural effects in fish and sea turtles for impulsive and non- impulsive sound (Popper et al., 2014)

Type of animal	**Relative risk of behavioural effects**	
	Impulsive sound	**Non-impulsive sound**
Fish: no swim bladder (particle motion detection)	(Near) High (Intermediate) Moderate (Far) Low	(Near) Moderate (Intermediate) Moderate (Far) Low
Fish: where swim bladder is not involved in hearing (particle motion detection)	(Near) High (Intermediate) Moderate (Far) Low	(Near) Moderate (Intermediate) Moderate (Far) Low
Fish: where swim bladder is involved in hearing (primarily pressure detection)	(Near) High (Intermediate) High (Far) Moderate	(Near) High (Intermediate) Moderate (Far) Low
Eggs and larvae	(Near) Moderate (Intermediate) Low (Far) Low	(Near) Moderate (Intermediate) Moderate (Far) Low

It is important to note that the Popper *et al*. (2014) criteria for disturbance due to sound are qualitative rather than quantitative. Consequently, a source of noise of a particular type (e.g. piling) would result in the same predicted potential impact, no matter the level of noise produced or the propagation characteristics.

Therefore, the criteria presented in the Washington State Department of Transport Biological Assessment Preparation for Transport Projects Advanced Training Manual (WSDOT, 2011) are also used in this assessment for predicting the extent of behavioural effects due to impulsive piling. The manual suggests an un-weighted sound pressure level of 150 dB re 1 μPa (rms) as the criterion for onset of behavioural effects, based on work by (Hastings, 2002). Sound pressure levels in excess of 150 dB re 1 μPa (rms) are expected to cause temporary

---

[4] It should be noted that the presence of a swim bladder does not necessarily mean that the fish can detect pressure. Some fish have swim bladders that are not involved in the hearing mechanism and can only detect particle motion.

behavioural changes, such as elicitation of a startle response, disruption of feeding, or avoidance of an area. The document notes that levels exceeding this threshold are not expected to cause direct permanent injury but may indirectly affect the individual fish (such as by impairing predator detection). It is important to note that this threshold is for onset of potential effects, and not necessarily an ‘adverse effect’ threshold.

12.2.2.3 Underwater Noise sources and Propagation Loss

Noise sources are usually described in dB re 1 μPa as if measured at 1 m from the source. In practice, it is not usually possible to measure at 1 m from a source, but this method allows different source levels to be compared and reported on a like-for-like basis. This method of specification involves assuming that the source is infinitesimally small so that at 1 m from this imagined point the sound pressure levels can be defined. In reality, for a large sound source such as a pile this imagined point at 1 m from the acoustic centre does not exist. Furthermore, the energy is distributed across the source and does not all emanate from this imagined acoustic centre point. Therefore, the stated sound pressure level at 1 m does not actually occur for large sources, such as piles. In the acoustic near-field, the sound pressure level will be significantly lower than would be predicted using this method.

The sound generated and radiated by a pile as it is driven into the ground is complex, due to the many components which make up the generation and radiation mechanisms. However, a wealth of experimental data is available which allow us to predict with a good degree of accuracy the sound generated by a pile at discrete frequencies. Third octave band noise spectra have been presented in literature for various piling activities (e.g. Matuschek and Betke 2009; De Jong and Ainslie 2008; Wyatt 2008; J. R. Nedwell et al. 2007; J. Nedwell and Howell 2004; Jeremy Nedwell et al., 2003; CDoT 2001; Nehls et al., 2007; Thomsen et al., 2006).

The source Sound Exposure Level is linked to the hammer energy E according to the methodology described in De Jong and Ainslie (2008), as follows:

$$\text{SEL} = 120 + 10\log_{10}\left(\frac{\beta E c_0 \rho}{4\pi}\right)$$

Where β is the acoustic energy conversion efficiency (in this case taken to be 0.5%), c_0 is the speed of sound in seawater in m/s, and ρ is the density of seawater in kg/m^3.

A more recent study by von Pein et al. provides a wider range of parameters:

$$\Delta SEL = 10log_{10}\left(\frac{E_1}{E_0}\right) + 16.7log_{10}\left(\frac{d_1}{d_0}\right) - 10log_{10}\left(\frac{m_{r,1}}{m_{r,0}}\right) + 750\frac{10log_{10}(|R|^2)}{2\cot\varphi}\left(\frac{1}{h_1} - \frac{1}{h_0}\right)$$

Where E = hammer energy, d = pile diameter, m = ram weight, R = reflection coefficient, φ the propagation angle and h the water depth.

12.2.2.4 Construction Phase Model

The underwater noise from each of the piling scenarios set out in Table 12.2.6 have been modelled. Each of the piling operations have been assessed according SEL. All piling locations were modelled using dBSea. From previous measurement analysis, the peak source level and third octave band information for 1.2 m diameter piling is known. As outlined in Section 12.2.5 piling noise level is proportional to pile diameter. Because we are piling in similar circumstances and location to the measurements, the extrapolation of source levels can be simplified to a simple ratio of diameters or piling energy. In the case of this model the pile diameter was used to extrapolate the source levels by using a correction factor. This correction factor is added to the 1.2 m diameter pile third octave band information and the subsequent levels are summed to obtain the new source level of the new pile size. The correction factor is given by:

$$\Delta\text{peak or }\Delta\text{SEL} = L_{peak}\ or\ SEL + 16.7\log_{10}(\frac{pile\ diameter}{1.2})$$

Where $pile\ diameter$ is the diameter of the pile needing its source level calculated and 1.2 m is the diameter of the measured pile. When calculating the SEL of an impulsive source, the crest factor is an important factor to consider, as its exclusion can lead to overestimating levels. The crest factor is the dB difference between the peak value and the average value of a signal and is subtracted from the SEL source level. From measurements made previously, the crest factor was calculated for each measured location. A crest factor of 30dB was chosen for the underwater noise model, which is a conservative estimate.

Overview of Piling Activity During Construction Phase

Modelling has been carried out at each of the locations noted in Table 12.2.6. In the case of extensive piling, such as the Ro-Ro Terminal (Area K) and Lo-Lo Terminal (Area N), separate models have been developed for the east and west end of the proposed activity, with Area N having both 2 and 5 piling rigs operating continuously modelled. The assessment of piling at Area K was taken to be representative of similar piling required at the Maritime Village.

The SPAR Road will be installed primarily with vibratory driving until rock is met (approximately 30 m down). After this the inside will be excavated by coring or auger drill. A socket will then be drilled in the rock below the pile toe, for later infilling through the pile with stell reinforced concrete. These operations are either much quieter (excavating the pile) and/or occur well into the sediment and are not assessed further (source levels similar to dredging, 177 dB SPL).

Table 12.2.6 Piling sizes and peak source levels for impact piling.

Location	Piling Required	Installation method assessed	Level	Approximate location (UTM 29N)
SPAR Bridge	1.02 m dia. 22.2 mm thick round piles.	Impact piling	204 dB $SEL_{\text{single blow}}$	East: 684621 North: 5914337
SPAR Road	1.2 m dia. 10mm thick round piles	Vibration piling	206 dB $SEL_{\text{single blow}}$	East: 684768 North: 5914204
SPAR Road	1.2 m dia. 10mm thick round piles	Vibration piling	206 dB $SEL_{\text{single blow}}$	East: 685120 North: 5914116
Ro-Ro Terminal (Area K) Impact piling	1.42 m dia. 25.4mm thick round piles	Impact piling	206 dB $SEL_{\text{single blow}}$	East: 686035 North: 5914067

Location	Piling Required	Installation method assessed	Level	Approximate location (UTM 29N)
Ro-Ro Terminal (Area K) Vibro piling	1.4 m wide sheet piles	Vibration	207 dB SPL	East: 686035 North: 5914067
Marina Finger Berths	1.02 m dia. 22.2 mm thick round piles.	Impact piling	204 dB SEL$_{\text{single blow}}$	East: 684898 North: 5914234
Ro-Ro Ramp	2.4 m dia. 40 mm thick guide (round) piles.	Impact piling	210 dB SEL$_{\text{single blow}}$	East: 685858 North: 5914125
Area N (West)	1.63 m dia. 22 mm thick round piles	Impact piling	207 dB SEL$_{\text{single blow}}$	East: 687034 North: 5914020
Area N (East)	1.63 m dia. 22.2 mm thick round raking piles.	Impact piling	207 dB SEL$_{\text{single blow}}$	East: 687682 North: 5914060
Area N x5 rigs simultaneously	1.63 m dia. 22.2 mm thick round raking piles.	Impact piling	207 dB SEL$_{\text{single blow}}$	East: 687329, 687682, 687128, 687529 North: 5914024, 5914060, 5913950, 5913951
NORA Dolphin	1.02 m dia. 22.2mm thick round piles.	Impact piling	204 dB SEL$_{\text{single blow}}$	East: 687805 North: 5914060
Tern Colony	0.51 m dia. 22 mm thick Round piles	Impact piling	199 dB SEL$_{\text{single blow}}$	East: 688289 North: 5914064
Turning Circle, King piles Impact piling	2.03 m dia. 22 mm thick Round piles	Impact piling	209 dB SEL$_{\text{single blow}}$	East: 686664 North: 5913976
Turning Circle, sheet piles Impact piling	1.4 m pair Sheet piles	Vibration	207 dB SPL	East: 686664 North: 5913976

The locations and installation types presented above are a worst-case representation covering the locations/areas with piling and the results are valid for comparable pile sizes and similar locations should the final installation plan change.

Piling Source Levels

For this Project, underwater noise measurements were carried out while king piles and sheet piles were being driven in the Liffey channel at Ocean Pier. Measurements were carried out while impact and vibratory piling was being carried out on 1.2 m diameter 'king' piles and vibratory piling on 1.46 m wide sheet piles. Measurements were carried out various distances from the source and the measurement data was used to calculate a source level at 1 metre for the king piles and a propagation loss factor for the Liffey channel area.

A summary of the broadband level of the various piling source is given in Table 12.2.7, with the impact piling leading to the largest impact ranges and therefore forming the basis of the assessment:

Table 12.2.7 Underwater Noise Modelling parameters. Broadband levels 250 – 20,000 Hz.

Parameter	Duration/blow count	Unweighted	Weighted for VHF group	Weighted for PCW group	Weighted for OCW group
Impact piling	Single blow	210 dB SEL	192	205	205
	1 hour (1.5 sec/blow, 50% duty cycle: 1200 blows/hour)	241 dB SEL	223	236	236
Vibration piling, round piles	1 second	211 dB SPL	164	198	196
	1 hour	247 dB SEL	199	234	231
Vibration piling, sheet piles	1 second	204 dB SPL	187	202	202
	1 hour	239 dB SEL	223	237	238

The values in Table 12.2.7 were used as basis for the propagation modelling (see Appendix 12.3 – Source band levels).

12.2.2.5 Operational Phase Model

A user-defined vessel source was used to model the shipping traffic as part of the operational phase of the 3FM Project. This source uses third octave band levels found in Abrahamsen (2012) which describe the noise emissions of a vessel travelling at 8 knots. This type of vessel at this speed is an accurate representation of the average shipping traffic arriving at and leaving Dublin Port. Only the SEL level type is necessary to model due to the non-impulsive nature of shipping noise. Two scenarios were modelled: one with the vessel source placed in the port area and one with the vessel further east in the navigation channel to cover two typical scenarios.

12.2.3 Existing Environment

Dublin Bay is home to Dublin Port and Dun Laoghaire Harbour along with a number of smaller harbours and marinas. Marine traffic includes large cargo ships, passenger cruise ships, large ferry vessels, fast ferries, trawlers and leisure traffic. The main shipping channels from the Irish Sea are north and south of the Burford Bank towards the entrance to Dublin Harbour between the Great South Wall and North Bull Wall. The dredged shipping channel on the eastern approaches to the port extends up the River Liffey as far as Tom Clarke Bridge.

The central port area from Berth 53 to the Alexandra Basin West is heavily trafficked by vessels on a daily basis. This working area in Dublin Port is relatively noisy in comparison to the greater Dublin Bay area. Noise in the port area is generated from shipping and a multitude of industrial sources. The port is accessed via the dredged navigation channel which extends some 2.5 km from the Great South Wall light to Berth 53. The channel is approximately 200 m wide and is currently 10 m deep (Chart Datum). This narrow shallow channel has the effect of confining noise from the port within that area and a short section of the channel and the River Liffey upstream.

12.2.3.1 Sensitivity of the Receiving Environment

Dublin Port has been a commercial seaport at its current location since the 1700’s. The area surrounding the port includes a mix of heavy industry, commercial, residential, conservation and amenity space. There are several water intakes and outflows in the inner port area associated with industrial developments. The flow noise from these, along with commercial and leisure vessel traffic increases local underwater noise levels in the port area. Maintenance dredging is carried out annually over a 4–6-week period between April and September contributing to the baseline underwater noise levels.

Marine mammals in outer Dublin Bay, east of the Poolbeg lighthouse include Phocids, Very High Frequency Cetaceans, High Frequency Cetaceans and Other Marine Carnivores (otters). Some Low Frequency Cetaceans have been recorded occasionally. Diving seabirds including auk species, and shallow divers such as terns and gulls are also present. West of the Poolbeg Lighthouse in the area enclosed by the Great South Wall and the North Bull Wall there have been relatively few sightings harbour porpoise, but small numbers of seals are found more regularly. Diving seabirds in the area are mainly shallow divers such as terns.

12.2.3.2 Ambient noise levels

The port continues to operate as normal. Construction work on the Alexandra Basin Redevelopment (ABR) Project (29N.PA0034) is nearing completion and the MP2 Project (ABP-304888-19) is currently under construction at the port. During construction piling works for the ABR Project, underwater noise levels were measured and reported in Table 12.2.8. Noise levels due to shipping at the Poolbeg Oil Jetty are elevated for the short period of time when a vessel passes and drop to background noise levels afterwards. Shipping noise Alexander Basin area remains elevated for most of the day due to ship berthing and loading/unloading activity. Typical noise levels (10th to 90th percentile) are 115-151 dB SPL (Figure 12.2.5) with natural background levels changing with the tide (increased level with increased depth, low tide 07:41 – high tide 14:19).

Note that “90th percentile” is the level over 90 % of the measurements, corresponding to the “LA10” often used to describe the level exceeded 10 % of the time (and 10th percentile corresponds to “LA90”).

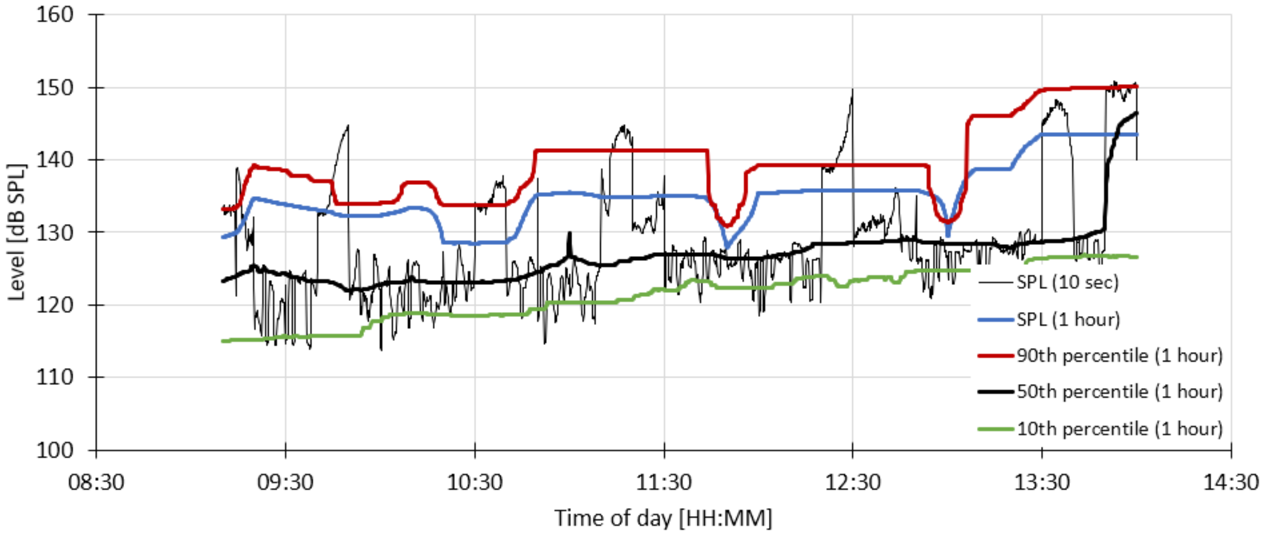


Figure 12.2.5 Example of noise levels measured in Dublin Port 2017 over a ~5-hour period (23 Nov 2017)

The piling noise levels in Table 12.2.8 were measured while piling was taking place on the Ocean Pier quay wall (which is enclosed in Alexandra Basin West). A notable feature of the piling noise was the intermittent nature of the noise source. While piling is underway 'all day', the actual piling strikes occur for one third of working hours. This is due to the need to ensure the piles are properly aligned, piling depth checks, changes in piling settings, meal breaks and equipment checks. The average 'striking period' duration was under 12 minutes with breaks of varying duration in between 'striking periods'. The inter-strike interval was 1.56 seconds (1,560 milliseconds), rounded to 1.5 seconds. A typical pile strike is shown in Figure 12.2.6.

Table 12.2.8 Measured noise levels at Dublin Port (2017)

Noise type	Level
Natural Background (10th percentile)	115-127 dB SPL
Typical levels (Median/50th percentile)	122-146 dB SPL
Vessels, Vibro piling, dredging (90th percentile)	131-151 dB SPL
Peak levels in 10 min duration (~200 m from piling)	140-168 dB L_P

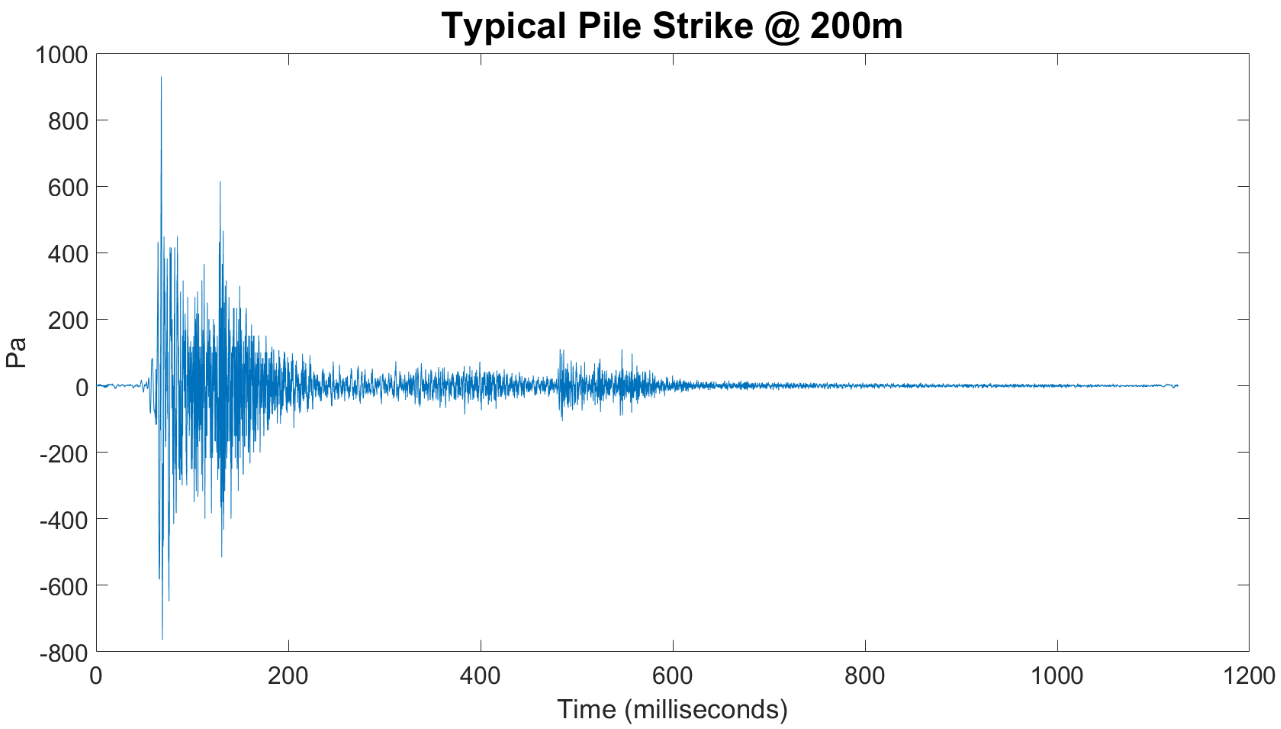


Figure 12.2.6 Typical piling strike measured at 200 metres from the source.

12.2.3.3 Sediment

The seabed in the port area has been described as a mix of fine sand and clay, leading to a moderately stiff mix of clayey sand. The sediment properties used for propagation modelling is presented in Table 12.2.9.

Table 12.2.9 Sediment properties used for propagation modelling

Sediment density [kg/m³]	Sediment soundspeed [m/s]	Sediment attenuation [dB/λ] (compressional waves)[5]	Sediment Grain Size [mm]	ISO 14688-1:2017 name
1555	1518	0.17	0.0111	Medium silt

12.2.3.4 Water properties

Water properties are based on conditions leading to the minimal transmission loss within the measured values for the site:

1. Higher temperatures – higher soundspeed
2. Lower salinities – less absorption at higher frequencies
3. Larger depth – less absorption of low frequencies into the sediment

The water properties used for propagation modelling is presented in Table 12.2.10.

---

[5] Shear waves ignored.

Table 12.2.10 Water properties used for propagation modelling

Temperature [°C]	Salinity [psu]	Soundspeed [m/s]	Density [kg/m³]
17.6	26.4	1505	1021

12.2.4 Impact Assessment - Underwater Noise Modelling

12.2.4.1 dBSea Model

There are several methods available for modelling the propagation of sound between a source and receiver ranging from very simple models which simply assume spreading according to distance from source such as 10 log(r) or 20 log(r) relationships to computationally intensive acoustic models (e.g. ray-tracing, normal-mode, parabolic equation, wavenumber integration and energy flux models). Semi-empirical models lie somewhere in between and provide a practicable balance for environmental impact assessment modelling. Sound propagation modelling for this assessment was carried out using dBSea, an underwater noise prediction and visualisation software package, using parabolic equation and raytracing methods. dBSea allows the input of user defined equations in order to model sound propagation over distance.

12.2.4.2 Underwater Noise Sources

dBSea allows the input of user-defined noise sources with specified third octave band levels. Each source is stated as either SPL or SEL per third octave band. In the case of this model, the assessment period is set to 3600 seconds. It is reasonable to assume that a species will move away from a noise source if it becomes disturbed and exposure of one hour at the maximum level is a conservative estimate of overall exposure. In total, twelve noise models were created in the dBSea model: seven impact piling source locations, two sheet piling source locations, one dredging location all during the construction phase and two shipping source locations during the operating phase. All noise sources are assumed to radiate sound energy equally in all directions.

12.2.4.3 Marine Species Weightings

dBSea allows the weighting of results to reflect the different hearing systems of various marine species. Southall defines eight distinct hearing groups among marine species and results for three of these groups have been modelled: high frequency cetaceans (HF), very high frequency cetaceans (VHF) and other marine carnivores in water (OCW). The HF group contains species such as the common dolphin, the VHF group contains species such as harbour porpoises and the OCW group contains all non-phocid marine carnivores which in this case are taken to represent otters. Unweighted results were also modelled in order to represent the hearing capabilities of fish.

12.2.4.4 Model Validation

A range of measurements undertaken from earlier work nearby was used to compare the modelling outputs to the measured data to estimate the confidence in the modelling and apply corrective measures, if needed. This comparison (Figure 12.2.7) shows that the model tends to underestimate the transmission loss for shorter ranges 0-200 m but has good accuracy for ranges 600-3500 m along the channel.

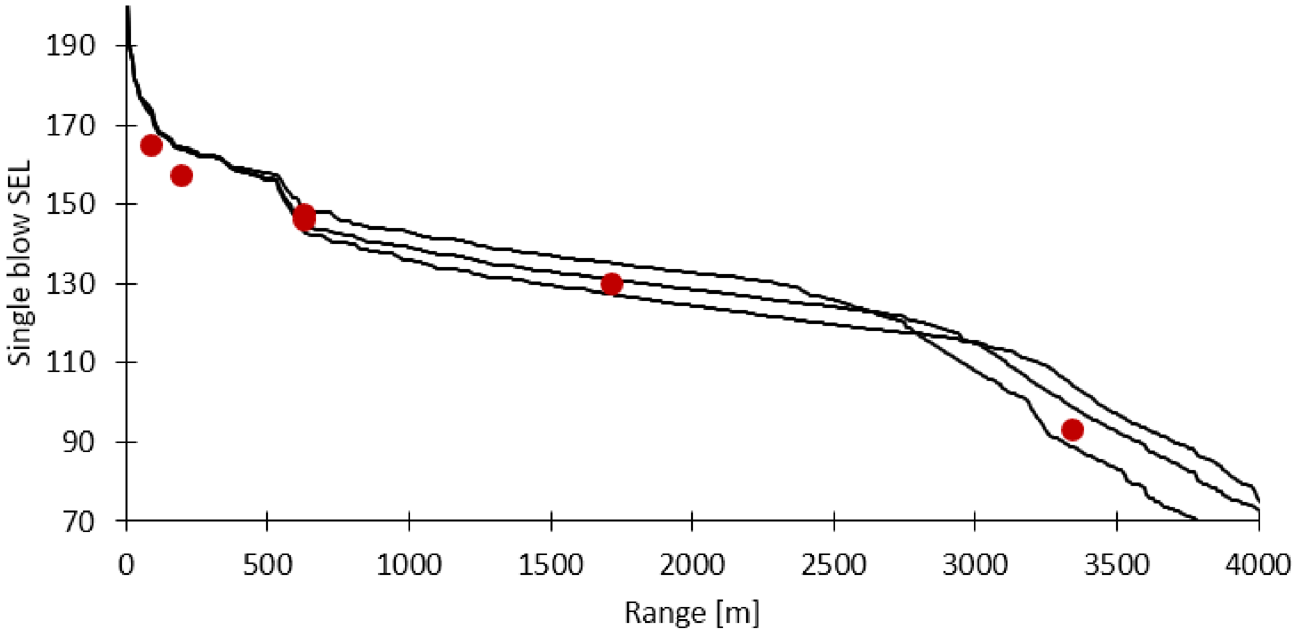


Figure 12.2.7 Comparison of three modelled radials with measured levels. All radials are in the main channel from a measured source (impact piling) east of Alexandra Basin West.

12.2.4.5 Noise Modelling Results

Figures and Tables here give an overview of the *max* range to limits for various activities modelled and the radius at which Temporary Threshold Shift (TTS) or Recoverable injury to fish may occur. Where "typical ranges/levels" is used this means median to 90th percentile covering all the relevant sites included in that summary.

Individual results for all modelled locations and activities are presented in section 12.2.6.

TTS is the main assessment criteria for marine mammals.

Results for Permanent Threshold shift (PTS) and Fish injury are included to allow comparison with studies using this metric as the main criteria.

PTS is not the main assessment criteria and only included for completeness, reflecting limits given in the Southall 2019 framework.

Max ranges are not necessarily representative of the general range of risk, especially for a site like Dublin Port where the noise level in the dredged channel will be much higher than in the surrounding shallower areas.

Results are generally presented as two scenarios based on showing impact of either:

A. "Short Duration":
   - A single blow (impact piling)
   - A one-second exposure (dredging, sheet piling and vessel noise).
   This is "instantaneous" impact, in the sense that an animal cannot swim away to avoid the noise.

B. "Long Duration" - One hours' activity:
   - 1200 blows (impact piling)
   - 3600 seconds (dredging, sheet piling and vessel noise).

This is cumulative impact, and we argue that an animal can leave the area in under an hour (1 m/s for 3600 seconds is 3.6 km – enough to leave the port area.)

12.2.4.6 Short Duration, TTS (single blow or one second)

Impulsive noise, TTS, Single Blow (Figure 12.2.8)

Fishes and OCW groups have negligible TTS risk ranges for a single blow, with the PCW group having typical (mean to 90th percentile) TTS risk ranges of 180 - 300 m. The VHF group has typical TTS risk ranges of 1700 - 2200 m, with a single location, the Ro-Ro ramp showing a TTS risk range to 2700 m along the dredged channel (extending to the entrance to Dublin Port, between the North and South wall). There is large variation in the modelled risk ranges due to variation in pile size, depth (2-10 m) and underwater geometry near the various sources (confined or more open) leading to a wide range on transmission losses in different directions.

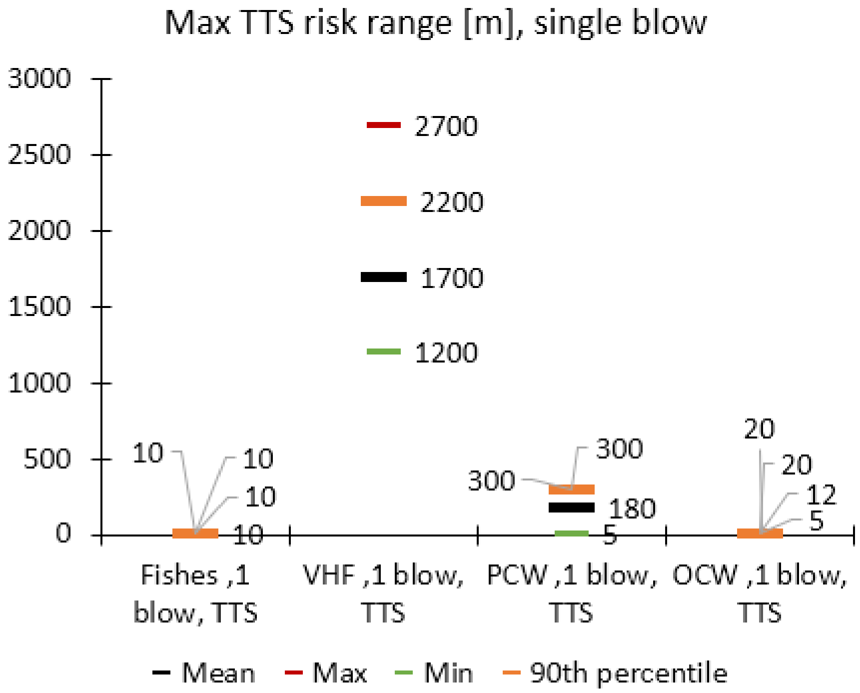


Figure 12.2.8 Overview of TTS risk ranges for a single blow for impact piling. Where no data is shown the range was under 5m.

Continuous Noise, TTS, 1 Second

For one second exposure none of the assessed hearing groups had TTS risk ranges >5m for Dredging or Vessel noise. The PCW group had TTS risk range of <20 m for Sheet piling and the VHF group <180 m.

12.2.4.7 Long Duration, TTS (1200 blows or one hour)

Impulsive noise, TTS, 1200 Blows (Figure 12.2.9)

Risk ranges for TTS for an hour for Fishes is typically 170 - 280 m, with a maximal risk range of 300 m.

Risk ranges for the OCW group after an hours' exposure typically extend to 1000 - 1400 m.

The risk ranges for both the PCW and VHF group are limited by the extend of the port area and the North and South wall at the inlet to the Dublin port. Both groups are likely to have their TTS threshold exceeded throughout the modelled area, even in the shallower parts between the dredged channel and Bull Island (during high tide).

Note that “5000 m” and “3800 m” are limited by the modelled area (and extent of the port inside South and North wall).

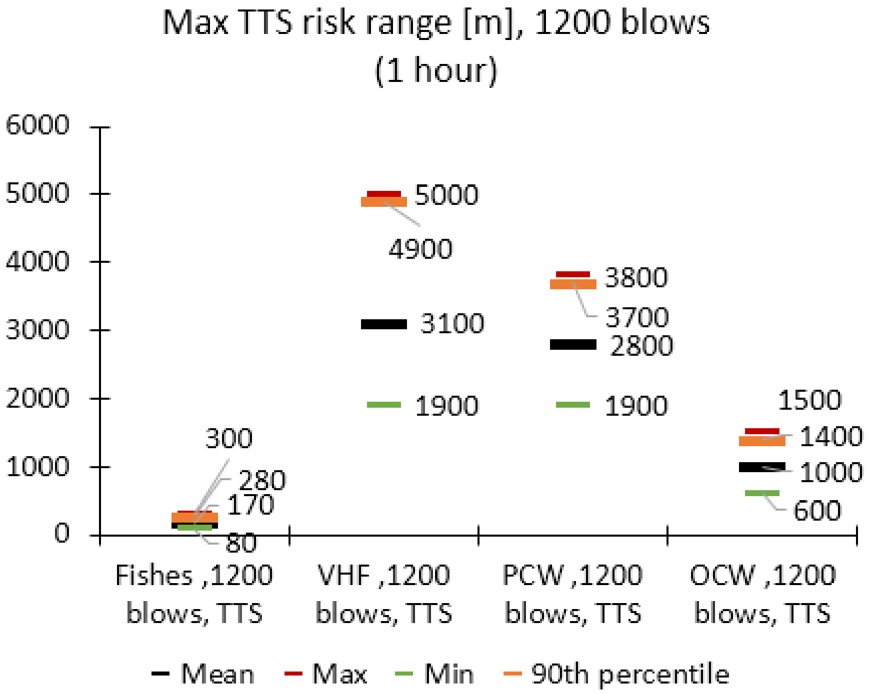


Figure 12.2.9 Overview of TTS risk ranges for 1200 blows for impact piling.

Continuous Noise, TTS, 1 Hour

None of the groups show measurable exceedances for the Vessel noise.

For dredging TTS ranges for the Fishes and OCW group are less than 5m while the PCW and VHF group show risk range of 30m and 90m respectively, for one hours’ exposure to dredging.

For Sheet piling the Fishes group show TTS risk ranges of approximately 5m.

The OCW group have risk ranges of 250 - 300m for Sheet piling.

The PCW group have TTS risk ranges to 2200 - 2400m for sheet piling and the VHF group’s risk ranges are again limited by the port enclosed area, with ranges extending to the Dublin port North and South wall.

12.2.4.8 Short Duration, PTS (Single blow or one second)

This section is included to facilitate comparison with other assessment that might use PTS as the main assessment criteria.

Impulsive Noise, PTS, Single Blow (Figure 12.2.10)

The Fishes and OCW group have risk ranges less than 5 m for single blows (their PTS limit is similar to or above the source level). The PCW group had some instances of significant PTS risk ranges (one at 100 m), but risk ranges generally around 30 m. The VHF group has significant PTS risk associated with the impact piling with single blow PTS risk to 500m for the Ro-Ro ramp for animals in the dredged channel. Typical risk ranges are 290 - 500m. There is large variation in the modelled risk ranges due to variation in pile size, depth (2-10m) and underwater geometry near the various sources (confined or more open) leading to a wide range on transmission losses in different directions.

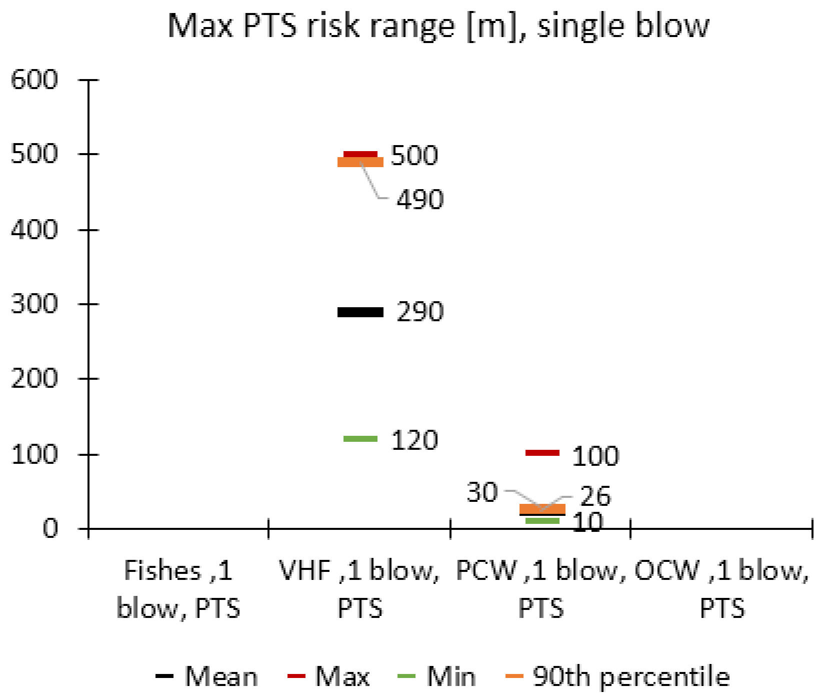


Figure 12.2.10. Overview of PTS risk ranges for a single blow for impact piling. Where no data is shown the range was under 5m.

Continuous Noise, PTS, 1 Second

None of the assessed hearing groups had PTS risk ranges >5m for Dredging, Sheet piling or Vessel noise.

12.2.4.9 Long Duration, PTS (1200 blows or one hour)

Impulsive Noise, PTS, 1200 blows (Figure 12.2.11)

Given the duration (1 hour, 1200 blows) the risk ranges for hearing groups Fishes and OCW are seen as negligible with maximal risk ranges of 150 m and 300 m respectively. For the PCW group animals will have to leave the dredged channel or port area to evade PTS risk, with typical risk ranges of 1400 - 1900 m. For the VHF group the shown risk ranges extent to the limits of the modelled area and the PTS threshold is exceeded for all areas inside the port walls (Dublin North Wall and South Wall).

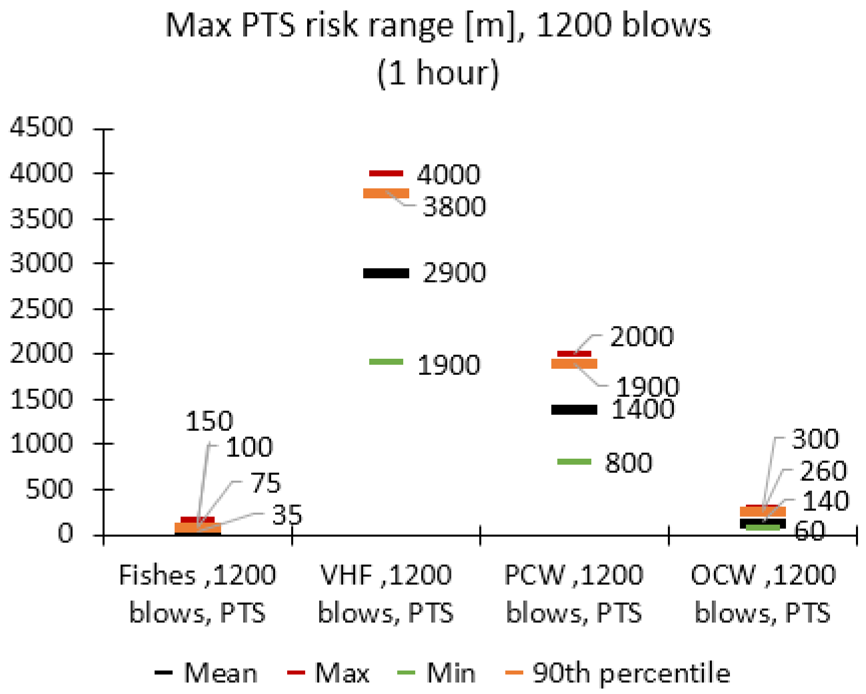


Figure 12.2.11 Overview of PTS risk ranges for 1200 blows for impact piling.

Continuous Noise, PTS, 1 Hour

None of the assessed hearing groups had PTS risk ranges >5m for dredging or vessel noise. The PCW group had PTS risk range of <250 m for sheet piling and the VHF group <1200.

12.2.5 Model Results Summary

In summary the results from modelling show:

1. TTS Limits for the VHF group will be exceeded to ranges up to 2700 m (PTS 500m) for single blows, meaning that a very large area should be free from porpoises before impact piling starts as animals cannot simply flee to avoid exceeding limits. For one hour’s activity (impact piling or vibro piling) any VHF group animal will have PTS limits exceeded if remaining inside the port (as limited by the North and South wall).
2. The PCW group (seals) will have limits exceeded to significant ranges for an hour’s exposure, with TTS risk throughout the port area (PTS risk to approximately 1km).
3. The Fishes group and OCW group (otter) have little to no risk of exceeding their TTS (or PTS) limits during impact piling unless stationary and close to the piling for longer durations (30 - 60minutes). For the largest pile at the Ro-Ro ramp, the Fishes group TTS range for 1 blow is less than 5m, for 10min/200 blows the TTS range is approximately 50m, for 30min/600 blows the TTS range is approximately 100m and for 60min/1200 blows the TTS range is approximately 300m.

Incorporating moving receivers (fleeing response) did not change the above results significantly and have not been pursued further (i.e. the moving receiver would need to start fleeing at ranges comparable to the given TTS/PTS ranges for stationary receivers).

The results presented are a worst-case representation covering the locations/areas with piling and the results are valid for comparable pile sizes and similar locations should the final installation plan change.

12.2.6 Maximal ranges for TTS and PTS risk

In the following the *max* risk ranges for TTS and PTS exceedance are listed in Table 12.2.11 to Table 12.2.27 ordered by the source location or activity. Visual model outputs are provided for max ranges for impact piling. The max range is generally representative for the range along the main channel, but not across the channel, where the shallower water will lead to shorter ranges.

There is large variation in the modelled risk ranges due to variation in pile size, depth (2-10m) and underwater geometry near the various sources (confined or more open) leading to a wide range on transmission losses in different directions.

Table 12.2.11 Max ranges for dredging at the turning circle.

Dredging – Turning Circle					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Dredging	1 second	Turning circle	Fishes	<10	<10
Dredging	1 second	Turning circle	VHF	<10	<10
Dredging	1 second	Turning circle	PCW	<10	<10
Dredging	1 second	Turning circle	OCW	<10	<10
Dredging	1 hour	Turning circle	Fishes	<10	<10
Dredging	1 hour	Turning circle	VHF	90	<10
Dredging	1 hour	Turning circle	PCW	30	<10
Dredging	1 hour	Turning circle	OCW	<10	<10

Table 12.2.12 Max ranges for Impact piling at the SPAR Bridge. (see Figure 12.2.12 and Figure 12.2.13)

Impact Piling – SPAR Bridge					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	SPAR	Fishes	<10	<10
Impact piling	1 blow	SPAR	VHF	1400	250
Impact piling	1 blow	SPAR	PCW	5	100
Impact piling	1 blow	SPAR	OCW	5	<10
Impact piling	1200 blows	SPAR	Fishes	50	80
Impact piling	1200 blows	SPAR	VHF	5000	4000
Impact piling	1200 blows	SPAR	PCW	3200	1000
Impact piling	1200 blows	SPAR	OCW	900	70

Figure 12.2.12. Impact piling, SPAR Bridge, Fish (unweighted) and OCW hearing group.

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

NOTE:

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50319610
   © Ordnance Survey Ireland/Government of Ireland.

Rev	Date	Drn	Chk'd	App'd	Description
P01	30/03/2023	MV	RP	EMcK	

Client: DUBLIN PORT COMPANY

West Pier Business Campus Dun Laoghaire, Co Dublin, Ireland.
Tel: +353 (0) 1 488 2900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Project Title: **DUBLIN PORT 3FM Project**

Drawing Title: **Impact Piling - SPAR**
Phocid Carnivores in Water and Very High Frequeny Cetaceans

Date	Scale	Drawn	Checked	Approved	Drawing File Name	Status	Version
30/03/2023	1:20,000 @A3	MV	RP	EMcK	IE000423-RPS-11-11-DR-Z-DR0002	S4	P01

Figure 12.2.13. Impact piling, SPAR Bridge, VHF and PCW hearing group.

Table 12.2.13 Max ranges for vibration piling at the SPAR road, west.

Vibro Piling – SPAR Viaduct road, West					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Vibration piling	1 second	SPAR viaduct, west	Fishes	<10	<10
Vibration piling	1 second	SPAR viaduct, west	VHF	10	<10
Vibration piling	1 second	SPAR viaduct, west	PCW	10	<10
Vibration piling	1 second	SPAR viaduct, west	OCW	<10	<10
Vibration piling	1 hour	SPAR viaduct, west	Fishes	20	<10
Vibration piling	1 hour	SPAR viaduct, west	VHF	650	30
Vibration piling	1 hour	SPAR viaduct, west	PCW	400	30
Vibration piling	1 hour	SPAR viaduct, west	OCW	30	10

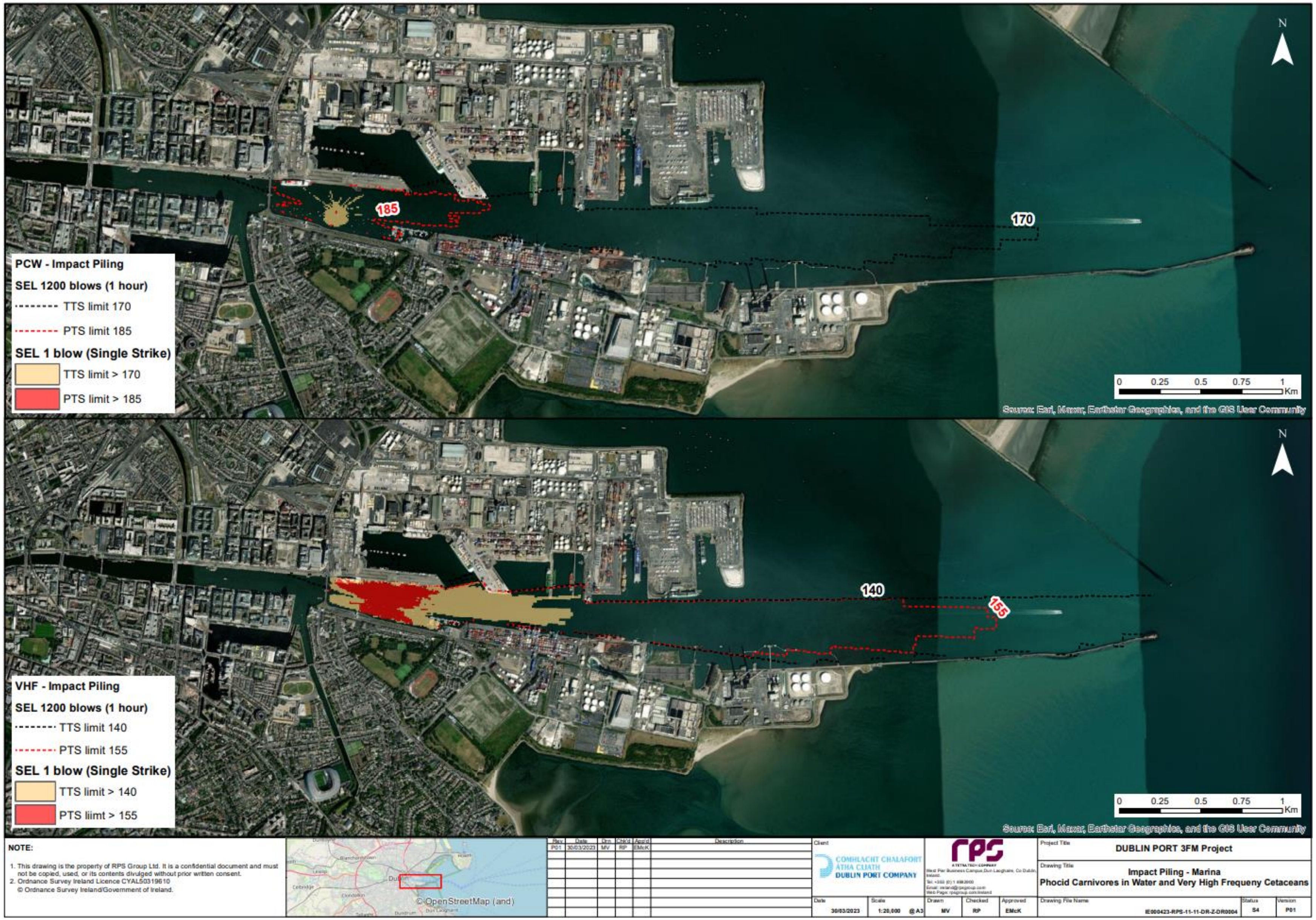
Table 12.2.14 Max ranges for vibration piling at the SPAR road, east.

Vibro Piling – SPAR Viaduct road, East					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Vibration piling	1 second	SPAR viaduct, east	Fishes	<10	<10
Vibration piling	1 second	SPAR viaduct, east	VHF	10	<10
Vibration piling	1 second	SPAR viaduct, east	PCW	10	<10
Vibration piling	1 second	SPAR viaduct, east	OCW	<10	<10
Vibration piling	1 hour	SPAR viaduct, east	Fishes	20	<10
Vibration piling	1 hour	SPAR viaduct, east	VHF	1000	50
Vibration piling	1 hour	SPAR viaduct, east	PCW	450	30
Vibration piling	1 hour	SPAR viaduct, east	OCW	30	10

Table 12.2.15 Max ranges for impact piling at the Marina. (see Figure 12.2.14 and Figure 12.2.15)

Impact Piling - Marina					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	Marina	Fishes	<10	<10
Impact piling	1 blow	Marina	VHF	1200	200
Impact piling	1 blow	Marina	PCW	100	10
Impact piling	1 blow	Marina	OCW	5	<10
Impact piling	1200 blows	Marina	Fishes	80	40
Impact piling	1200 blows	Marina	VHF	5000	3800
Impact piling	1200 blows	Marina	PCW	3700	800
Impact piling	1200 blows	Marina	OCW	700	80

Figure 12.2.14. Impact piling, Marina, Fish (unweighted) and OCW hearing group.



NOTE:

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50319610
© Ordnance Survey Ireland/Government of Ireland.

Rev	Date	Drn	Chk'd	App'd	Description
P01	30/03/2023	MV	RP	EMcK	

Client: COMHLACHT CHALAFORT ÁTHA CLIATH DUBLIN PORT COMPANY

rps A TETRA TECH COMPANY
West Pier Business Campus Dun Laoghaire, Co Dublin, Ireland.
Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Project Title: DUBLIN PORT 3FM Project

Drawing Title: Impact Piling - Marina
Phocid Carnivores in Water and Very High Frequeny Cetaceans

Date	Scale	Drawn	Checked	Approved	Drawing File Name	Status	Version
30/03/2023	1:20,000 @ A3	MV	RP	EMcK	IE000423-RPS-11-11-DR-Z-DR0004	S4	P01

Figure 12.2.15. Impact piling, Marina, VHF and PCW hearing group.

Table 12.2.16 Max ranges for impact piling at the Ro-Ro ramps. (see Figure 12.2.16 and Figure 12.2.17)

Impact Piling – Ro-Ro Ramp					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	Ro-Ro	Fishes	<10	<10
Impact piling	1 blow	Ro-Ro	VHF	2700	500
Impact piling	1 blow	Ro-Ro	PCW	300	20
Impact piling	1 blow	Ro-Ro	OCW	20	<10
Impact piling	1200 blows	Ro-Ro	Fishes	300	90
Impact piling	1200 blows	Ro-Ro	VHF	3800	3800
Impact piling	1200 blows	Ro-Ro	PCW	3800	1900
Impact piling	1200 blows	Ro-Ro	OCW	1200	300

NOTE:

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50319610
© Ordnance Survey Ireland/Government of Ireland.

Figure 12.2.16. Impact piling, RO-RO ramp, Fish (unweighted) and OCW hearing group.

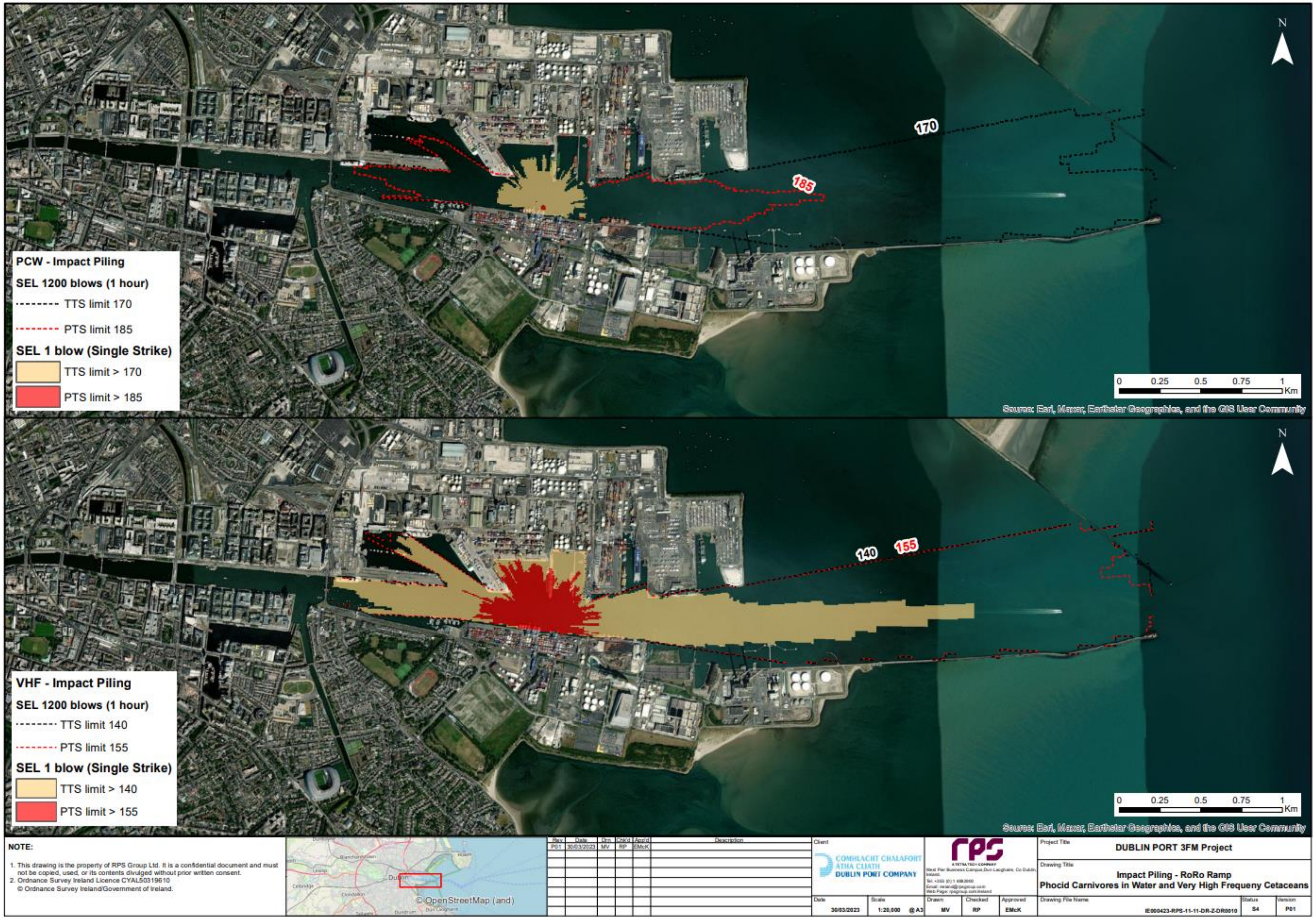
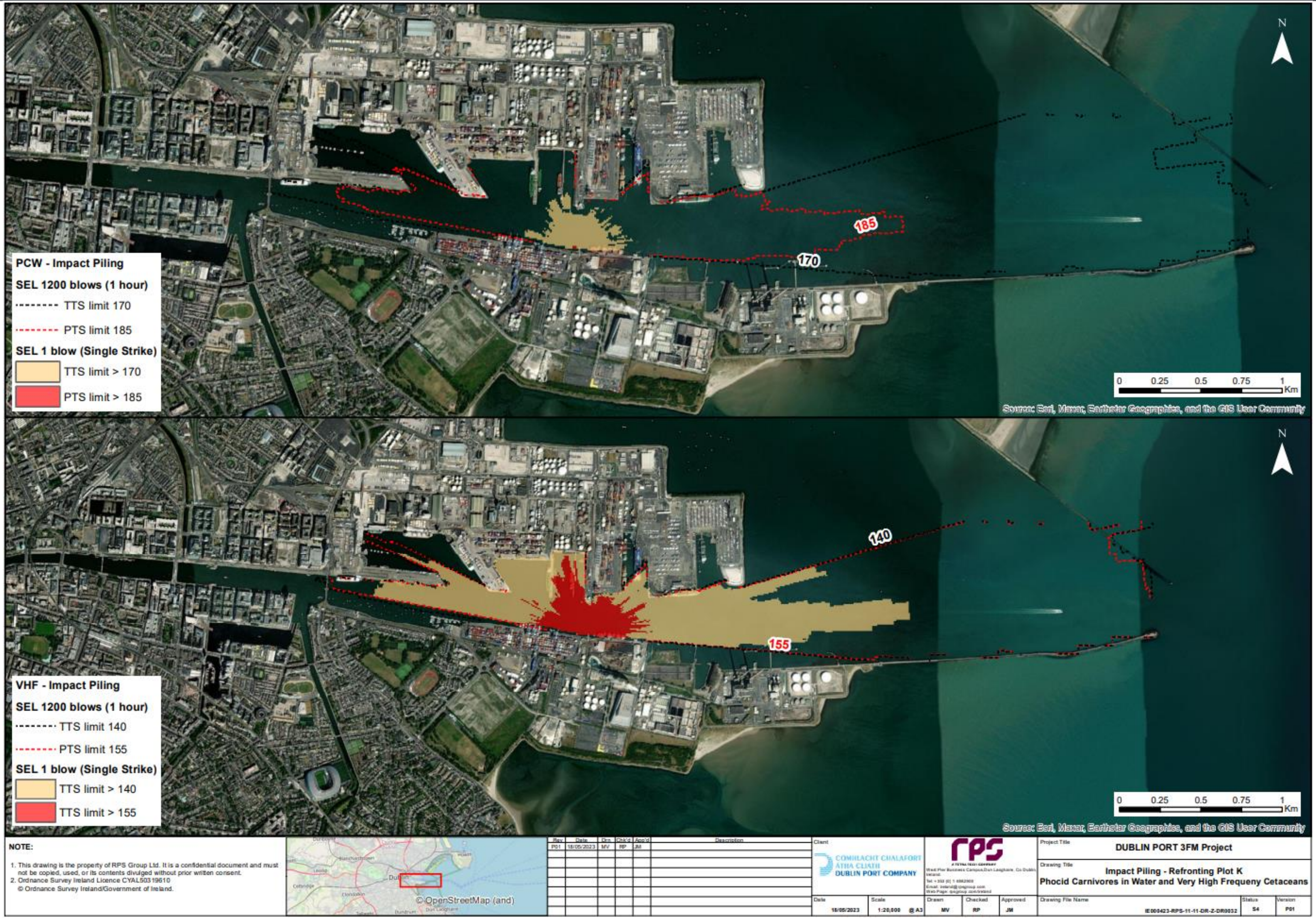


Figure 12.2.17 Impact piling, RO-RO ramp, VHF and PCW hearing group.

Table 12.2.17 Max ranges for impact piling at Area K. (see Figure 12.2.18 and Figure 12.2.19)

Impact piling – Area K, Refronting works,					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	Area K, refronting	Fishes	<10	<10
Impact piling	1 blow	Area K, refronting	VHF	2000	500
Impact piling	1 blow	Area K, refronting	PCW	300	20
Impact piling	1 blow	Area K, refronting	OCW	20	<10
Impact piling	1200 blows	Area K, refronting	Fishes	250	100
Impact piling	1200 blows	Area K, refronting	VHF	3500	3500
Impact piling	1200 blows	Area K, refronting	PCW	3500	1700
Impact piling	1200 blows	Area K, refronting	OCW	1300	200

Figure 12.2.18. Impact piling, Area K, Fish (unweighted) and OCW hearing group.



NOTE:

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50319610
© Ordnance Survey Ireland/Government of Ireland.

Figure 12.2.19. Impact piling, Area K, VHF and PCW hearing group.

Table 12.2.18 Max ranges for vibration piling at Area K.

Area K, Refronting works, Vibro piling					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Vibration piling	1 second	Area K, refronting	Fishes	<10	<10
Vibration piling	1 second	Area K, refronting	VHF	300	<10
Vibration piling	1 second	Area K, refronting	PCW	50	<10
Vibration piling	1 second	Area K, refronting	OCW	<10	<10
Vibration piling	1 hour	Area K, refronting	Fishes	40	<10
Vibration piling	1 hour	Area K, refronting	VHF	3500	1700
Vibration piling	1 hour	Area K, refronting	PCW	3200	300
Vibration piling	1 hour	Area K, refronting	OCW	500	25

Table 12.2.19 Max ranges for impact piling at Area N, single rig, west. (see Figure 12.2.20 and Figure 12.2.21)

Impact Piling – Area N West					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	Area N West	Fishes	<10	<10
Impact piling	1 blow	Area N West	VHF	1500	300
Impact piling	1 blow	Area N West	PCW	250	20
Impact piling	1 blow	Area N West	OCW	5	<10
Impact piling	1200 blows	Area N West	Fishes	150	80
Impact piling	1200 blows	Area N West	VHF	2600	2600
Impact piling	1200 blows	Area N West	PCW	2600	1200
Impact piling	1200 blows	Area N West	OCW	1000	100

Figure 12.2.20. Impact piling, Area N west, Single piling rig, Fish (unweighted) and OCW hearing group.

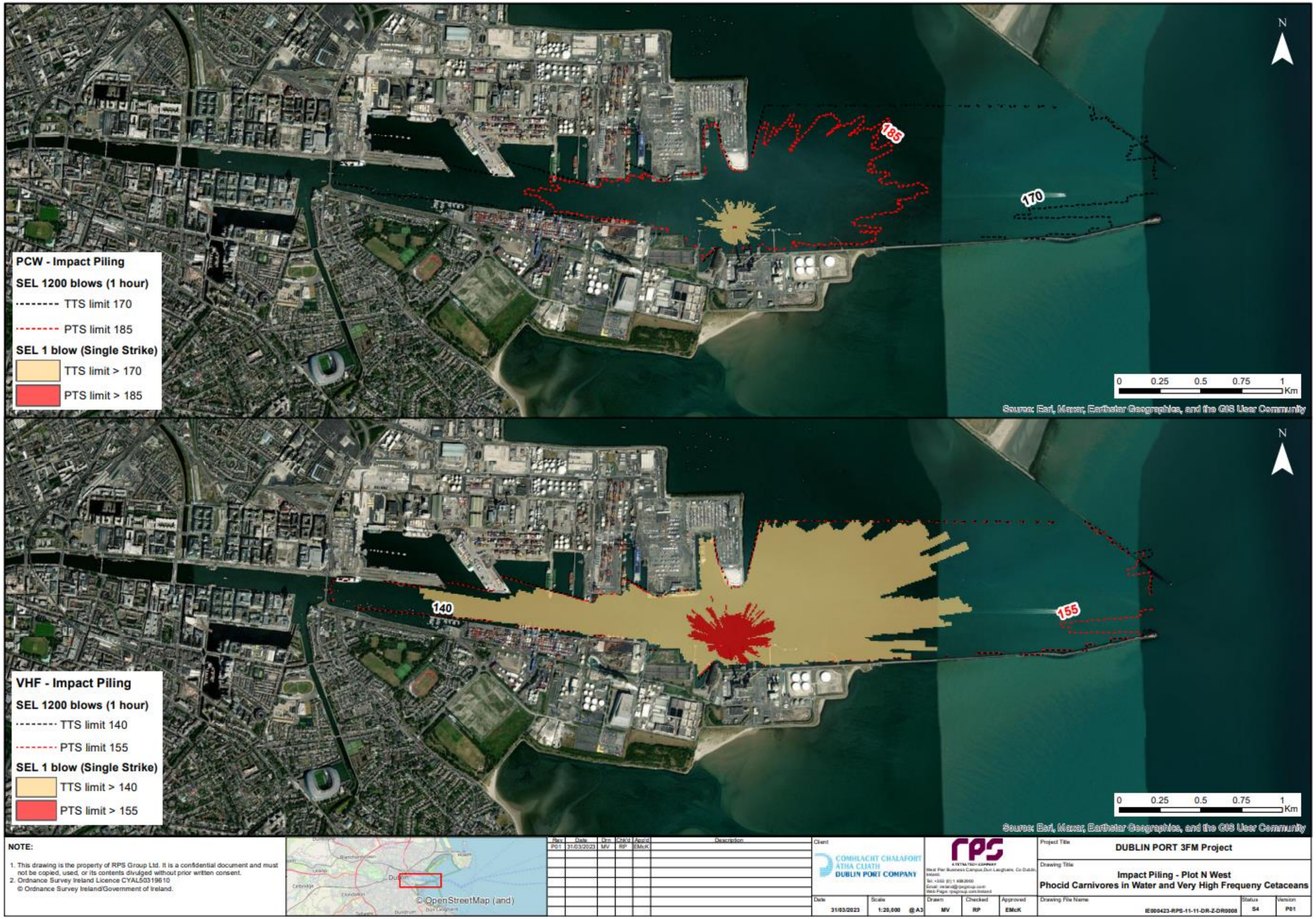
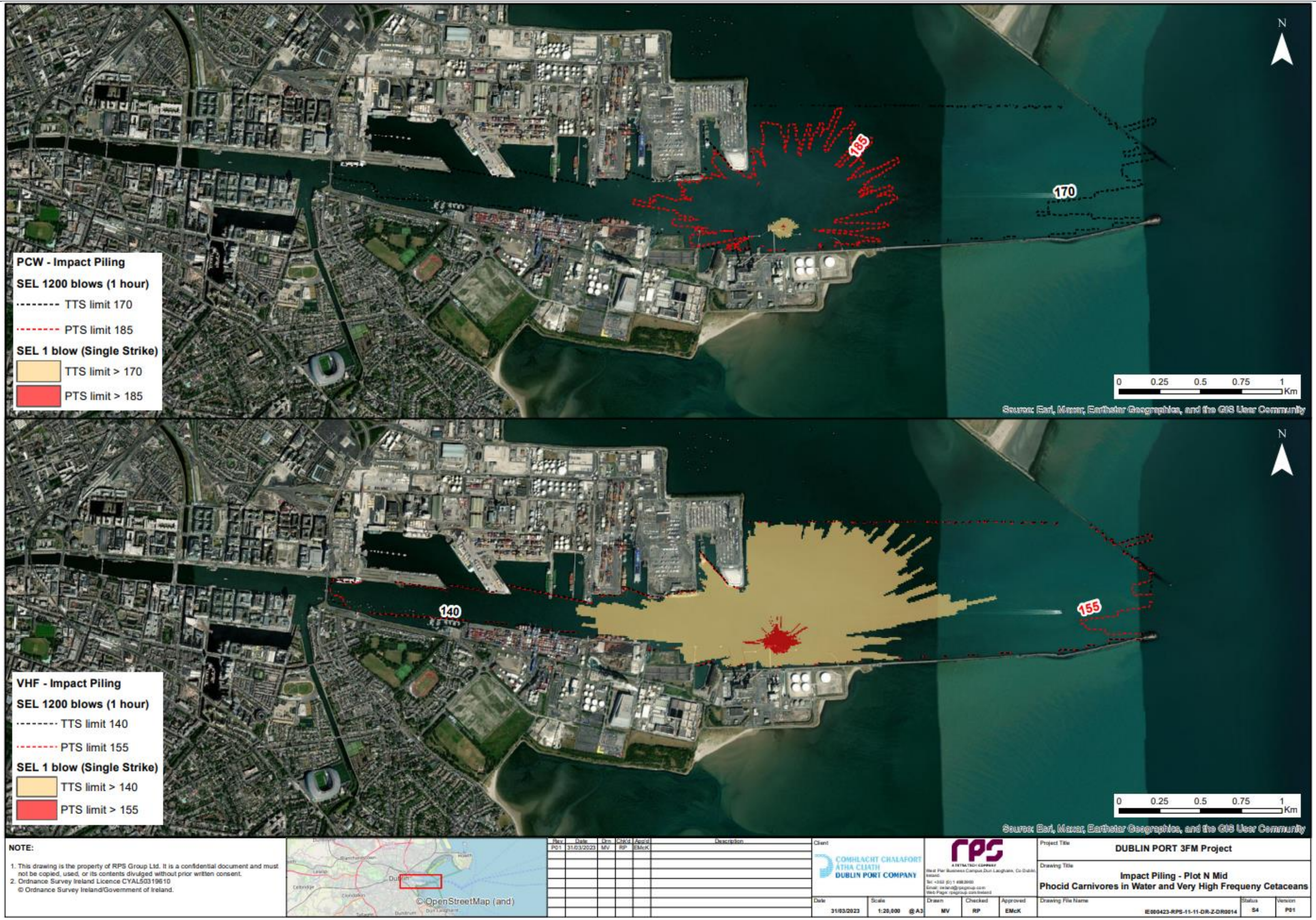


Figure 12.2.21. Impact piling, Area N west, Single piling rig, VHF and PCW hearing group.

Table 12.2.20 Max ranges for impact piling at Area N, single rig, middle location. (see Figure 12.2.22 and Figure 12.2.23)

Impact Piling – Area N Mid					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	Area N Mid	Fishes	<10	<10
Impact piling	1 blow	Area N Mid	VHF	1300	200
Impact piling	1 blow	Area N Mid	PCW	100	20
Impact piling	1 blow	Area N Mid	OCW	<10	<10
Impact piling	1200 blows	Area N Mid	Fishes	100	60
Impact piling	1200 blows	Area N Mid	VHF	2400	2400
Impact piling	1200 blows	Area N Mid	PCW	2400	1000
Impact piling	1200 blows	Area N Mid	OCW	700	60

Figure 12.2.22. Impact piling, Area N middle, Single piling rig, Fish (unweighted) and OCW hearing group.



NOTE:

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50319610
© Ordnance Survey Ireland/Government of Ireland.

Figure 12.2.23. Impact piling, Area N middle, Single piling rig, VHF and PCW hearing group.

Table 12.2.21 Max ranges for impact piling at Area N, single rig, east. (see Figure 12.2.24 and Figure 12.2.25)

Impact Piling – Area N East					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	Area N East	Fishes	<10	<10
Impact piling	1 blow	Area N East	VHF	1500	250
Impact piling	1 blow	Area N East	PCW	150	20
Impact piling	1 blow	Area N East	OCW	10	<10
Impact piling	1200 blows	Area N East	Fishes	160	70
Impact piling	1200 blows	Area N East	VHF	2000	2000
Impact piling	1200 blows	Area N East	PCW	2000	1500
Impact piling	1200 blows	Area N East	OCW	700	70

NOTE:

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50319610
© Ordnance Survey Ireland/Government of Ireland.

Figure 12.2.24. Impact piling, Area N east, Single piling rig, Fish (unweighted) and OCW hearing group.

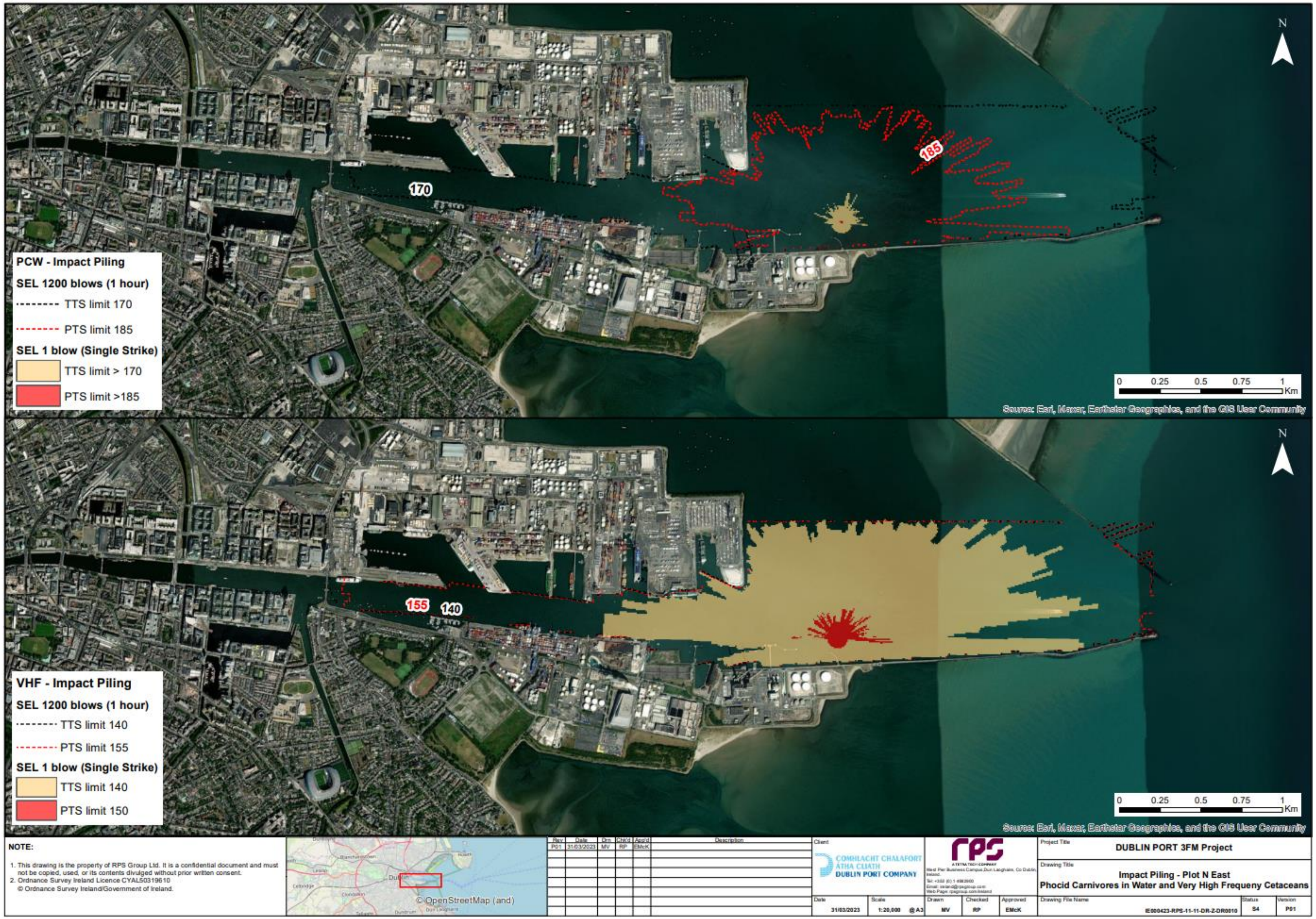


Figure 12.2.25. Impact piling, Area N east, Single piling rig, VHF and PCW hearing group.

Table 12.2.22 Max ranges for impact piling at Area N, 2 rigs simultaneously. (see Figure 12.2.26 and Figure 12.2.27)

Impact Piling – Area N Cumulative					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	Area N Cumulative	Fishes	<10	<10
Impact piling	1 blow	Area N Cumulative	VHF	1400	250
Impact piling	1 blow	Area N Cumulative	PCW	100	15
Impact piling	1 blow	Area N Cumulative	OCW	<10	<10
Impact piling	1200 blows	Area N Cumulative	Fishes	180	60
Impact piling	1200 blows	Area N Cumulative	VHF	2000	2000
Impact piling	1200 blows	Area N Cumulative	PCW	2000	1500
Impact piling	1200 blows	Area N Cumulative	OCW	1000	100

Figure 12.2.26. Impact piling, Area N west + east, two piling rigs, Fish (unweighted) and OCW hearing group.

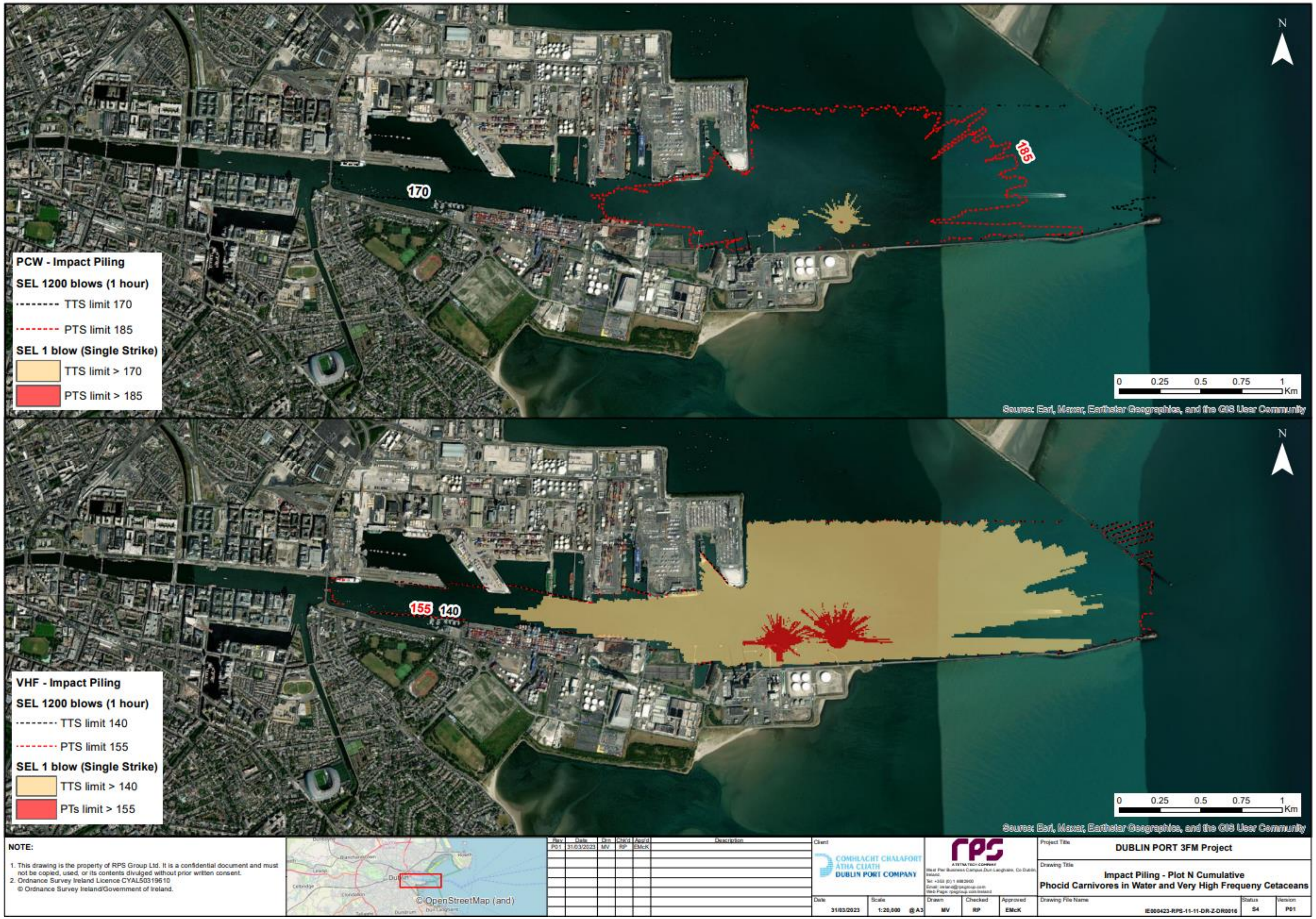


Figure 12.2.27. Impact piling, Area N west + east, two piling rigs, VHF and PCW hearing group.

Table 12.2.23 Max ranges for impact piling at Area N, 5 rigs simultaneously. (see Figure 12.2.28 and Figure 12.2.29)

Impact Piling – Area, N 5 rigs simultaneous					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	Area N x4	Fishes	10	<10
Impact piling	1 blow	Area N x4	VHF	2000	400
Impact piling	1 blow	Area N x4	PCW	250	30
Impact piling	1 blow	Area N x4	OCW	20	<10
Impact piling	1200 blows	Area N x4	Fishes	280	150
Impact piling	1200 blows	Area N x4	VHF	2000	2000
Impact piling	1200 blows	Area N x4	PCW	2000	2000
Impact piling	1200 blows	Area N x4	OCW	1500	250

Figure 12.2.28. Impact piling, Area N, five piling rigs, Fish (unweighted) and OCW hearing group.

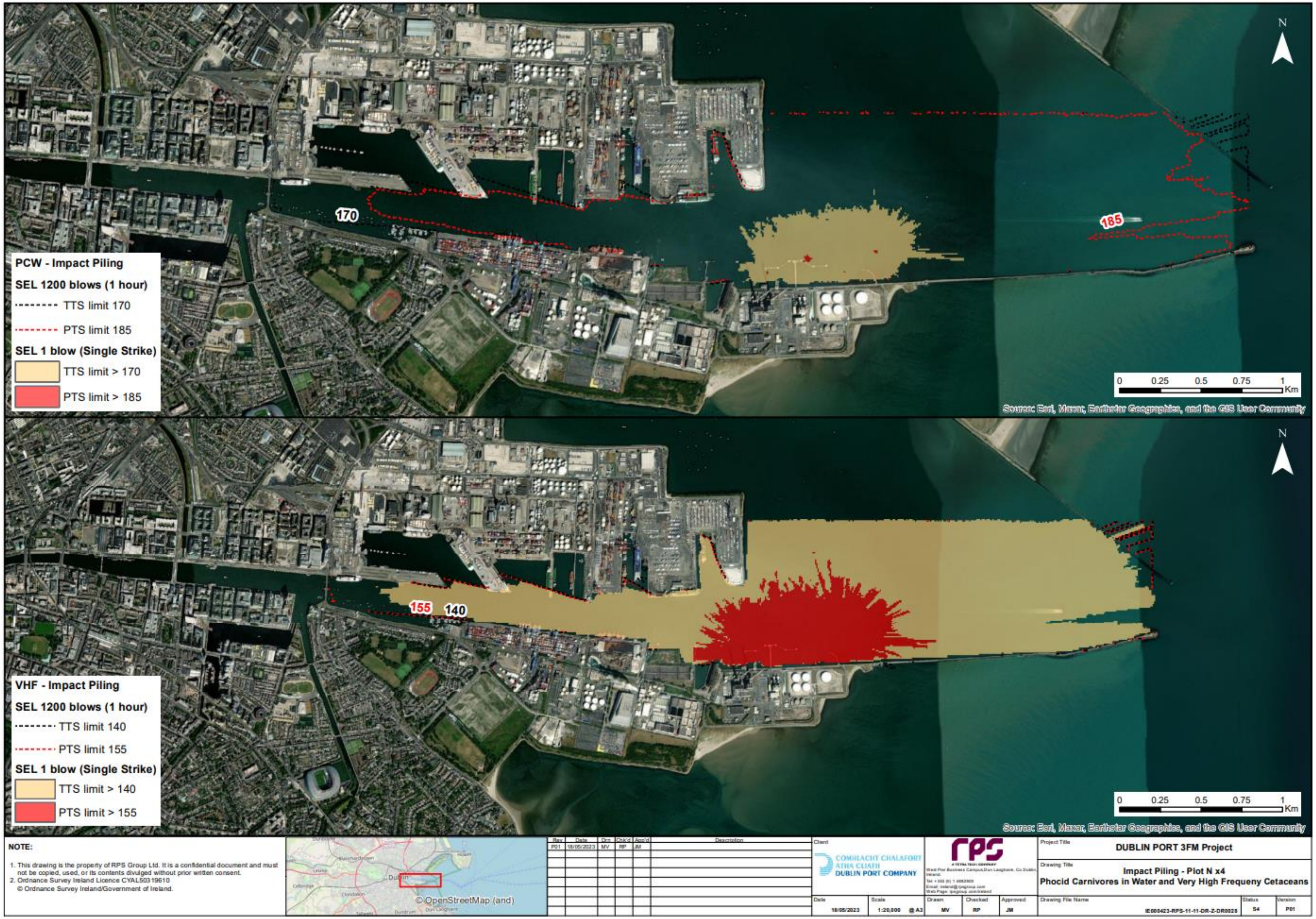


Figure 12.2.29. Impact piling, Area N, five piling rigs, VHF and PCW hearing group.

Table 12.2.24 Max ranges for impact piling at NORA Dolphin. (see Figure 12.2.30 and Figure 12.2.31)

Impact Piling – NORA Dolphin					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	NORA	Fishes	<10	<10
Impact piling	1 blow	NORA	VHF	1500	120
Impact piling	1 blow	NORA	PCW	100	<10
Impact piling	1 blow	NORA	OCW	<10	<10
Impact piling	1200 blows	NORA	Fishes	100	60
Impact piling	1200 blows	NORA	VHF	1900	1900
Impact piling	1200 blows	NORA	PCW	1900	1000
Impact piling	1200 blows	NORA	OCW	600	80

NOTE:

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50319610
© Ordnance Survey Ireland/Government of Ireland.

Figure 12.2.30. Impact piling, NORA Dolphin, Fish (unweighted) and OCW hearing group.

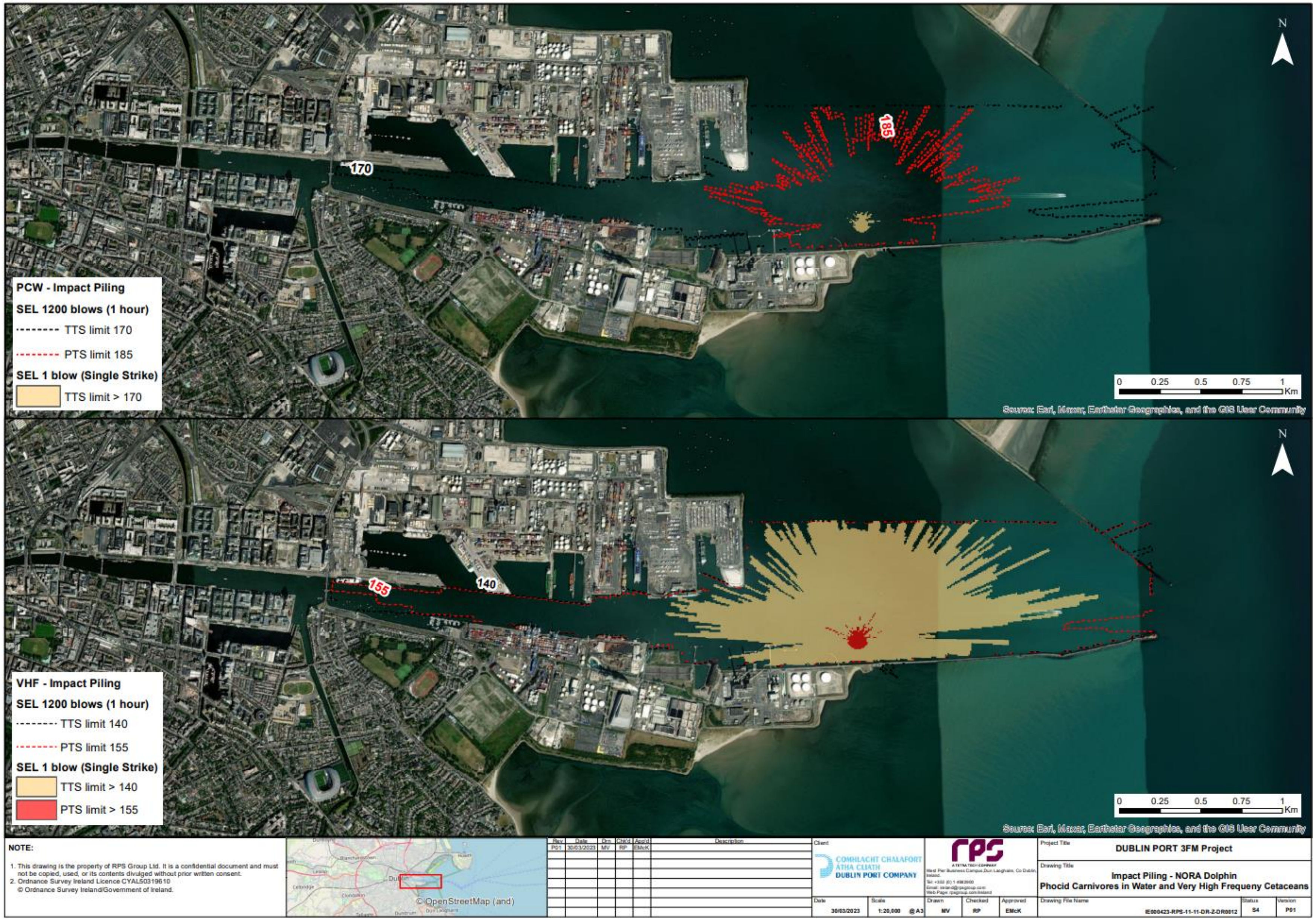


Figure 12.2.31. Impact piling, NORA Dolphin, VHF and PCW hearing group.

Table 12.2.25 Max ranges for vessel noise in main channel, location 1.

Vessel Noise - Channel					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Shipping 1	1 second	Near NORA dolphin	Fishes	<10	<10
Shipping 1	1 second	Near NORA dolphin	VHF	<10	<10
Shipping 1	1 second	Near NORA dolphin	PCW	<10	<10
Shipping 1	1 second	Near NORA dolphin	OCW	<10	<10
Shipping 1	1 hour	Near NORA dolphin	Fishes	<10	<10
Shipping 1	1 hour	Near NORA dolphin	VHF	<10	<10
Shipping 1	1 hour	Near NORA dolphin	PCW	<10	<10
Shipping 1	1 hour	Near NORA dolphin	OCW	<10	<10

Table 12.2.26 Max ranges for vessel noise in main channel, location 2.

Vessel Noise - Channel					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Shipping 2	1 second	Near Ro-Ro ramp	Fishes	<10	<10
Shipping 2	1 second	Near Ro-Ro ramp	VHF	<10	<10
Shipping 2	1 second	Near Ro-Ro ramp	PCW	<10	<10
Shipping 2	1 second	Near Ro-Ro ramp	OCW	<10	<10
Shipping 2	1 hour	Near Ro-Ro ramp	Fishes	<10	<10
Shipping 2	1 hour	Near Ro-Ro ramp	VHF	<10	<10
Shipping 2	1 hour	Near Ro-Ro ramp	PCW	<10	<10
Shipping 2	1 hour	Near Ro-Ro ramp	OCW	<10	<10

Table 12.2.27 Max ranges for dredging noise at Berth 45.

Dredging Noise - Channel					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Dredging	1 second	Berth 45	Fishes	<10	<10
Dredging	1 second	Berth 45	VHF	<10	<10
Dredging	1 second	Berth 45	PCW	<10	<10
Dredging	1 second	Berth 45	OCW	<10	<10
Dredging	1 hour	Berth 45	Fishes	<10	<10
Dredging	1 hour	Berth 45	VHF	50	<10
Dredging	1 hour	Berth 45	PCW	10	<10
Dredging	1 hour	Berth 45	OCW	<10	<10

Table 12.2.28 Max ranges for impact piling at Turning Circle. (see Figure 12.2.32 and Figure 12.2.33)

Dredging Noise - Channel					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	Turning Circle	Fishes	<10	<10
Impact piling	1 blow	Turning Circle	VHF	2200	300
Impact piling	1 blow	Turning Circle	PCW	300	20
Impact piling	1 blow	Turning Circle	OCW	<10	<10
Impact piling	1200 blows	Turning Circle	Fishes	280	100
Impact piling	1200 blows	Turning Circle	VHF	3000	3000
Impact piling	1200 blows	Turning Circle	PCW	3000	1600
Impact piling	1200 blows	Turning Circle	OCW	1400	260

Figure 12.2.32. Impact piling, Turning circle, Fish (unweighted) and OCW hearing group.

Figure 12.2.33. Impact piling, Turning circle, VHF and PCW hearing group.

Table 12.2.29 Max ranges for vibration piling of sheet piles at Turning Circle.

Dredging Noise - Channel					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Vibration piling	1 second	Turning Circle	Fishes	<10	<10
Vibration piling	1 second	Turning Circle	VHF	1000	20
Vibration piling	1 second	Turning Circle	PCW	70	<10
Vibration piling	1 second	Turning Circle	OCW	<10	<10
Vibration piling	1 hour	Turning Circle	Fishes	60	<10
Vibration piling	1 hour	Turning Circle	VHF	3000	2800
Vibration piling	1 hour	Turning Circle	PCW	3000	600
Vibration piling	1 hour	Turning Circle	OCW	1000	20

Table 12.2.30 Max ranges for impact piling at Tern Colony. (see Figure 12.2.34 and Figure 12.2.35)

Dredging Noise - Channel					
Activity	**Duration/blowcount**	**Location name**	**Group**	**TTS risk range**	**PTS risk range**
Impact piling	1 blow	Berth 45	Fishes	<10	<10
Impact piling	1 blow	Berth 45	VHF	1350	210
Impact piling	1 blow	Berth 45	PCW	150	10
Impact piling	1 blow	Berth 45	OCW	<10	<10
Impact piling	1200 blows	Berth 45	Fishes	90	35
Impact piling	1200 blows	Berth 45	VHF	3800	3400
Impact piling	1200 blows	Berth 45	PCW	3100	1200
Impact piling	1200 blows	Berth 45	OCW	1000	80

NOTE:

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. ©Tailte Éireann. All rights reserved. Licence number CYAL50360216

Rev	Date	Drn	Chk'd	App'd	Description
P01	10/06/2024	MV	RP	RP	

Client: COMHLACHT CHALAFORT ÁTHA CLIATH DUBLIN PORT COMPANY

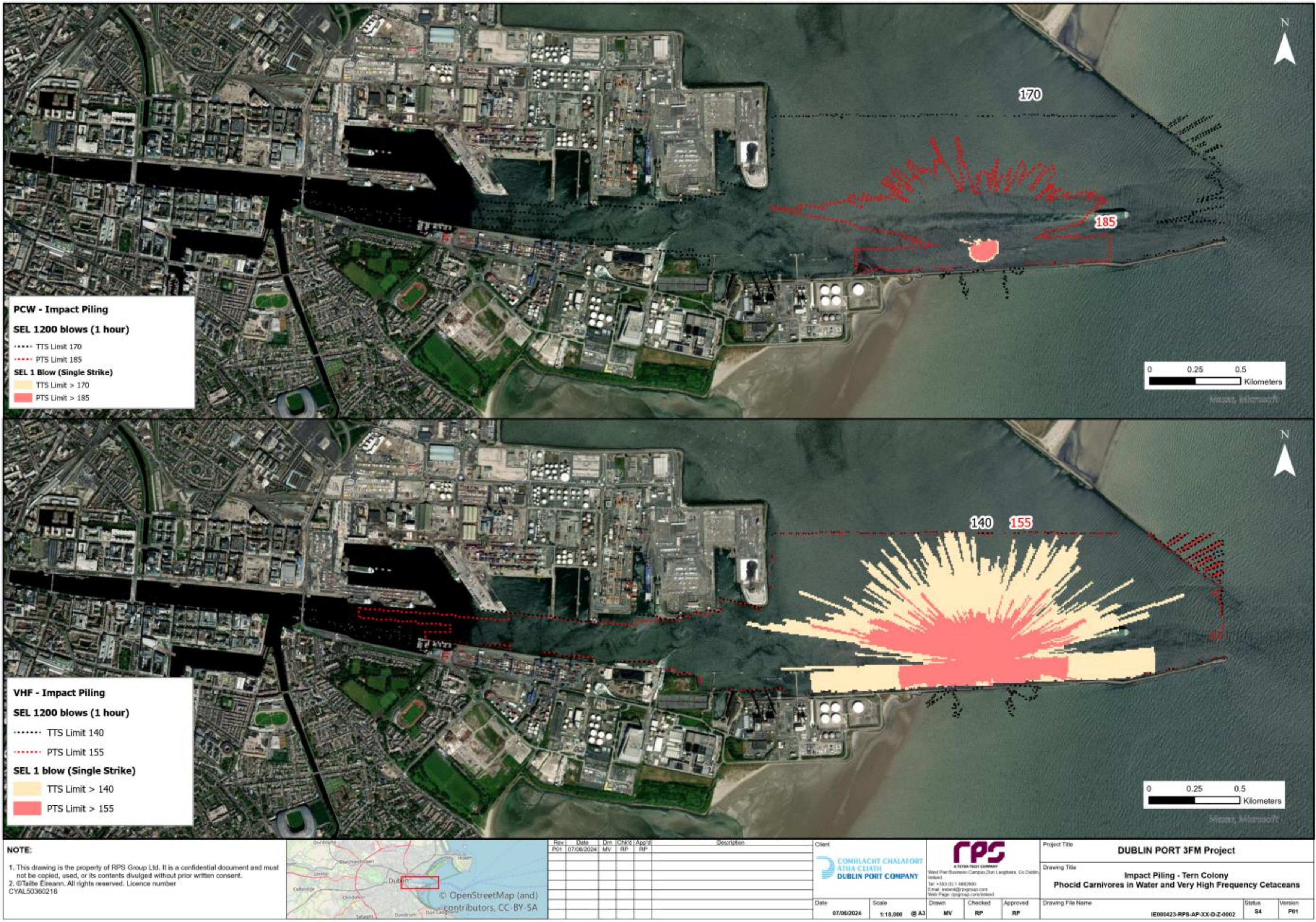
A TETRA TECH COMPANY
West Pier Business Campus,Dun Laoghaire, Co Dublin, Ireland
Tel: +353 (0) 1 4882900
Email: ireland@rpsgroup.com
Web Page: rpsgroup.com/ireland

Project Title: **DUBLIN PORT 3FM Project**

Drawing Title: **Impact Piling - Tern Colony Unweighted/Fishes and Other Marine Carnivores in Water**

Date	Scale	Drawn	Checked	Approved	Drawing File Name	Status	Version
10/06/2024	1:18,000 @ A3	MV	RP	RP	IE000423-RPS-AP-XX-D-Z-0001	S4	P01

Figure 12.2.34. Impact piling, Tern Colony, Fish (unweighted) and OCW hearing group.



NOTE:

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. ©Tailte Éireann. All rights reserved. Licence number CYAL50360216

Figure 12.2.35. Impact piling, Tern Colony, VHF and PCW hearing group.

12.2.7 Cumulative Impacts

DPC has considered the phasing of the 3FM Project with riverside construction works associated with the ABR Project and the MP2 Project.

- ABR Project – Riverside construction works are at an advanced stage and will be completed prior to commencement of the 3FM Project. No cumulative impact is therefore envisaged.
- MP2 Project – Construction of riverside Berths 52 & 53 are expected to commence in 2023. This elements of the MP2 Project will be completed prior to commencement of the 3FM Project. No cumulative impact is therefore envisaged for this element of the MP2 Project. The MP2 Project however also requires riverside works on the North Port at Berth 50A and Oil Berth 3 which is scheduled to commence in 2028. DPC will ensure that piling at Area K, opposite to these Berths, does not take place at the same time. This mitigation measure will ensure no cumulative impact.
- Shipping Traffic - The underwater noise impact of shipping traffic in and out of Dublin Port has been quantified in the baseline measurements and modelled. The cumulative impact of these existing underwater noise sources does not alter the impact of the proposed 3FM Project.

Other projects which have the potential to cause a cumulative impact comprise the following:

- Replacement of elements of the ESB/ Uisce Éireann Discharge Channel adjacent to ESB Poolbeg Generating Station – Further to consultation with ESB and Irish Water it is expected that these works will be completed prior to commencement of the 3FM Project. No cumulative impact is therefore envisaged,
- Proposals for Point Bridge (upstream of Tom Clarke Bridge) and Dodder Bridge – These projects are being developed by Dublin City Council (DCC). They are at an early stage in the design process and have not been advanced to planning. Nevertheless, it is likely that the timeframe for these projects will overlap with the 3FM Project. DPC, in consultation with DCC, will ensure that piling at the SPAR Bridge and Point Bridge/Dodder Bridge does not take place at the same time. This mitigation measure will ensure no cumulative impact.

12.2.8 Mitigation Measures

12.2.8.1 Construction Phase

Noise levels arising during the construction phase are significant, especially compared to the limits of the PCW and VHF groups (seals and porpoises) with likely significant hearing impact (TTS) and hearing injury (PTS) following impact piling if present inside the port (inside the South and North wall). The most significant impacts will 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 simultaneously.
- Impact piling at the NORA dolphin, given its proximity to the dredged channel.

Levels inside the South and North Walls will exceed both the PTS and TTS limit for the VHF group (harbour porpoises) for the whole port area within an hour (1200 blows) and for the PCW hearing group (seals), the TTS threshold will be exceeded throughout the port, with the PTS limit exceeded to approximately 1km range. Given the above, a range of mitigation measures will be implemented during the construction works. Table 12.2.31 presents a summary of the mitigation measures.

Table 12.2.31 Table of Proposed Mitigation

Impact/Concern	Magnitude	Significance	Proposed Mitigation
Hearing injury or serios impact from underwater noise from impact piling. PCW and VHF groups.	Significant increase in impulsive noise capable of causing serious hearing impact or injury.	Severe risk of exceedance of TTS and PTS limits for VHF and PCW hearing groups.	Marine Mammal Observer to scan prior to impact pile driving in accordance with NPWS guidelines for impact piling, and seek to verify that there are no porpoises within the port walls before impact piling starts and that seals are 1000 m from the piling site. During impact piling at NORA dolphin, Ro-Ro ramp, and “Area N” an additional MMO will be present on the easternmost part pf Dublin Port, north of the Liffey to monitor animals fleeing into the shallow water north of the channel. Use of slow starts of impact piling after MMO verified absence of animals, 30 second inter-blow-intervals for impact piling unless results from monitoring show modelled levels to be higher than real levels.
Fish migration	Assuming fish response to TTS levels, potential intermittent impact on movement upriver.	Slight to none, TTS limits are only exceeded to <50 m for 10 min continuous impact piling (worst case)	Exclusionary period March-May on riverside impact piling works Daytime operation

12.2.8.2 Operational Phase

Underwater noise levels during the operational phase of the 3FM Project are not expected to change the underwater noise levels in any measurable way. No mitigation measures are therefore required for the operational phase.

12.2.9 Monitoring

Underwater noise monitoring surveys will be carried out during the construction phase to verify the modelling assumptions and results.

12.2.10 Conclusions

Given implementation of the proposed mitigation, there is little to no risk of exceedance of TTS or PTS thresholds during the construction phase (minimum two years for Area N).

No significant underwater noise levels will arise during the operation of Dublin Port.

APPENDIX 12.3 – SOURCE BAND LEVELS

Unweighted source band levels for the three types of piling.

Centre band frequency [Hz]	Impact piling Single blow SEL	Vibration piling round piles 1 second SPL	Vibration piling sheet piles 1 second SPL
316	196	186	162
398	197	211	172
501	196	190	167
631	207	185	183
794	186	185	180
1000	189	173	185
1250	196	151	188
1600	194	161	201
2000	194	146	194
2500	196	158	187
3150	199	160	181
4000	197	134	189
5000	196	122	192
6300	191	115	195
8000	191	169	187
10000	194	151	180
12500	187	90	171
16000	171	112	147

Appendix C: Ornithology Surveys

Contents

APPENDIX 7.5.1

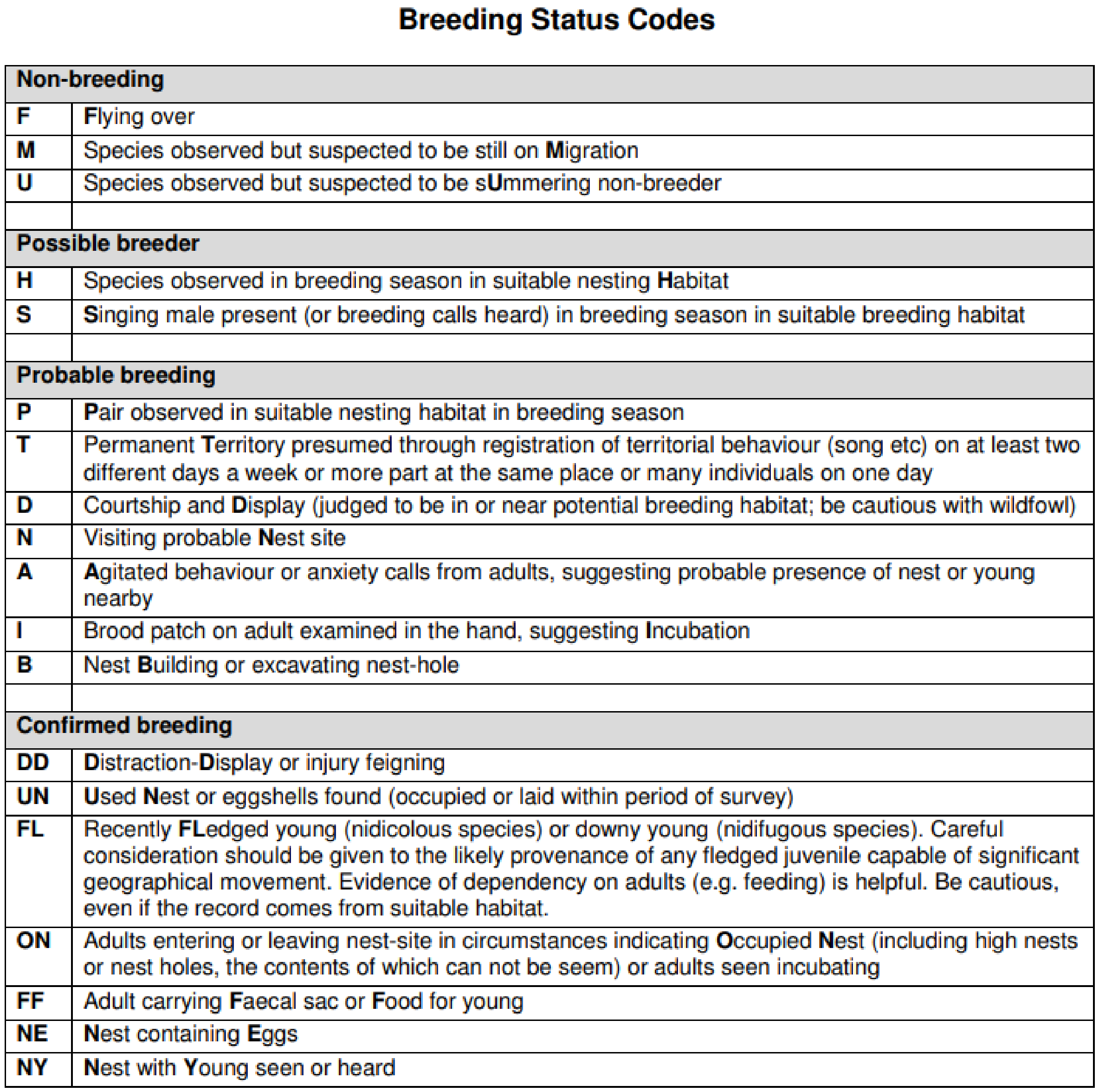
-

7.5.1a BTO Species Codes

BTO SPECIES CODES

AC	Arctic Skua	GA	Gadwall	LE	Long-eared Owl	SM	Sand Martin
AE	Arctic Tern	GX	Gannet	LT	Long-tailed Tit	SS	Sanderling
AV	Avocet	GW	Garden Warbler	MG	Magpie	TE	Sandwich Tern
BO	Barn Owl	GY	Garganey	MA	Mallard	VI	Savi's Warbler
BY	Barnacle Goose	GC	Goldcrest	MN	Mandarin Duck	SQ	Scarlet Rosefinch
BA	Bar-tailed Godwit	EA	Golden Eagle	MX	Manx Shearwater	SP	Scaup
BR	Bearded Tit	OL	Golden Oriole	MR	Marsh Harrier	CY	Scottish Crossbill
BS	Berwick's Swan	GF	Golden Pheasant	MT	Marsh Tit	SW	Sedge Warbler
BI	Bittern	GP	Golden Plover	MW	Marsh Warbler	NS	Serin
BK	Black Grouse	GN	Goldeneye	MP	Meadow Pipit	SA	Shag
TY	Black Guillemot	GO	Goldfinch	MU	Mediterranean Gull	SU	Shelduck
BX	Black Redstart	GD	Goosander	ML	Merlin	SX	Shorelark
BJ	Black Tern	GI	Goshawk	M.	Mistle Thrush	SE	Short-eared Owl
B.	Blackbird	GH	Grasshopper Warbler	MO	Montagu's Harrier	SV	Shoveler
BC	Blackcap	GB	Great Black-backed Gull	MH	Moorhen	SK	Siskin
BH	Black-headed Gull	GG	Great Crested Grebe	MS	Mute Swan	S.	Skylark
BN	Black-necked Grebe	ND	Great Northern Diver	N.	Nightingale	SZ	Slavonian Grebe
BW	Black-tailed Godwit	NX	Great Skua	NJ	Nightjar	SN	Snipe
BV	Black-throated Diver	GS	Great Spotted Woodpecker	NH	Nuthatch	SB	Snow Bunting
BT	Blue Tit	GT	Great Tit	OP	Osprey	ST	Song Thrush
BU	Bluethroat	GE	Green Sandpiper	OC	Oystercatcher	SH	Sparrowhawk
BL	Brambling	G.	Green Woodpecker	PX	Peafowl/Peacock	AK	Spotted Crake
BG	Brent Goose	GR	Greenfinch	PE	Peregrine	SF	Spotted Flycatcher
BF	Bullfinch	GK	Greenshank	PH	Pheasant	DR	Spotted Redshank
BZ	Buzzard	H.	Grey Heron	PF	Pied Flycatcher	SG	Starling
CG	Canada Goose	P.	Grey Partridge	PW	Pied Wagtail	SD	Stock Dove
CP	Capercaillie	GV	Grey Plover	PG	Pink-footed Goose	SC	Stonechat
C.	Carrion Crow	GL	Grey Wagtail	PT	Pintail	TN	Stone-curlew
CW	Cetti's Warbler	GJ	Greylag Goose	PO	Pochard	TM	Storm Petrel
CH	Chaffinch	GU	Guillemot	PM	Ptarmigan	SL	Swallow
CC	Chiffchaff	FW	Guineafowl (Helmeted)	PU	Puffin	SI	Swift
CF	Chough	HF	Hawfinch	PS	Purple Sandpiper	TO	Tawny Owl
CL	Cirl Bunting	HH	Hen Harrier	Q.	Quail	T.	Teal
CT	Coal Tit	HG	Herring Gull	RN	Raven	TK	Temminck's Stint
CD	Collared Dove	HY	Hobby	RA	Razorbill	TP	Tree Pipit
CM	Common Gull	HZ	Honey Buzzard	RG	Red Grouse	TS	Tree Sparrow
CS	Common Sandpiper	HC	Hooded Crow	KT	Red Kite	TC	Treecreeper
CX	Common Scoter	HP	Hoopoe	ED	Red-backed Shrike	TU	Tufted Duck
CN	Common Tern	HM	House Martin	RM	Red-breasted Merganser	TT	Turnstone
CO	Coot	HS	House Sparrow	RQ	Red-crested Pochard	TD	Turtle Dove
CA	Cormorant	JD	Jackdaw	FV	Red-footed Falcon	TW	Twite
CB	Corn Bunting	J.	Jay	RL	Red-legged Partridge	WA	Water Rail
CE	Corncrake	K.	Kestrel	NK	Red-necked Phalarope	W.	Wheatear
CI	Crested Tit	KF	Kingfisher	LR	Redpoll (Lesser)	WM	Whimbrel
CR	Crossbill (Common)	KI	Kittiwake	RK	Redshank	WC	Whinchat
CK	Cuckoo	KN	Knot	RT	Redstart	WG	White-fronted Goose
CU	Curlew	LM	Lady Amherst's Pheasant	RH	Red-throated Diver	WH	Whitethroat
DW	Dartford Warbler	LA	Lapland Bunting	RE	Redwing	WS	Whooper Swan
DI	Dipper	L.	Lapwing	RB	Reed Bunting	WN	Wigeon
DO	Dotterel	TL	Leach's Petrel	RW	Reed Warbler	WT	Willow Tit
DN	Dunlin	LB	Lesser Black-backed Gull	RZ	Ring Ouzel	WW	Willow Warbler
D.	Dunnock	LS	Lesser Spotted Woodpecker	RP	Ringed Plover	OD	Wood Sandpiper
EG	Egyptian Goose	LW	Lesser Whitethroat	RI	Ring-necked Parakeet	WO	Wood Warbler
E.	Eider	LI	Linnet	R.	Robin	WK	Woodcock
FP	Feral Pigeon	ET	Little Egret	DV	Rock Dove (not feral)	WL	Woodlark
ZL	Feral/hybrid goose	LG	Little Grebe	RC	Rock Pipit	WP	Woodpigeon
ZF	Feral/hybrid mallard type	LU	Little Gull	RO	Rook	WR	Wren
FF	Fieldfare	LO	Little Owl	RS	Roseate Tern	WY	Wryneck
FC	Firecrest	LP	Little Ringed Plover	RY	Ruddy Duck	YW	Yellow Wagtail
F.	Fulmar	AF	Little Tern	RU	Ruff	Y.	Yellowhammer

7.5.1b BTO Breeding Status Codes



Breeding Status Codes

Non-breeding	
F	**F**lying over
M	Species observed but suspected to be still on **M**igration
U	Species observed but suspected to be s**U**mmering non-breeder
Possible breeder	
H	Species observed in breeding season in suitable nesting **H**abitat
S	**S**inging male present (or breeding calls heard) in breeding season in suitable breeding habitat
Probable breeding	
P	**P**air observed in suitable nesting habitat in breeding season
T	Permanent **T**erritory presumed through registration of territorial behaviour (song etc) on at least two different days a week or more part at the same place or many individuals on one day
D	Courtship and **D**isplay (judged to be in or near potential breeding habitat; be cautious with wildfowl)
N	Visiting probable **N**est site
A	**A**gitated behaviour or anxiety calls from adults, suggesting probable presence of nest or young nearby
I	Brood patch on adult examined in the hand, suggesting **I**ncubation
B	Nest **B**uilding or excavating nest-hole
Confirmed breeding	
DD	**D**istraction-**D**isplay or injury feigning
UN	**U**sed **N**est or eggshells found (occupied or laid within period of survey)
FL	Recently **FL**edged young (nidicolous species) or downy young (nidifugous species). Careful consideration should be given to the likely provenance of any fledged juvenile capable of significant geographical movement. Evidence of dependency on adults (e.g. feeding) is helpful. Be cautious, even if the record comes from suitable habitat.
ON	Adults entering or leaving nest-site in circumstances indicating **O**ccupied **N**est (including high nests or nest holes, the contents of which can not be seem) or adults seen incubating
FF	Adult carrying **F**aecal sac or **F**ood for young
NE	**N**est containing **E**ggs
NY	**N**est with **Y**oung seen or heard

7.5.1c Qualifying Interests SPAs

South Dublin Bay and River Tolka Estary SPA

- Light-bellied Brent Goose (Branta bernicla hrota) [A046]
- Oystercatcher (Haematopus ostralegus) [A130]
- Ringed Plover (Charadrius hiaticula) [A137]
- Grey Plover (Pluvialis squatarola) [A141]
- Knot (Calidris canutus) [A143]
- Sanderling (Calidris alba) [A144]
- Dunlin (Calidris alpina) [A149]
- Bar-tailed Godwit (Limosa lapponica) [A157]
- Redshank (Tringa totanus) [A162]
- Black-headed Gull (Chroicocephalus ridibundus) [A179]
- Roseate Tern (Sterna dougallii) [A192]
- Common Tern (Sterna hirundo) [A193]
- Arctic Tern (Sterna paradisaea) [A194]
- Wetland and Waterbirds [A999]

North Bull Island SPA

- Light-bellied Brent Goose (Branta bernicla hrota) [A046]
- Shelduck (Tadorna tadorna) [A048]
- Teal (Anas crecca) [A052]
- Pintail (Anas acuta) [A054]
- Shoveler (Anas clypeata) [A056]
- Oystercatcher (Haematopus ostralegus) [A130]
- Golden Plover (Pluvialis apricaria) [A140]
- Grey Plover (Pluvialis squatarola) [A141]
- Knot (Calidris canutus) [A143]
- Sanderling (Calidris alba) [A144]
- Dunlin (Calidris alpina) [A149]

- Black-tailed Godwit (Limosa limosa) [A156]
- Bar-tailed Godwit (Limosa lapponica) [A157]
- Curlew (Numenius arquata) [A160]
- Redshank (Tringa totanus) [A162]
- Turnstone (Arenaria interpres) [A169]
- Black-headed Gull (Chroicocephalus ridibundus) [A179]
- Wetland and Waterbirds [A999]

Baldoyle Bay SPA

- Light-bellied Brent Goose (Branta bernicla hrota) [A046]
- Shelduck (Tadorna tadorna) [A048]
- Ringed Plover (Charadrius hiaticula) [A137]
- Golden Plover (Pluvialis apricaria) [A140]
- Grey Plover (Pluvialis squatarola) [A141]
- Bar-tailed Godwit (Limosa lapponica) [A157]
- Wetland and Waterbirds [A999]

Dalkey Islands SPA

- Roseate Tern (Sterna dougallii) [A192]
- Common Tern (Sterna hirundo) [A193]
- Arctic Tern (Sterna paradisaea) [A194]

Howth Head SPA

- Kittiwake (Rissa tridactyla) [A188]

Ireland's Eye SPA

- Cormorant (Phalacrocorax carbo) [A017]
- Herring Gull (Larus argentatus) [A184]

- Kittiwake (Rissa tridactyla) [A188]
- Guillemot (Uria aalge) [A199]
- Razorbill (Alca torda) [A200]

Malahide Estuary SPA

- Great Crested Grebe (Podiceps cristatus) [A005]
- Light-bellied Brent Goose (Branta bernicla hrota) [A046]
- Shelduck (Tadorna tadorna) [A048]
- Pintail (Anas acuta) [A054]
- Goldeneye (Bucephala clangula) [A067]
- Red-breasted Merganser (Mergus serrator) [A069]
- Oystercatcher (Haematopus ostralegus) [A130]
- Golden Plover (Pluvialis apricaria) [A140]
- Grey Plover (Pluvialis squatarola) [A141]
- Knot (Calidris canutus) [A143]
- Dunlin (Calidris alpina) [A149]
- Black-tailed Godwit (Limosa limosa) [A156]
- Bar-tailed Godwit (Limosa lapponica) [A157]
- Redshank (Tringa totanus) [A162]
- Wetland and Waterbirds [A999]

7.5.1d Vantage Point Survey

Date	Species	Number	Height band
30/09/2022	Herring Gull	2	B
30/09/2022	Herring Gull	4	B
30/09/2022	Black-headed Gull	6	B
30/09/2022	Herring Gull	11	C
30/09/2022	Herring Gull	4	C
30/09/2022	Black-headed Gull	2	B
30/09/2022	Herring Gull	5	C
30/09/2022	Black-headed Gull	2	B
30/09/2022	Black-headed Gull	2	C
30/09/2022	Herring Gull	7	C
30/09/2022	Black-headed Gull	4	C
30/09/2022	Herring Gull	12	C
30/09/2022	Herring Gull	7	C
30/09/2022	Black-headed Gull	4	A
30/09/2022	Buzzard	1	C
30/09/2022	Herring Gull	7	B
30/09/2022	Black-headed Gull	6	A
30/09/2022	Herring Gull	13	C
30/09/2022	Herring Gull	7	C
30/09/2022	Black-headed Gull	5	A
30/09/2022	Herring Gull	14	B
26/10/2022	Herring Gull	9	A
26/10/2022	Herring Gull	6	B
26/10/2022	Black-headed Gull	7	B
26/10/2022	Common Gull	3	B
26/10/2022	Mediterranean Gull	1	A
26/10/2022	Black-headed Gull	9	A
26/10/2022	Herring Gull	6	B
26/10/2022	Herring Gull	11	B
26/10/2022	Common Gull	4	A
28/11/2022	Black-headed Gull	7	C
28/11/2022	Herring Gull	8	B
28/11/2022	Herring Gull	3	B
28/11/2022	Black-headed Gull	11	B
28/11/2022	Mallard	6	C

APPENDIX 7.5.1

Date	Species	Number	Height band
28/11/2022	Black-headed Gull	17	C
28/11/2022	Herring Gull	14	C
28/11/2022	Cormorant	1	C
28/11/2022	Cormorant	2	C
28/11/2022	Herring Gull	22	C
28/11/2022	Black-headed Gull	19	B
28/11/2022	Black-headed Gull	11	B
28/11/2022	Black-headed Gull	3	B
28/11/2022	Black-headed Gull	7	B
13/12/2022	Herring Gull	7	B
13/12/2022	Black-headed Gull	3	B
13/12/2022	Herring Gull	9	C
13/12/2022	Herring Gull	3	B
13/12/2022	Black-headed Gull	3	B
13/12/2022	Black-headed Gull	11	C
13/12/2022	Shag	2	C
13/12/2022	Herring Gull	19	B
13/12/2022	Great Black-backed Gull	1	C
13/12/2022	Herring Gull	6	C
13/12/2022	Herring Gull	3	B
13/12/2022	Mediterranean Gull	1	A
21/12/2022	Herring Gull	7	B
21/12/2022	Herring Gull	9	C
21/12/2022	Black-headed Gull	2	C
21/12/2022	Black-headed Gull	3	C
21/12/2022	Black-headed Gull	17	C
21/12/2022	Herring Gull	8	B
21/12/2022	Mediterranean Gull	2	B
21/12/2022	Black-headed Gull	2	C
21/12/2022	Herring Gull	7	B
21/12/2022	Shag	1	C
21/12/2022	Black-headed Gull	1	B
21/12/2022	Herring Gull	3	B
21/12/2022	Herring Gull	1	C
21/12/2022	Black-headed Gull	11	C
21/12/2022	Herring Gull	16	B
21/12/2022	Sparrowhawk	1	C

Date	Species	Number	Height band
26/01/2023	Herring Gull	3	C
26/01/2023	Herring Gull	7	B
26/01/2023	Herring Gull	1	B
26/01/2023	Black-headed Gull	7	B
26/01/2023	Herring Gull	9	B
26/01/2023	Great Black-backed Gull	1	B
26/01/2023	Black-headed Gull	1	B
26/01/2023	Black-headed Gull	7	B
26/01/2023	Common Gull	2	B
26/01/2023	Black-headed Gull	11	B
26/01/2023	Common Gull	3	C
17/01/2023	Herring Gull	3	B
17/01/2023	Black-headed Gull	2	B
17/01/2023	Brent Goose	7	C
17/01/2023	Black-headed Gull	3	B
17/01/2023	Grey Heron	1	B
17/01/2023	Herring Gull	9	C
17/01/2023	Cormorant	1	C
17/01/2023	Mallard	2	C
02/02/2023	Black-headed Gull	11	B
02/02/2023	Black-headed Gull	6	B
02/02/2023	Common Gull	3	B
02/02/2023	Great Black-backed Gull	2	B
02/02/2023	Herring Gull	7	C
02/02/2023	Herring Gull	7	A
02/02/2023	Lesser Black-backed Gull	1	B
02/02/2023	Herring Gull	2	C
02/02/2023	Lesser Black-backed Gull	1	B
02/02/2023	Herring Gull	1	B
02/02/2023	Black-headed Gull	19	C
02/02/2023	Mallard	3	C
02/02/2023	Herring Gull	3	C
02/02/2023	Great Black-backed Gull	1	C
11/02/2023	Herring Gull	27	C
11/02/2023	Black-headed Gull	19	B
11/02/2023	Lesser Black-backed Gull	1	B
11/02/2023	Lesser Black-backed Gull	2	B

Date	Species	Number	Height band
11/02/2023	Black-headed Gull	11	B
11/02/2023	Great Black-backed Gull	1	B
11/02/2023	Herring Gull	6	C
11/02/2023	Black-headed Gull	7	C
11/02/2023	Mediterranean Gull	1	B
11/03/2023	Black-headed Gull	7	C
11/03/2023	Herring Gull	2	C
11/03/2023	Herring Gull	9	C
11/03/2023	Herring Gull	2	B
11/03/2023	Herring Gull	3	B
11/03/2023	Brent Goose	3	C
11/03/2023	Herring Gull	4	C
11/03/2023	Brent Goose	11	C
11/03/2023	Herring Gull	9	C
11/03/2023	Black-headed Gull	1	C
11/03/2023	Black-headed Gull	6	A
11/03/2023	Common Gull	7	B
11/03/2023	Common Gull	3	A
11/03/2023	Lesser Black-backed Gull	2	C
25/03/2023	Herring Gull	7	B
25/03/2023	Black-headed Gull	11	C
25/03/2023	Herring Gull	3	C
25/03/2023	Herring Gull	9	B
25/03/2023	Herring Gull	7	C
25/03/2023	Herring Gull	7	C
25/03/2023	Sparrowhawk	1	A
25/03/2023	Black-headed Gull	4	C
02/02/2024	Cormorant	1	B
02/02/2024	Brent Goose	9	B
02/02/2024	Herring Gull	5	B
02/02/2024	Herring Gull	2	A
02/02/2024	Black Guillemot	1	A
02/02/2024	Black-headed Gull	7	A
02/02/2024	Black-headed Gull	3	B
02/02/2024	Mallard	4	B
02/02/2024	Cormorant	1	B

APPENDIX 7.5.1

Date	Species	Number	Height band
02/02/2024	Brent Goose	5	A
02/02/2024	Herring Gull	6	B
02/02/2024	Common Gull	3	B
02/02/2024	Black-headed Gull	11	B
02/02/2024	Cormorant	1	A
02/02/2024	Oystercatcher	2	B
02/02/2024	Black-headed Gull	6	A
02/02/2024	Black-headed Gull	3	B
02/02/2024	Black Guillemot	1	A
02/02/2024	Black-headed Gull	9	A
02/02/2024	Common Gull	2	A
02/02/2024	Great Black-backed Gull	2	B
02/02/2024	Herring Gull	4	B
27/02/2024	Brent Goose	9	B
27/02/2024	Herring Gull	4	B
27/02/2024	Brent Goose	11	B
27/02/2024	Black-headed Gull	2	A
27/02/2024	Black-headed Gull	6	B
27/02/2024	Black-headed Gull	14	A
27/02/2024	Cormorant	1	A
27/02/2024	Common Gull	3	B
27/02/2024	Great Black-backed Gull	2	B
27/02/2024	Mallard	1	A
27/02/2024	Black-headed Gull	2	B
27/02/2024	Herring Gull	4	C
27/02/2024	Black-headed Gull	6	A
27/02/2024	Common Gull	1	B
27/02/2024	Black-headed Gull	3	B
27/02/2024	Black-headed Gull	9	B
27/02/2024	Black-headed Gull	27	C
05/03/2024	Black Guillemot	1	A
05/03/2024	Black Guillemot	2	A
05/03/2024	Oystercatcher	2	B
05/03/2024	Herring Gull	5	C
05/03/2024	Common Gull	3	C
05/03/2024	Black-headed Gull	3	B
05/03/2024	Brent Goose	22	B

Date	Species	Number	Height band
05/03/2024	Little Egret	1	B
05/03/2024	Cormorant	1	B
05/03/2024	Grey Heron	1	A
05/03/2024	Oystercatcher	2	B
05/03/2024	Black Guillemot	2	A
05/03/2024	Mallard	2	A
05/03/2024	Black Guillemot	2	A
05/03/2024	Herring Gull	4	C
05/03/2024	Redshank	2	A
05/03/2024	Mallard	2	B
05/03/2024	Mute Swan	2	B
05/03/2024	Great Black-backed Gull	2	C
05/03/2024	Mallard	6	B
05/03/2024	Black Guillemot	1	A
05/03/2024	Herring Gull	3	C
05/03/2024	Brent Goose	7	C
05/03/2024	Little Egret	2	B
05/03/2024	Black-headed Gull	2	C

7.5.1e TTTCC Survey

SPECIES	April		May		June		July		August		September		October		November		December		January		February		March	
	HT	LT	HT	LT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT
	20/04	26/04	13/05	22/05	04/06	30/06	10/07	17/07	05/08	18/08	12/09	23/09	03/10	27/10	03/11	29/11	13/12	21/12	23/01	16/01	11/02	02/02	08/03	21/03
Arctic Tern	0	0	0	0	30	30	33	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black Guillemot	8	10	13	4	28	35	17	17	0	8	7	6	3	2	10	10	5	6	2	8	1	4	6	0
Black-headed Gull	264	270	0	6	16	0	354	200	244	0	185	323	255	450	193	688	616	781	541	786	670	712	892	678
Black-tailed Godwit	0	0	0	0	0	0	14	0	0	0	0	0	11	0	0	0	0	10	0	11	9	19	0	11
Common Guillemot	0	0	0	0	0	0	0	0	0	0	6	9	0	7	3	2	2	2	2	0	2	4	0	7
Common Gull	8	19	0	0	0	0	12	117	1	11	0	0	0	2	110	29	112	60	100	11	0	221	87	0
Common Tern	0	0	42	50	40	52	40	39	22	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cormorant	7	9	12	7	24	29	18	19	16	112	36	25	39	70	57	13	26	28	10	32	20	14	13	9
Curlew	0	0	0	4	0	0	4	0	14	0	17	11	7	0	0	27	0	0	0	0	0	0	0	0
Dunlin	0	0	0	0	0	0	0	0	12	0	113	0	0	0	0	111	0	0	0	9	100	330	2	0
Gannet	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great black-backed Gull	0	0	2	7	19	4	0	3	2	4	3	1	3	1	6	2	2	3	0	0	0	2	0	2
Great Northern Diver	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Great-crested Grebe	0	0	0	0	0	0	0	0	0	1	1	0	0	2	0	0	3	0	2	1	0	0	1	0
Greenshank	0	3	0	0	0	0	0	0	3	4	4	0	2	0	2	3	0	0	0	1	4	3	0	1
Grey Heron	0	0	0	0	0	1	1	0	2	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0
Herring Gull	105	123	34	100	215	2250	54	447	499	550	72	87	11	38	0	19	50	111	61	17	70	20	11	45
Lesser black-backed Gull	3	11	4	19	14	39	0	19	4	17	7	2	0	2	0	0	0	0	0	1	0	0	2	0
Little Egret	0	2	1	6	5	0	3	0	4	2	0	0	0	2	0	7	0	0	0	1	2	4	0	0
Little Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Little Tern	0	0	19	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Mallard	0	7	0	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mediterranean Gull	7	0	0	0	1	0	0	0	3	7	0	4	11	0	0	0	0	3	9	0	0	0	0	0
Oystercatcher	0	0	0	20	0	0	44	0	0	0	0	0	0	0	0	0	0	0	3	0	80	1500	0	0
Razorbill	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	0	3	0	0	0	4	2
Red-breasted Merganser	0	0	0	0	0	0	0	0	0	0	3	2	0	1	0	0	13	7	6	3	0	0	2	0
Redshank	4	7	2	3	0	0	11	0	22	17	220	0	18	0	18	44	0	11	17	2	49	66	5	17
Ringed Plover	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0
Sanderling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Sandwich Tern	0	0	0	0	0	0	3	6	4	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shag	0	0	3	4	0	2	0	0	3	2	2	5	2	2	2	1	0	1	0	0	0	0	1	0
Shelduck	0	0	2	6	0	0	0	3	2	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0
Teal	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	6	4	0	0	3	4	0

APPENDIX 7.5.1

Turnstone	0	6	0	0	0	0	0	0	0	6	17	7	0	17	4	7	0	2	0	8	1	7	0	0

7.5.1f Co-ordinated TTTCC Survey

BULL ISLAND	Oct-23											
Time	Hr1		Hr2		Hr3		Hr4		Hr5		Hr6	
Foraging / Roosting	F	R	F	R	F	R	F	R	F	R	F	R
Bar-tailed Godwit	0	0	0	0	40	0	0	0	0	0	0	0
Black-headed Gull	45	0	100	52	185	120	0	50	0	0	0	0
Black-tailed Godwit	0	0	0	0	88	550	72	155	0	40	0	0
Common Gull	0	0	0	0	0	0	0	0	0	0	0	0
Common sandpiper	0	0	0	0	0	0	0	0	0	0	0	0
Cormorant	1	0	0	0	0	0	0	1	1	0	0	0
Curlew	0	0	12	0	10	0	0	12	0	0	0	0
Dunlin	0	0	0	0	0	0	0	0	0	0	0	0
Golden plover	0	0	0	151	0	100	0	0	0	0	0	0
Great Black-backed Gull	0	0	0	0	1	2	0	0	0	0	0	1
Greenshank	0	0	0	0	0	0	0	0	0	0	0	0
Grey Heron	0	0	2	0	2	0	0	0	0	0	0	0
Grey Plover	0	0	0	0	0	0	0	0	0	0	0	0
Herring Gull	6	0	6	0	25	0	0	0	0	8	0	0
Knot	0	0	0	0	250	0	157	900	0	200	0	0
Lapwing	0	0	0	0	0	0	0	0	0	0	0	0
Lesser black-backed gull	0	0	0	0	0	0	0	0	0	0	4	0
Light-bellied Brent goose	0	0	120	0	166	0	20	4	20	0	0	0
Little egret	14	0	49	10	23	0	0	0	0	0	0	0
Little grebe	0	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	21	0	20	0	0	0	0	8	0	0
Oystercatcher	11	0	72	0	370	63	250	0	0	150	0	0
Red-breasted merganser	0	0	0	0	0	0	0	0	2	0	0	0
Redshank	11	0	122	112	145	0	42	100	20	20	0	0
Ringed Plover	0	0	0	0	0	0	0	0	0	0	0	0
Shelduck	0	0	0	0	0	0	0	0	0	0	0	0
Teal	0	0	0	0	0	0	0	25	0	0	0	0
Turnstone	0	0	12	0	20	0	35	0	0	0	0	0
Wigeon	4	0	9	0	0	0	0	0	0	0	0	0
TOTAL	92	0	525	325	1305	835	576	1247	43	426	4	1

BULL ISLAND	Nov-23											
Time	Hr1		Hr2		Hr3		Hr4		Hr5		Hr6	
Foraging / Roosting	F	R	F	R	F	R	F	R	F	R	F	R
Bar-tailed Godwit	0	0	0	0	0	0	0	0	0	0	0	0
Black-headed Gull	6	60	16	18	36	0	51	26	105	0	50	0
Black-tailed Godwit	59	260	162	0	40	0	0	0	1	0	11	0
Common Gull	0	0	0	0	0	0	0	0	0	0	0	0
Common sandpiper	0	0	0	0	0	0	0	0	0	0	0	0
Cormorant	0	0	0	0	0	0	0	0	0	0	0	0
Curlew	5	0	2	0	10	0	1	0	1	0	1	0
Dunlin	187	0	153	130	20	0	0	0	0	0	10	0
Golden plover	0	0	0	45	0	0	0	0	0	0	0	0
Great Black-backed Gull	0	0	1	0	0	0	0	1	0	0	1	0
Greenshank	0	0	0	0	2	0	0	0	0	0	0	0
Grey Heron	1	1	0	0	1	0	1	0	0	0	2	0
Grey Plover	0	0	0	0	0	0	0	0	0	0	0	0
Herring Gull	0	29	24	2	17	0	11	6	25	0	21	0
Knot	600	6525	20	1220	2	0	0	50	6	60	1	0
Lapwing	0	0	0	0	0	0	0	0	0	0	0	0
Lesser black-backed gull	0	0	0	0	0	0	0	0	0	0	8	0
Light-bellied Brent goose	329	152	69	45	212	0	144	26	339	0	259	0
Little egret	1	0	0	20	1	0	4	0	2	0	2	0
Little grebe	12	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	4	0	0	0	0	0	0	0	0	0	0
Oystercatcher	283	80	6	133	112	0	82	0	74	0	141	0
Red-breasted merganser	0	0	0	0	0	0	0	0	0	0	0	0
Redshank	110	35	51	25	87	0	94	0	63	0	113	0
Ringed Plover	0	0	0	0	1	0	0	0	0	0	0	0
Shelduck	0	0	0	0	0	0	0	0	0	0	0	0
Teal	0	0	0	2	0	0	0	0	0	0	0	0
Turnstone	9	0	0	0	0	0	0	0	2	0	21	0
Wigeon	0	0	10	0	24	0	43	0	34	0	6	0
TOTAL	1602	7146	514	1640	565	0	431	109	652	60	647	0

BULL ISLAND	Dec-23											
Time	Hr1		Hr2		Hr3		Hr4		Hr5		Hr6	
Foraging / Roosting	F	R	F	R	F	R	F	R	F	R	F	R
Bar-tailed Godwit	8	0	0	0	0	0	0	0	0	0	0	0
Black-headed Gull	26	0	52	0	60	25	36	0	10	155	11	128
Black-tailed Godwit	73	0	40	0	22	4	31	0	67	60	107	19
Common Gull	0	0	0	0	2	0	3	0	1	40	2	4
Common sandpiper	0	0	0	0	0	0	0	0	0	0	0	0
Cormorant	1	0	0	0	0	0	0	0	0	0	0	0
Curlew	15	0	12	0	9	0	5	0	4	0	3	0
Dunlin	805	0	162	0	67	0	193	0	388	200	559	70
Golden plover	0	50	0	75	0	70	45	0	0	0	10	6
Great Black-backed Gull	0	0	0	0	0	0	0	0	0	0	0	0
Greenshank	0	0	0	0	0	0	0	0	0	0	0	0
Grey Heron	0	0	0	0	0	0	0	0	0	0	0	0
Grey Plover	1	0	0	0	1	0	1	0	0	0	1	0
Herring Gull	14	12	32	0	56	8	4	0	0	16	0	28
Knot	0	5000	0	5030	2	0	0	0	250	650	930	730
Lapwing	0	0	0	0	0	0	0	0	0	0	0	0
Lesser black-backed gull	1	0	0	0	1	0	1	0	0	2	0	1
Light-bellied Brent goose	100	25	0	0	0	0	0	0	0	1	0	10
Little egret	0	0	0	0	0	0	0	0	0	0	0	0
Little grebe	0	0	0	0	0	0	0	0	5	0	5	0
Mallard	0	0	0	0	0	0	0	0	0	0	0	0
Oystercatcher	157	10	135	0	148	31	213	0	226	125	162	40
Red-breasted merganser	1	0	0	0	1	0	0	0	1	0	0	0
Redshank	133	0	90	0	56	0	37	0	30	0	77	0
Ringed Plover	1	0	0	0	0	0	1	0	0	0	0	0
Shelduck	0	0	0	0	0	0	0	0	0	0	0	0
Teal	45	0	2	0	0	0	0	0	0	0	0	0
Turnstone	7	0	0	0	9	0	0	0	1	0	2	0
Wigeon	0	0	0	0	0	0	33	0	5	14	22	12
TOTAL	1380	5097	525	5105	434	138	603	0	988	1263	1891	1048

APPENDIX 7.5.1

BULL ISLAND	Jan-24												Feb-24												Mar-24											
Time	**Hr1**		**Hr2**		**Hr3**		**Hr4**		**Hr5**		**Hr6**		**Hr1**		**Hr2**		**Hr3**		**Hr4**		**Hr5**		**Hr6**		**Hr1**		**Hr2**		**Hr3**		**Hr4**		**Hr5**		**Hr6**	
Foraging / Roosting	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**
Bar-tailed Godwit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-headed Gull	13	59	15	133	119	215	85	50	90	71	35	211	0	0	0	25	0	12	0	76	0	0	0	200	12	5	0	0	94	0	91	0	4	19	34	0
Black-tailed Godwit	0	0	11	0	18	116	55	180	19	5	14	1	36	80	0	0	0	0	0	0	22	0	0	0	14	0	12	0	67	0	125	0	187	0	67	0
Common Gull	6	63	0	151	194	387	48	51	11	21	14	68	0	50	0	180	0	0	0	86	0	10	0	663	48	6	90	0	312	0	183	0	101	133	40	0
Common sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0
Cormorant	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curlew	0	0	0	0	12	7	10	3	8	4	14	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	10	0	5	0
Dunlin	34	0	193	230	734	350	541	71	70	55	34	0	86	200	0	120	0	0	0	0	0	0	0	0	0	0	42	0	173	0	168	0	102	0	14	0
Golden plover	0	0	0	0	0	95	0	95	0	145	0	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Black-backed Gull	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greenshank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Heron	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	3	0
Grey Plover	0	0	0	0	0	0	0	1	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Herring Gull	12	25	14	0	7	38	8	19	1	16	4	6	0	0	0	0	0	0	0	0	0	31	0	140	9	0	6	0	105	0	56	0	31	24	12	0
Knot	0	0	1	0	200	650	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	75	26	0
Lapwing	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lesser black-backed gull	0	0	1	0	0	0	0	2	0	3	0	7	0	0	0	0	0	0	0	0	0	0	0	80	0	0	2	0	30	0	4	0	4	0	0	0
Light-bellied Brent goose	1	0	1	0	0	0	0	0	44	8	3	0	98	300	9	263	220	0	180	0	220	0	140	6	69	15	106	13	231	0	76	20	175	0	34	0
Little egret	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0
Little grebe	0	0	0	0	1	0	0	0	0	0	9	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	2	0	0	0	0	0	8	0	8	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oystercatcher	0	0	26	37	235	82	172	36	104	49	120	38	60	460	82	0	0	0	200	100	207	0	0	0	0	33	0	0	24	0	76	0	85	0	31	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	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Redshank	5	0	102	55	56	7	43	8	27	14	87	12	40	0	25	0	0	0	0	0	0	0	31	0	12	26	95	5	247	0	182	0	87	0	51	0
Ringed Plover	0	7	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shelduck	0	14	48	0	0	0	3	0	0	0	6	0	2	0	2	0	0	2	2	0	0	0	0	0	0	4	0	0	8	0	20	0	12	0	12	0
Teal	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	4	0	0	8	0	0	0	0	0	0	16	0	0	0
Turnstone	4	0	8	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	14	60	123	67	0	0	0	0	0	6	0
Wigeon	6	0	7	0	64	4	9	0	10	0	10	0	0	0	10	6	0	0	0	0	4	0	3	0	4	12	0	0	4	0	27	0	19	3	10	0
TOTAL	90	168	438	606	1640	1951	983	516	393	408	359	496	328	1090	128	594	222	14	384	262	453	41	180	1089	169	123	413	141	1362	1	1019	20	867	256	345	0

APPENDIX 7.5.1

POOLBEG OUTFALL	Oct-23											
Time	Hr1		Hr2		Hr3		Hr4		Hr5		Hr6	
Foraging / Roosting	F	R	F	R	F	R	F	R	F	R	F	R
Bar-tailed godwit	0	0	0	0	0	0	0	0	0	0	0	0
Black-headed gull	332	0	277	59	309	5	300	90	326	87	321	152
Black-tailed godwit	213	0	10	15	3	42	0	0	0	0	0	0
Black guillemot	0	0	0	0	0	0	0	0	0	0	0	0
Common gull	0	0	0	0	0	0	0	0	0	0	0	0
Cormorant	0	6	0	9	5	24	3	24	2	22	3	34
Curlew	0	0	0	0	1	0	0	0	0	0	0	0
Dunlin	2	0	0	0	0	0	0	0	0	0	0	0
Great black-backed gull	0	0	0	0	0	3	0	0	0	0	0	0
Grey heron	0	0	1	0	1	0	0	0	0	0	0	0
Guillemot	0	0	0	0	0	4	0	0	0	0	0	0
Herring gull	113	0	7	3	12	0	0	3	4	0	6	0
Knot	0	0	0	0	0	0	0	0	0	0	0	0
Lesser black-backed gull	4	0	0	0	0	0	0	0	0	0	0	0
Light-bellied brent goose	0	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	0	0	0	0
Mediterranean gull	0	0	0	0	0	0	0	0	0	0	0	0
Oystercatcher	0	0	0	1	0	0	0	0	0	0	0	0
Razorbill	0	0	0	0	0	0	0	0	0	0	0	0
Redshank	24	0	3	18	2	3	0	4	0	0	0	0
Ringed plover	0	0	0	0	0	0	0	0	0	0	0	0
Sanderling	25	0	0	0	0	0	0	0	0	0	0	0
Shag	0	0	0	0	0	0	2	0	0	0	0	0
Teal	15	0	12	0	28	0	14	0	0	0	0	0
Turnstone	11	0	14	0	8	0	0	0	0	0	0	0
Wigeon	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	739	6	324	105	369	81	319	121	332	109	330	186

POOLBEG OUTFALL	Nov-23											
Time	Hr1		Hr2		Hr3		Hr4		Hr5		Hr6	
Foraging / Roosting	F	R	F	R	F	R	F	R	F	R	F	R
Bar-tailed godwit	0	0	0	0	0	0	0	0	0	0	0	0
Black-headed gull	641	12	465	25	609	0	598	0	556	90	513	84
Black-tailed godwit	3	0	19	0	2	3	1	0	2	0	1	0
Black guillemot	0	0	0	0	0	0	0	0	0	0	0	0
Common gull	0	1	0	0	1	1	0	0	1	0	0	0
Cormorant	1	0	0	2	1	7	2	0	0	0	0	6
Curlew	0	0	0	0	0	0	0	0	0	0	0	0
Dunlin	0	0	0	0	0	0	0	0	0	0	0	0
Great black-backed gull	0	0	0	1	0	0	0	0	0	0	0	0
Grey heron	0	0	0	0	0	0	0	0	1	0	1	0
Guillemot	0	0	0	0	0	0	0	0	0	0	0	0
Herring gull	0	0	0	1	8	0	10	2	0	11	1	3
Knot	0	0	0	0	0	0	0	0	3	0	0	0
Lesser black-backed gull	0	0	0	0	0	0	0	0	0	0	0	0
Light-bellied brent goose	0	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	0	0	0	0
Mediterranean gull	0	0	0	0	0	0	0	0	0	0	0	0
Oystercatcher	0	0	0	0	0	0	0	0	0	0	1	0
Razorbill	0	0	0	0	1	0	1	0	2	0	0	0
Redshank	14	2	19	0	19	2	21	10	38	0	19	0
Ringed plover	0	0	0	0	0	0	0	0	0	0	0	0
Sanderling	8	0	0	0	7	52	89	0	170	4	83	0
Shag	0	0	0	0	0	0	0	0	0	0	0	0
Teal	168	13	126	0	117	20	41	40	58	40	78	56
Turnstone	10	5	25	91	31	0	34	0	36	1	15	0
Wigeon	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	845	33	654	120	796	85	797	52	867	146	712	149

POOLBEG OUTFALL	Dec-23											
Time	Hr1		Hr2		Hr3		Hr4		Hr5		Hr6	
Foraging / Roosting	F	R	F	R	F	R	F	R	F	R	F	R
Bar-tailed godwit	5	0	0	0	0	0	0	0	0	0	2	0
Black-headed gull	584	49	428	59	756	13	518	82	403	219	732	175
Black-tailed godwit	33	14	21	4	24	3	4	0	11	0	0	0
Black guillemot	0	0	0	0	0	0	0	0	0	0	0	0
Common gull	0	0	0	0	0	0	0	0	1	0	1	0
Cormorant	7	0	3	6	1	6	3	0	5	14	2	14
Curlew	0	0	0	0	0	0	0	0	0	0	0	0
Dunlin	3	0	0	0	0	0	0	0	0	0	0	0
Great black-backed gull	0	0	0	0	1	1	1	0	1	0	1	0
Grey heron	0	0	0	0	0	0	0	0	0	0	0	0
Guillemot	0	0	0	0	0	0	0	0	0	0	0	0
Herring gull	7	0	19	3	30	0	8	1	0	0	0	7
Knot	0	0	0	0	0	0	0	0	0	0	0	0
Lesser black-backed gull	0	0	0	0	0	0	0	0	0	0	0	0
Light-bellied brent goose	0	0	0	0	0	0	0	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	0	0	0	0
Mediterranean gull	0	0	0	0	0	0	0	0	0	0	0	0
Oystercatcher	0	0	1	0	0	0	0	0	0	0	0	0
Razorbill	0	0	0	0	0	0	0	0	0	0	0	0
Redshank	15	0	14	5	5	1	9	0	5	3	3	0
Ringed plover	0	0	0	0	0	0	0	0	0	0	0	0
Sanderling	68	0	15	0	75	0	127	0	78	0	6	0
Shag	0	0	0	0	0	0	0	0	0	0	0	0
Teal	223	133	231	98	289	89	242	68	147	30	154	35
Turnstone	26	0	29	4	21	0	6	0	21	4	14	0
Wigeon	4	0	4	1	1	0	1	0	3	0	0	0
TOTAL	975	196	765	180	1203	113	919	151	675	270	915	231

APPENDIX 7.5.1

POOLBEG OUTFALL	Jan-24												Feb-24												Mar-24											
Time	**Hr1**		**Hr2**		**Hr3**		**Hr4**		**Hr5**		**Hr6**		**Hr1**		**Hr2**		**Hr3**		**Hr4**		**Hr5**		**Hr6**		**Hr1**		**Hr2**		**Hr3**		**Hr4**		**Hr5**		**Hr6**	
Foraging / Roosting	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**
Bar-tailed godwit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-headed gull	638	13	724	16	906	59	1050	226	979	21	597	26	146	23	320	37	382	82	468	168	663	33	415	3	250	26	290	29	303	16	350	69	335	70	235	111
Black-tailed godwit	0	0	0	0	28	0	28	0	318	9	246	198	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	16	87	45	110
Black guillemot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	8	0	3	0
Common gull	15	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	33	1	116	3	34	0	128	0	4	12	32	60	161	5	216	2	190	0	160	0
Cormorant	2	0	1	0	0	0	0	0	0	0	0	0	3	2	0	2	2	0	1	0	2	0	2	0	1	9	0	12	1	10	1	16	1	10	0	6
Curlew	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Dunlin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great black-backed gull	0	0	2	2	0	0	2	0	2	0	0	0	1	3	3	6	0	0	0	0	0	0	0	1	0	0	0	2	0	2	0	2	0	2	0	0
Grey heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Guillemot	4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Herring gull	0	0	5	0	193	0	302	32	526	24	707	39	0	0	0	0	0	0	0	0	0	1	12	18	39	3	49	0	60	33	41	48	41	23	49	45
Knot	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lesser black-backed gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Light-bellied brent goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	14	0
Mallard	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	4	0
Mediterranean gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	1	0	0	0	0	0	0	0	0	0
Oystercatcher	0	9	0	4	0	0	0	0	0	0	0	0	0	0	0	2	0	6	0	6	0	6	0	6	0	3	0	2	0	0	1	0	3	0	1	0
Razorbill	0	0	0	0	0	0	0	0	0	0	0	0													0	0	0	0	0	0	0	0	0	0	0	0
Redshank	0	3	0	3	15	1	27	2	18	0	18	0	0	7	4	9	0	9	0	9	0	9	0	5	0	2	0	8	0	10	7	0	8	0	18	0
Ringed plover	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanderling	0	0	0	0	15	0	45	0	64	0	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Shag	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Teal	16	168	124	137	154	0	156	33	276	20	162	20	164	42	214	66	98	164	94	154	104	104	78	119	101	53	123	28	32	103	118	18	52	43	38	82
Turnstone	7	0	13	0	43	0	39	0	47	0	12	0	0	0	7	6	24	18	8	2	12	13	3	8	0	26	14	4	4	16	14	0	18	0	20	0
Wigeon	0	18	6	4	0	6	12	0	9	4	8	0	18	0	14	14	16	19	18	23	21	18	22	6	4	0	4	0	0	0	0	0	0	0	0	0

APPENDIX 7.5.1

SHELLYBANKS	Oct-23												Nov-23												Dec-23											
Time	Hr1		Hr2		Hr3		Hr4		Hr5		Hr6		Hr1		Hr2		Hr3		Hr4		Hr5		Hr6		Hr1		Hr2		Hr3		Hr4		Hr5		Hr6	
Foraging / Roosting	F	R	F	R	F	R	F	R	F	R	F	R	F	R	F	R	F	R	F	R	F	R	F	R	F	R	F	R	F	R	F	R	F	R	F	R
Bar-tailed Godwit	0	0	18	0	23	0	0	0	3	0	0	0	0	0	49	0	16	29	9	14	11	0	0	0	594	0	426	0	483	0	423	0	460	0	561	0
Black-headed Gull	16	18	27	16	82	8	58	0	31	6	0	32	0	0	108	0	15	68	9	23	11	0	0	9	62	0	91	9	103	0	145	0	149	82	184	180
Black-tailed Godwit	0	0	136	4	156	0	67	0	28	0	0	0	0	0	34	0	15	7	0	0	35	0	0	0	38	0	148	0	181	0	369	0	270	0	201	0
Black guillemot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brent Goose	0	0	0	0	4	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	7	0	14	0	0	0	16	0	0	0
Common Gull	0	0	0	1	7	0	7	0	0	0	0	0	0	16	8	0	2	5	0	3	0	12	2	7	3	11	0	6	20	0	0	0	2	9	1	2
Cormorant	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	2	2	1	0	2	2	0	2	0	3	0
Curlew	3	0	3	0	16	0	26	0	12	0	0	3	2	5	21	0	14	0	4	1	2	1	27	0	9	2	18	1	24	0	25	0	20	0	28	2
Dunlin	0	0	6	0	17	0	34	0	6	0	0	0	0	0	17	0	52	0	8	0	0	0	104	0	32	0	54	0	59	0	45	0	88	0	0	0
Gannet	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Black-backed Gull	0	0	4	2	8	0	5	2	0	0	0	3	4	9	14	0	13	6	0	2	0	2	1	3	9	3	9	4	11	0	6	8	14	11	9	5
Great-crested Grebe	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greenshank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0
Grey Heron	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	2	1	1	0	0	0	0	0
Grey Plover	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	3	1	2	0	0	0	0	4	14	0	2	0	2	0	0	0	1	0	3	3	0
Herring Gull	2	3	11	9	23	0	23	11	12	9	0	8	3	22	34	0	10	22	0	0	0	16	0	0	28	6	25	0	42	0	37	18	47	23	51	14
Knot	0	0	0	4	6	0	16	0	0	0	0	0	0	10	12	0	19	0	0	9	0	0	27	0	0	0	18	0	51	0	62	0	41	0	11	0
Lesser Black-backed Gull	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	1	0	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Light-bellied Brent Goose	0	0	0	0	0	0	0	0	0	0	0	0	11	0	16	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Egret	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2	0	2	0	1	0	3	0	0	0	2	0	0	0	3	0	2	0	2	0	0	0
Mallard	0	0	0	0	2	0	0	0	0	0	0	0	0	0	7	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mediterranean Gull	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Oystercatcher	0	0	18	0	37	0	55	0	32	0	0	11	3	14	19	0	0	0	11	2	7	9	0	0	44	16	66	5	73	0	60	0	164	0	140	16
Red-breasted Merganser	0	0	0	0	0	0	6	0	1	0	2	0	4	0	0	0	0	0	2	0	0	0	0	0	6	0	8	0	0	0	4	0	6	0	11	0
Red-throated diver																									0	0	0	0	0	0	0	0	0	0	0	0
Redshank	2	0	6	0	12	0	10	0	12	0	0	0	12	0	17	0	12	0	8	0	5	0	9	0	17	0	5	0	16	0	7	0	9	0	0	0
Ringed Plover	0	0	0	0	8	11	0	8	0	0	0	0	0	0	11	0	9	0	0	7	8	0	0	0	0	0	4	9	0	0	9	0	0	0	0	0
Sanderling	0	0	4	0	24	0	39	0	14	0	0	0	38	0	26	0	46	0	12	0	26	0	31	0	73	0	85	0	114	0	102	0	148	0	67	0
Shag	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shelduck	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	11	0	2	0	4	0	0	0
Turnstone	0	0	6	0	3	0	19	0	10	0	0	0	0	0	0	0	0	0	4	0	3	0	0	0	4	0	2	0	0	0	27	0	30	0	0	0
TOTAL	23	21	239	37	432	20	377	26	162	15	2	57	81	76	400	3	232	141	70	63	121	41	205	34	934	42	968	38	1207	3	1330	27	1472	128	1270	219

APPENDIX 7.5.1

SHELLYBANKS	Jan-24												Feb-24												Mar-24											
Time	**Hr1**		**Hr2**		**Hr3**		**Hr4**		**Hr5**		**Hr6**		**Hr1**		**Hr2**		**Hr3**		**Hr4**		**Hr5**		**Hr6**		**Hr1**		**Hr2**		**Hr3**		**Hr4**		**Hr5**		**Hr6**	
Foraging / Roosting	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**
Bar-tailed Godwit	0	0	15	16	16	11	31	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	0	95	0	12	0	0	0
Black-headed Gull	112	3000	3052	222	3500	196	3500	182	2000	87	7	42	96	0	141	0	0	0	85	0	164	0	378	9	0	14	0	41	102	0	28	68	0	33	0	0
Black-tailed Godwit	0	108	45	92	37	91	305	0	134	0	16	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	273	0	117	0	85	32	0	0
Black guillemot	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Brent Goose	9	0	11	0	0	0	0	0	0	0	0	0	23	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Gull	0	18	31	16	0	0	0	23	5	11	2	0	6	0	16	0	0	0	0	0	14	4	24	0	0	1	0	6	11	4	4	10	0	2	0	0
Cormorant	2	0	2	0	1	2	2	1	0	0	0	0	0	0	0	0	5	0	0	0	0	0	2	0	0	0	3	0	2	0	2	2	0	2	0	0
Curlew	0	0	0	0	2	4	3	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	16	0	17	3	5	0
Dunlin	0	0	18	0	28	0	31	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	42	0	0	0	0	0	9	0	26	0	16	0	0	0
Gannet	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Great Black-backed Gull	4	12	8	9	9	11	0	0	3	11	8	12	4	0	0	0	0	6	0	2	5	2	37	18	0	0	0	0	26	5	52	4	0	4	0	0
Great-crested Grebe	2	0	5	0	4	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Greenshank	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Heron	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Herring Gull	1	76	148	61	24	47	9	80	6	42	0	76	23	0	11	0	0	11	0	4	45	0	128	66	0	2	0	11	75	3	134	8	32	34	0	0
Knot	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lesser Black-backed Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	0	2	4	0	0	0	0
Light-bellied Brent Goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	12	0	0	0
Little Egret	0	0	0	0	0	2	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	1	0	0	0	0	0
Mallard	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mediterranean Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0
Oystercatcher	34	0	49	12	56	22	58	12	18	52	12	170	23	9	26	0	0	0	0	0	18	0	37	11	3	0	7	0	26	0	29	0	56	17	11	0
Red-breasted Merganser	2	0	6	0	6	0	0	0	0	0	0	0	5	0	0	0	4	0	0	0	0	0	4	0	0	0	0	0	4	0	4	0	0	0	0	0
Red-throated diver	1	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redshank	16	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	16	0	0	0	0	0	17	0	11	0	10	0	0	0
Ringed Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanderling	0	0	61	0	74	0	27	0	29	0	9	0	0	0	0	0	0	0	0	0	29	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0
Shag	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
Shelduck	4	0	0	0	0	0	0	0	2	0	0	0	8	0	2	0	0	0	0	0	0	0	6	0	0	0	0	4	4	0	2	0	0	6	0	0
Turnstone	12	0	15	0	5	0	11	0	0	0	0	0	4	0	0	0	7	0	4	0	3	0	0	0	0	0	0	0	27	0	0	0	5	0	0	0
TOTAL	206	3214	3481	428	3762	386	3981	298	2215	207	59	335	194	9	219	0	23	17	92	6	290	6	714	104	3	17	10	62	635	12	527	97	245	134	16	0

7.5.1g Disturbance Survey

Date	Disturbance Type	Time of event	Species affected	Number disturbed	Reaction	Distance to disturbance (m)	Duration of disturbance (min)	Notes
14-Oct	Other powered boat	08:10	Lesser Black-backed Gull	42	Short flight <50m	100	4	Irish Ferry
14-Oct	Other powered boat	08:10	Black-headed Gull	100	Short flight <50m	100	4	Irish Ferry
14-Oct	Other powered boat	08:15	Cormorant	2	Short flight <50m	70	3	Irish Ferry
14-Oct	Other powered boat	08:15	Black-headed Gull	16	Short flight <50m	70	3	Irish Ferry
14-Oct	Other powered boat	08:23	Black-headed Gull	65	Short flight <50m	100	3	Irish Ferry
14-Oct	Other powered boat	08:25	Black-headed Gull	20	Short flight <50m	150	3	Irish Ferry
14-Oct	Other powered boat	09:20	Black-headed Gull	100	Short flight <50m	50	2	Tug/pilot boat
14-Oct	Other powered boat	09:22	Grey Heron	1	Long flight >50m	100	1	Tug/pilot boat
14-Oct	Other powered boat	09:50	Black-headed Gull	26	Short flight <50m	100	4	Container ship
14-Oct	Other powered boat	09:50	Cormorant	2	Walk/ Swim/Dive away	100	4	Container ship
14-Oct	Other powered boat	09:53	Black-headed Gull	65	Short flight <50m	100	1	Speed boat
14-Oct	Other powered boat	09:53	Lesser Black-backed Gull	16	Short flight <50m	100	1	Speed boat
14-Oct	Other powered boat	09:53	Guillemot	6	Walk/ Swim/Dive away	100	1	Speed boat
14-Oct	Other powered boat	10:00	Guillemot	3	Walk/ Swim/Dive away	100	5	Seatruck
14-Oct	Other powered boat	10:00	Black-headed Gull	120	Short flight <50m	100	5	Seatruck
14-Oct	Other powered boat	10:08	Black-headed Gull	20	Short flight <50m	75	3	Seatruck
14-Oct	Other powered boat	10:10	Black-headed Gull	50	Short flight <50m	50	1	Speed boat
14-Oct	Other powered boat	10:15	Black-headed Gull	20	Short flight <50m	100	1	Speed boat
14-Oct	Other powered boat	10:15	Cormorant	1	Short flight <50m	100	1	Speed boat
14-Oct	Other powered boat	10:37	Cormorant	1	Long flight >50m	100	1	Speed boat
14-Oct	Other powered boat	10:37	Black-headed Gull	32	Short flight <50m	100	1	Speed boat
14-Oct	Other powered boat	11:20	Black-headed Gull	40	Short flight <50m	100	3	Irish Ferry
14-Oct	Other powered boat	11:20	Cormorant	1	Long flight >50m	100	1	Irish Ferry
14-Oct	Other powered boat	12:00	Black-headed Gull	10	Short flight <50m	100	4	Stena
14-Oct	Other powered boat	12:02	Black-headed Gull	22	Short flight <50m	100	3	Stena
14-Oct	Other powered boat	12:08	Black-headed Gull	2	Walk/ Swim/Dive away	50	1	Seatruck
14-Oct	Other powered boat	12:11	Cormorant	2	Long flight >50m	50	1	Seatruck
14-Oct	Other powered boat	12:14	Black-headed Gull	10	Walk/ Swim/Dive away	100	1	Seatruck
14-Oct	Other powered boat	12:14	Black-headed Gull	30	Walk/ Swim/Dive away	100	1	Seatruck
14-Oct	Helicopter	12:15	Turnstone	25	Long flight >50m	>100	2	Helicopter
18-Oct	Drone	13:25	Black-headed Gull	22	Long flight >50m	-	3	

Date	Disturbance Type	Time of event	Species affected	Number disturbed	Reaction	Distance to disturbance (m)	Duration of disturbance (min)	Notes
18-Oct	Drone	13:25	Herring Gull	19	Long flight >50m	-	3	
18-Oct	Drone	13:25	Redshank	2	Long flight >50m	-	3	
18-Oct	GI Vessel	14:10	Black-headed Gull	220	Short flight <50m	150	2	
18-Oct	Drone	14:33	Black-headed Gull	44	Walk/ Swim/Dive away	150	1	
18-Oct	GI Vessel	14:40	Cormorant	19	Walk/ Swim/Dive away	200	1	
18-Oct	GI Vessel	15:09	Black-headed Gull	17	Alert	130	1	
18-Oct	GI Vessel	15:50	Black-headed Gull	30	Alert	200	1	
18-Oct	GI Vessel	15:54	Black-headed Gull	47	Alert	150	1	
18-Oct	GI Vessel	15:57	Black-headed Gull	22	Alert	150	1	
18-Oct	Walkers	16:15	Turnstone	12	Alert	100	1	
25-Oct	GI Vessel	10:11	Black-headed Gull	48	Short flight <50m	150	1	
25-Oct	Walkers	10:13	Turnstone	16	Short flight <50m	100	1	
25-Oct	GI Vessel	10:57	Black-headed Gull	48	Short flight <50m	200	1	
25-Oct	GI Vessel	11:18	Guillemot	3	Walk/ Swim/Dive away	200		
25-Oct	GI Vessel	11:18	Black-headed Gull	25	Short flight <50m	200		
25-Oct	Other powered boat	11:33	Black-headed Gull	15	Short flight <50m	150		
25-Oct	Other powered boat	11:37	Black-headed Gull	3	Short flight <50m	130		
25-Oct	Other powered boat	11:37	Cormorant	1	Walk/ Swim/Dive away	130		
25-Oct	Other powered boat	12:14	Cormorant	25	Long flight >50m	150		
25-Oct	Other powered boat	12:14	Black-headed Gull	65	Short flight <50m	150		
25-Oct	GI Vessel	13:27	Black-headed Gull	48	Short flight <50m	200	1	
25-Oct	GI Vessel	13:27	Mediterranean Gull	1	Short flight <50m	200	1	
25-Oct	GI Vessel	13:33	Mediterranean Gull	1	Short flight <50m	250	1	
25-Oct	GI Vessel	13:33	Black-headed Gull	20	Short flight <50m	250	1	
25-Oct	GI Vessel	13:33	Common Gull	1	Short flight <50m	250	1	
25-Oct	GI Vessel	13:37	Black-headed Gull	15	Short flight <50m	250	1	
25-Oct	Predator (i.e. BOP)	13:40	Black-headed Gull	320	Long flight >50m	200	2	Buzzard
25-Oct	GI Vessel	13:51	Black-headed Gull	22	Short flight <50m	300	1	
25-Oct	GI Vessel	13:54	Black-headed Gull	29	Short flight <50m	250	1	
25-Oct	GI Vessel	13:54	Common Gull	1	Short flight <50m	250	1	
25-Oct	GI Vessel	14:05	Black-headed Gull	25	Short flight <50m	250	1	
25-Oct	Other powered boat	14:15	Black-headed Gull	56	Short flight <50m	200	1	
25-Oct	Other powered boat	14:23	Black-headed Gull	27	Short flight <50m	200	1	

Date	Disturbance Type	Time of event	Species affected	Number disturbed	Reaction	Distance to disturbance (m)	Duration of disturbance (min)	Notes
28-Oct	Other powered boat	08:20	Black-headed Gull	33	Short flight <50m	200	1	
28-Oct	Other powered boat	08:25	Cormorant	13	Short flight <50m	150	1	
28-Oct	Other powered boat	08:44	Turnstone	12	Short flight <50m	150	1	
28-Oct	Other powered boat	08:51	Black-headed Gull	59	Long flight >50m	200	2	
28-Oct	GI Vessel	09:10	Guillemot	3	Short flight <50m	200	1	
28-Oct	Other powered boat	09:33	Guillemot	7	Walk/ Swim/Dive away	200	1	
28-Oct	Other powered boat	09:44	Black Guillemot	4	Walk/ Swim/ Dive away	200	1	
28-Oct	Other powered boat	11:19	Black-headed Gull	29	Short flight <50m	200	1	
28-Oct	GI Vessel	11:33	Black-headed Gull	37	Short flight <50m	200	2	
28-Oct	GI Vessel	11:49	Cormorant	4	Walk/ Swim/ Dive away	130	1	
28-Oct	GI Vessel	11:54	Black-headed Gull	44	Short flight <50m	150	3	
28-Oct	GI Vessel	12:00	Black-headed Gull	37	Walk/ Swim/Dive away	200	2	
28-Oct	Other powered boat	12:05	Guillemot	8	Walk/ Swim/Dive away	200	1	
28-Oct	GI Vessel	12:07	Cormorant	17	Short flight <50m	150	1	
28-Oct	GI Vessel	12:50	Black-headed Gull	53	Short flight <50m	200	2	
28-Oct	Other powered boat	13:11	Cormorant	19	Walk/ Swim/Dive away	200	2	
28-Oct	Other powered boat	13:27	Guillemot	7	Walk/ Swim/Dive away	150	1	
28-Oct	GI Vessel	13:33	Black-headed Gull	33	Walk/ Swim/Dive away	130	1	
28-Oct	GI Vessel	13:55	Mediterranean Gull	7	Walk/ Swim/Dive away	200	1	
28-Oct	GI Vessel	14:01	Black-headed Gull	110	Long flight >50m	150	3	
02-Nov	Other powered boat	08:43	Cormorant	22	Short flight <50m	150	2	
02-Nov	GI Vessel	08:52	Black-headed Gull	44	Short flight <50m	150	2	
02-Nov	GI Vessel	08:59	Black-headed Gull	63	Long flight >50m	200	3	
02-Nov	GI Vessel	09:00	Common Gull	16	Short flight <50m	130	1	
02-Nov	Other powered boat	10:00	Mediterranean Gull	11	Short flight <50m	150	1	
02-Nov	Other powered boat	11:20	Cormorant	13	Alert	150	1	
02-Nov	Other powered boat	11:33	Herring Gull	33	Short flight <50m	150	1	
02-Nov	GI Vessel	11:37	Black-headed Gull	47	Short flight <50m	200	2	
02-Nov	GI Vessel	11:57	Black-headed Gull	57	Short flight <50m	200	3	
02-Nov	GI Vessel	12:00	Black-headed Gull	33	Short flight <50m	150	3	
02-Nov	Other powered boat	13:07	Black-headed Gull	59	Short flight <50m	150	1	
02-Nov	GI Vessel	13:10	Black-headed Gull	77	Long flight >50m	200	1	
02-Nov	Other powered boat	13:20	Herring Gull	14	Short flight <50m	130	1	

Date	Disturbance Type	Time of event	Species affected	Number disturbed	Reaction	Distance to disturbance (m)	Duration of disturbance (min)	Notes
02-Nov	Other powered boat	13:21	Cormorant	19	Walk/ Swim/Dive away	200	1	
02-Nov	Other powered boat	13:27	Black-headed Gull	66	Short flight <50m	200	1	
02-Nov	GI Vessel	13:55	Black-headed Gull	60	Short flight <50m	150	2	
02-Nov	GI Vessel	14:00	Cormorant	35	Short flight <50m	200	1	
05-Nov	GI Vessel	08:20	Black-headed Gull	39	Alert	200	1	
05-Nov	GI Vessel	08:33	Cormorant	17	Alert	150	1	
05-Nov	Other powered boat	09:00	Black-headed Gull	30	Alert	150	1	
05-Nov	Unpowered Boat	09:21	Guillemot	5	Alert	130	1	
05-Nov	Other powered boat	10:03	Black-headed Gull	20	Alert	150	1	
05-Nov	Other powered boat	10:10	Cormorant	29	Alert	150	1	
05-Nov	GI Vessel	11:04	Black-headed Gull	55	Walk/ Swim/Dive away	150	1	
05-Nov	Other powered boat	11:15	Black-headed Gull	67	Walk/ Swim/Dive away	200	2	
05-Nov	Other powered boat	11:12	Black-headed Gull	50	Alert	200	1	
05-Nov	Unpowered Boat	11:19	Black-headed Gull	59	Walk/ Swim/Dive away	200	1	
05-Nov	Other powered boat	11:50	Black Guillemot	7	Alert	150	1	
05-Nov	Other powered boat	12:00	Black-headed Gull	41	Alert	150	1	
11-Nov	Other powered boat	10:03	Black-headed Gull	47	Alert	150	1	
11-Nov	Other powered boat	10:57	Black-headed Gull	29	Alert	150	1	
11-Nov	Other powered boat	11:10	Guillemot	4	Alert	200	1	
11-Nov	Other powered boat	12:02	Black-headed Gull	50	Walk/ Swim/Dive away	200	2	
11-Nov	GI Vessel	12:11	Common Gull	13	Alert	200	1	
11-Nov	GI Vessel	12:14	Cormorant	17	Alert	150	1	
11-Nov	GI Vessel	12:40	Black-headed Gull	61	Walk/ Swim/Dive away	150	2	
11-Nov	Other powered boat	12:47	Mediterranean Gull	11	Alert	200	1	
11-Nov	Other powered boat	12:50	Black-headed Gull	41	Walk/ Swim/Dive away	200	1	
11-Nov	Other powered boat	14:11	Black-headed Gull	27	Alert	200	1	
11-Nov	GI Vessel	14:33	Razorbill	6	Alert	200	1	
11-Nov	Other powered boat	14:50	Great Black-backed Gull	4	Alert	150	1	
11-Nov	Other powered boat	15:15	Herring Gull	39	Alert	200	2	
14-Nov	GI Vessel	08:19	Black-headed Gull	111	Short flight <50m	150	1	
14-Nov	Other powered boat	08:22	Teal	7	Alert	150	1	
14-Nov	Other powered boat	08:33	Cormorant	7	Walk/ Swim/Dive away	130	1	
14-Nov	Other powered boat	08:40	Black Guillemot	9	Walk/ Swim/Dive away	130	1	

Date	Disturbance Type	Time of event	Species affected	Number disturbed	Reaction	Distance to disturbance (m)	Duration of disturbance (min)	Notes
14-Nov	GI Vessel	09:01	Herring Gull	7	Walk/ Swim/Dive away	200	1	
14-Nov	GI Vessel	09:11	Cormorant	7	Walk/ Swim/Dive away	200	2	
14-Nov	Birdwatchers/photographers	10:30	Turnstone	29	Long flight >50m	120	2	
14-Nov	Helicopter	10:53	Cormorant	30	Long flight >50m	500	3	
14-Nov	Helicopter	10:53	Black-headed Gull	220	Long flight >50m	500	3	
14-Nov	GI Vessel	11:10	Razorbill	4	Alert	200	1	
14-Nov	GI Vessel	12:19	Black-headed Gull	47	Walk/ Swim/Dive away	200	1	
14-Nov	GI Vessel	12:44	Black-headed Gull	53	Walk/ Swim/Dive away	150	2	
14-Nov	Other powered boat	12:50	Cormorant	6	Alert	150	1	
14-Nov	GI Vessel	12:57	Cormorant	11	Alert	200	1	
14-Nov	Other powered boat	13:00	Black-headed Gull	33	Alert	150	1	
17-Nov	Other powered boat	08:07	Black-headed Gull	47	Alert	200	1	
17-Nov	Other powered boat	08:51	Black-headed Gull	66	Alert	200	2	
17-Nov	Helicopter	09:01	Black-headed Gull	60	Alert	200	2	
17-Nov	Other powered boat	09:13	Cormorant	16	Alert	150	1	
17-Nov	Helicopter	10:03	Black-headed Gull	70	Alert	200	1	
17-Nov	Other powered boat	10:14	Cormorant	11	Alert	200	1	
17-Nov	Other powered boat	10:44	Black-headed Gull	27	Alert	200	1	
17-Nov	Other powered boat	10:47	Black-headed Gull	49	Alert	150	2	
17-Nov	Other powered boat	10:50	Black-headed Gull	660	Short flight <50m	300	5	
17-Nov	Other powered boat	12:17	Black-headed Gull	60	Walk/ Swim/Dive away	200	2	
17-Nov	Other powered boat	12:22	Black-headed Gull	41	Alert	150	1	
17-Nov	Predator (i.e. BOP)	12:37	Cormorant	12	Alert	200	1	
17-Nov	Other powered boat	13:10	Teal	7	Walk/ Swim/Dive away	200	4	
18-Nov	GI Vessel	11:15	Black-headed Gull	47	Alert	200	1	
18-Nov	Other powered boat	11:33	Common Gull	50	Walk/ Swim/Dive away	200	1	
18-Nov	Other powered boat	11:40	Black-headed Gull	30	Alert	200	1	
18-Nov	Other powered boat	11:57	Herring Gull	2	Alert	200	2	
18-Nov	Other powered boat	12:12	Common Gull	110	Short flight <50m	200	3	
18-Nov	Other powered boat	13:01	Black-headed Gull	20	Alert	200	1	
18-Nov	Other powered boat	13:57	Cormorant	11	Alert	200	2	
18-Nov	Other powered boat	14:00	Black-headed Gull	72	Walk/ Swim/Dive away	150	3	
18-Nov	Other powered boat	15:15	Black-headed Gull	60	Walk/ Swim/Dive away	200	2	

Date	Disturbance Type	Time of event	Species affected	Number disturbed	Reaction	Distance to disturbance (m)	Duration of disturbance (min)	Notes
18-Nov	Other powered boat	15:22	Black-headed Gull	17	Alert	200	1	
18-Nov	Walkers	15:40	Turnstone	17	Alert	130	1	
18-Nov	Walkers	15:43	Turnstone	20	Alert	120	1	
18-Nov	Other powered boat	15:50	Black-headed Gull	40	Alert	150	1	
18-Nov	Walkers	16:02	Black-headed Gull	53	Walk/ Swim/Dive away	130	2	
21-Nov	Other powered boat	10:17	Black-headed Gull	47	Alert	200	1	
21-Nov	Other powered boat	10:37	Black-headed Gull	35	Alert	500	2	
21-Nov	Other powered boat	11:01	Common Gull	50	Walk/ Swim/Dive away	200	1	
21-Nov	Helicopter	11:04	Teal	7	Alert	500	2	
21-Nov	Other powered boat	12:03	Black-headed Gull	27	Alert	200	1	
21-Nov	Other powered boat	12:09	Herring Gull	40	Alert	200	1	
21-Nov	Other powered boat	12:40	Black-headed Gull	31	Alert	200	1	
21-Nov	Walkers	12:53	Black-headed Gull	40	Alert	130	1	
21-Nov	Walkers	13:11	Cormorant	11	Alert	150	2	
21-Nov	Other powered boat	14:14	Common Gull	100	Long flight >50m	200	2	
21-Nov	Other powered boat	14:17	Common Gull	27	Alert	200	1	
21-Nov	Other powered boat	14:40	Black-headed Gull	30	Alert	130	1	
21-Nov	Other powered boat	15:00	Black-headed Gull	40	Alert	150	1	
21-Nov	Helicopter	15:01	Turnstone	22	Alert	130	1	
23-Nov	Other powered boat	08:42	Black-headed Gull	47	Alert	200	1	
23-Nov	GI Vessel	08:44	Cormorant	23	Alert	200	1	
23-Nov	GI Vessel	08:51	Black-headed Gull	50	Alert	200	2	
23-Nov	Other powered boat	09:07	Herring Gull	17	Alert	200	1	
23-Nov	Other powered boat	10:43	Black-headed Gull	66	Walk/ Swim/Dive away	200	3	
23-Nov	Other powered boat	10:47	Black-headed Gull	49	Walk/ Swim/Dive away	200	2	
23-Nov	Other powered boat	10:52	Teal	11	Alert	200	1	
23-Nov	Other powered boat	11:01	Turnstone	13	Alert	150	1	
23-Nov	Other powered boat	11:22	Guillemot	12	Alert	200	1	
23-Nov	GI Vessel	11:53	Black-headed Gull	60	Walk/ Swim/Dive away	200	3	
23-Nov	Other powered boat	12:40	Black-headed Gull	41	Alert	150	1	
23-Nov	Other powered boat	12:53	Cormorant	19	Alert	150	1	
23-Nov	Other powered boat	13:15	Black-headed Gull	27	Alert	200	1	
23-Nov	GI Vessel	13:30	Black-headed Gull	39	Alert	150	1	

7.5.1h Black Guillemot Management Plan

BLACK GUILLEMOT MANAGEMENT PLAN 2023-2030

DUBLIN PORT COMPANY

NI2541 Dublin Port
Black Guillemot Management
Plan
D02
March 2024

www.rpsgroup.com

Document Status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
D01	Draft	RN	TMcN	AGB	2023-02-23
D02	Final – 2023 data added	RN	TMcN	AGB	2024-03-06

Approval for issue

Dr Alan Barr	Alan Barr	2024-03-23

This report was prepared by RPS Ireland Ltd (NI) ('RPS') within the terms of its engagement and in direct response to a scope of services. This report is strictly limited to the purpose and the facts and matters stated in it and does not apply directly or indirectly and must not be used for any other application, purpose, use or matter. In preparing the report, RPS may have relied upon information provided to it at the time by other parties. RPS accepts no responsibility as to the accuracy or completeness of information provided by those parties at the time of preparing the report. The report does not take into account any changes in information that may have occurred since the publication of the report. If the information relied upon is subsequently determined to be false, inaccurate or incomplete then it is possible that the observations and conclusions expressed in the report may have changed. RPS does not warrant the contents of this report and shall not assume any responsibility or liability for loss whatsoever to any third party caused by, related to or arising out of any use or reliance on the report howsoever. No part of this report, its attachments or appendices may be reproduced by any process without the written consent of RPS. All enquiries should be directed to RPS.

Prepared by:
Richard Nairn / Tony McNally / Alan Barr

RPS Ireland Ltd (NI)

Elmwood House, 74 Boucher Road
Belfast, Co. Antrim, BT12 6RZ

T 0044 28 9066 7914
E **alan.barr@rpsgroup.com**

Prepared for:
Eamon McElroy

Dublin Port Company

Port Centre, Alexandra Rd, North Dock, Dublin, D01 H4C6, Ireland

T 00353 1 887 6000
E

Contents

Figures

Tables

1 INTRODUCTION

Black Guillemots are small seabirds, members of the auk family that are related to Puffins. They generally nest in crevices in rocky cliffs but, where such sites are not available, they readily adapt to nesting in holes in quay walls and other artificial structures in ports and harbours. They are found in many harbours around the Irish coast and are very tolerant of port activity and human presence. They form loose colonies and readily adapt to breeding in nest boxes provided that these are correctly sited (Figure 1.1).

The Irish population of Black Guillemots is included on the Amber List of Birds of Conservation Concern in Ireland (Gilbert et al. 2021). This means that it is of medium conservation concern. It is a species for which the global population is concentrated in Europe.

The breeding population of Black Guillemots in Dublin Port has been monitored annually by Natura Consultants, on behalf of Dublin Port Company (DPC), since 2013 (with the exception of 2020 due to the pandemic restrictions). The surveys covered all quay walls, jetties and other structures from Poolbeg Power Station to Talbot Bridge in the River Liffey.

This gives an overall trend in population and usage of different sections of the port. This programme is part of the monitoring plan for DPC’s ABR project and has been reported annually to the planning authority.

Figure 1.1 Black Guillemots in ramp (top left), quay wall (bottom left) and nest box (right) in Dublin Port

1.1 Objectives

The planning authority has set conditions for DPC’s MP2 Project Foreshore consent. Condition 2(b) requires the preparation of a Dublin Port Black Guillemot Conservation Plan, incorporating a schedule and map or diagram of the recently known black guillemot nesting sites within the port, the current status of these nesting sites, their potential to be retained into the future and any measures required to secure or repair them.

This plan is also to include the location of nest boxes to be installed in the port area to compensate for any recent losses of black guillemot nest sites in the port or to be lost as a result of the MP2 Project (*Reason: To conserve populations of bird species occurring in Dublin Port and adjacent areas*).

The conservation plan outlined below provides information on the location of currently available breeding sites. It also identifies sites where new artificial nesting sites (including nest boxes) may be located within the area being redeveloped for the MP2 Project and the proposed 3FM Project.

2 REVIEW OF EXISTING DATA FROM PAST SURVEYS

The population of Black Guillemots breeding in Dublin Port has fluctuated markedly since 2013. The most recent count of Black Guillemots in 2023 recorded 87 birds. This is well above the average number of 65 over the ten years of available survey records (Figure 2.1). Numbers of birds were lower from 2018 to 2021, but recent counts suggest a substantial increase, and indicate that the population has recovered to pre-ABR Project levels.

While the surveys record all birds present 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. The nests are not accessible due to height above water and it is not therefore possible to inspect the contents in the interior of nest sites.

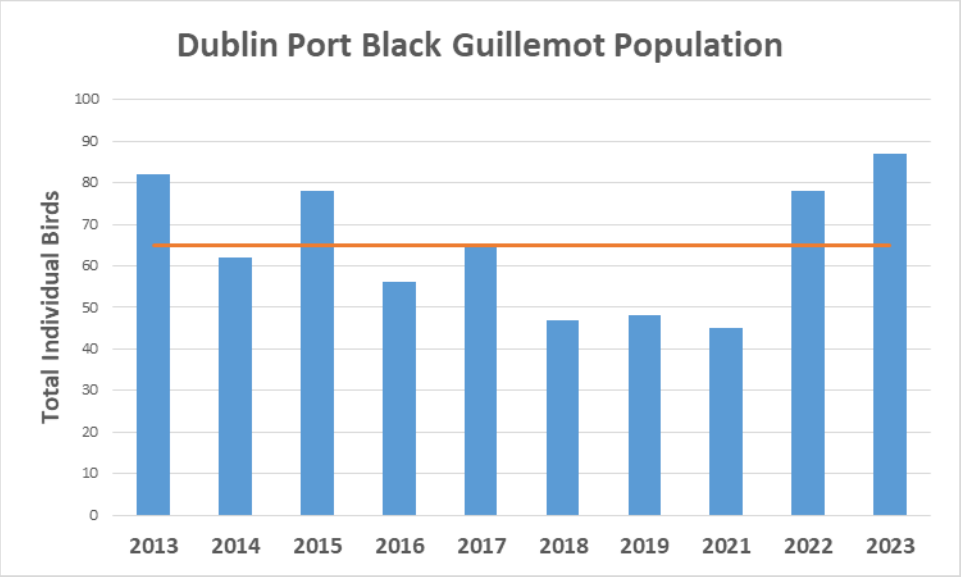


Figure 2.1 Total population of Black Guillemots breeding in Dublin Port 2013-2023. Red line shows overall mean.

3 CURRENT STATUS OF ALL POTENTIAL NESTING SITES

In September 2021 an inspection of all current and potential nest sites in the Port was undertaken from an inflatable boat. In Table 3.1 summarises the result, along with the location by shipping berth number and their status (Figure 3.1).

Table 3.1 Results of Black Guillemot breeding census 2021

Port section	Nest site no.	Berth no.	Type of nest site	Status since 2019	Potential to be retained
North Wall Extension	1	18	Drainage hole	Unoccupied	Yes
	2	18	Drainage hole	Unoccupied	Yes
Alexandra Basin West	3	23	Drainage hole	Occupied	Yes
	4	23	Drainage hole	Occupied	Yes
	5	24	Drainage hole	Unoccupied/ Grill	Yes
	6	24	Drainage hole	Occupied	Yes
	7	25	Drainage hole	Occupied	Yes
	8	25?	Drainage hole	Occupied	Yes
	9	25?	Drainage hole	Occupied	Yes
	10	30	Drainage hole	Unoccupied	No
	11	31	Drainage hole	Unoccupied	No
Alexandra Basin East	12	38	Ro/Ro Ramp no. 2	Occupied	Yes
	13	38	Ro/Ro Ramp no. 2	Occupied	Yes
East Oil Jetty	14		13 nestboxes	3 Occupied	No
Berths 51 and 51A	15	51	Ro/Ro Ramp no. 1	Occupied	Yes
	16	51	Ro/Ro Ramp no. 1	Occupied	Yes
	17	51A	Ro/Ro Ramp no. 9	Occupied	Yes
	18	51A	Ro/Ro Ramp no. 9	Occupied	Yes
Berths 52 and 53	19	52	Ro/Ro Ramp no. 7	Occupied	No
	20	53	Ro/Ro Ramp no. 6	Occupied	No
Pigeon House	21		East of Pigeon House Hbr	Occupied	No
	22		West of Pigeon House Hbr	Occupied	No
South Bank Quay	23	46	Drainage hole	Occupied	Yes
	24	45	Drainage hole	Occupied	Yes
Marine Terminals	25	42	Drainage hole	Occupied	Yes
	26	41	Drainage hole	Occupied	Yes

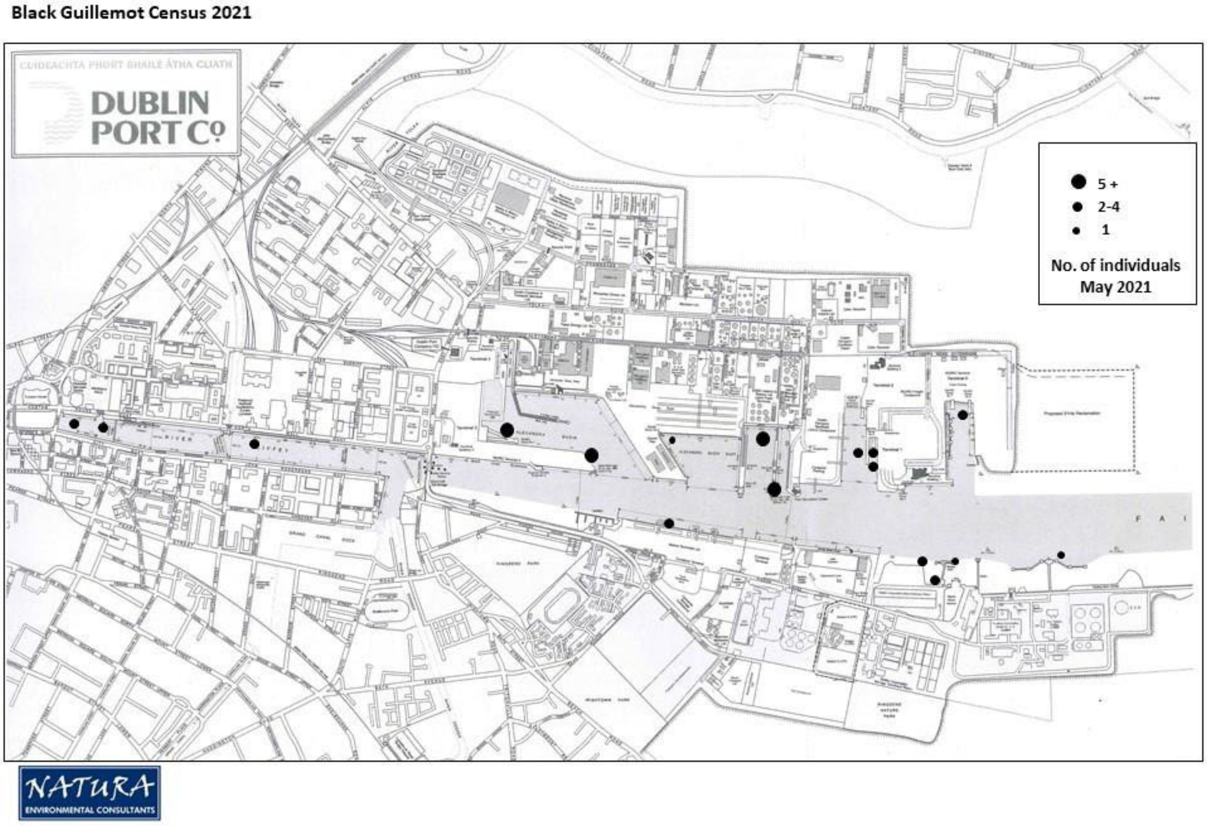


Figure 3.1 **Results of Black Guillemot breeding census 2021**

4 POTENTIAL OF NEST SITES TO BE RETAINED AND MEASURES REQUIRED

The table above shows that there are up to 26 potential nest sites in existing structures within Dublin Port (east of the Tom Clarke Bridge), a proportion of which have been occupied in recent years. The adult population of Black Guillemots in the port (2022-2023) is currently around 80 birds and this is supplemented by juveniles in the summer period.

From the table it is evident that the majority of currently used nest sites are in drainage holes in quay structures or ramps that will not be altered under the consented ABR Project and MP2 Project nor under the proposed 3FM Project. No additional measures are required to retain these sites other than the removal of a grill from site number 5 in Berth 24.

The potential nest sites that will be impacted by current and proposed developments are in Berths 30, 31, East Oil Jetty, Berths 52, 53 on the north side of the port and either side of the Pigeon House Harbour on the south side.

It is well established that Black Guillemots will readily nest in custom-made nest boxes that mimic the type of enclosed sites they select in quays and ramps. Large numbers of such nest boxes have been successfully deployed at Bangor Harbour, Co. Down (Greenwood 2002), Rockabill, Co. Dublin and Greenore Port, Co. Louth. It is important that the nest boxes are robust and durable in the harsh marine environment. They also need to be sited:

a) Where they will not interfere with shipping or other uses of the port;

b) Where they will remain dry and not become flooded by rainfall;

c) Where they cannot be reached by egg scavengers such as rats;

d) Where the birds can drop directly into the sea below.

The most appropriate sites are underneath open structures such as jetties. The sites should be distributed around the port to avoid concentrating large numbers in one area. The best locations have been identified in Figure 4.1 and as follows:

4.1 Phase 1: MP2 Project

1. ***RoRo Jetty in Alexandra Basin West:*** This structure comprises nine individual reinforced concrete dolphin pile caps supported on vertical tubular steel bearing piles and is already constructed under the ABR project. A total of 6 nest boxes are proposed.
2. ***Proposed Berth 53 at eastern end of the port:*** This will be an open pile structure. A total of 6 nest boxes are proposed.

4.2 Phase 2: 3FM Project

3. ***Proposed dolphins and walkways in Area N:*** This proposed new jetty at the at east end of Area N will be built as part of the 3FM project which has yet to be granted planning permission. This will be an open pile structure. A total of 8 nest boxes are proposed.

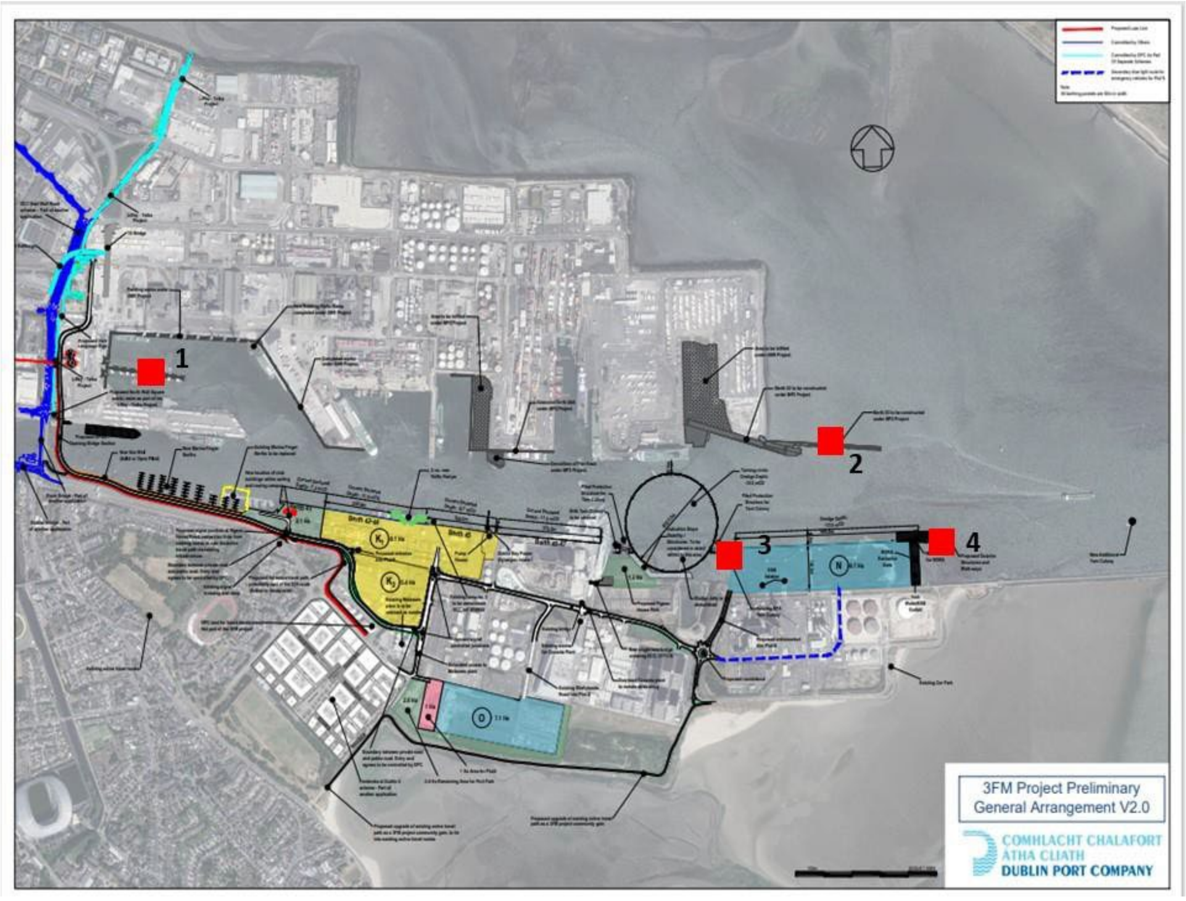


Figure 4.1 **Proposed locations for groups of Black Guillemot next boxes**

5 NEST BOX CONSTRUCTION

Custom-made nest boxes are available from Genesis Nest Boxes in Killarney. These are constructed to standard dimensions, defined by the British Trust for Ornithology (du Feu 1993). The material used is ResCom® Cellular Magnesia Cement board, which is held together with stainless steel and aluminium fixings and fittings. It is primarily a board produced for waterproofing and its fireproof qualities, rated Class 1A fireproof. It is waterproof, fire rated for 2.5 hours, mould resistant and rodent proof. It has been used for silt traps on farmland where it has been submerged in streams, exposed to rain, hail, sleet, sunshine, and frost deterioration. The materials are guaranteed for up to 30 years (Figure 5.1).

Figure 5.1 Nest box design

6 MONITORING

Annual monitoring of the use of all nest sites, including new nest boxes, will continue to be undertaken with two complete surveys by boat to all parts of the port in the period late April-early May. While this survey will record the occupation of nest sites it is unable to assess breeding success due to lack of access to the inside of the nest cavities.

7 REFERENCES

Du Feu, C. (1993). *Nestboxes.* BTO Guide 23, British Trust for Ornithology. Thetford.

Gilbert, G., Stanbury, A. & Lewis, L. (2021). Birds of Conservation Concern in Ireland 4: 2020–2026 *Irish Birds* 43, 1-22.

Greenwood, J.G. (2002). Nesting cavity choice by Black Guillemots *Cepphus grille. Atlantic Seabirds* 4: 119-122.

7.5.11 Tern Colony Management Plan

TERN COLONY MANAGEMENT PLAN 2023-2030

DUBLIN PORT COMPANY

NI2541 Dublin Port
Tern Colony Management Plan
D06
March 2024

www.rpsgroup.com

Document Status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
D01	Internal Review	AMC / KA	--	--	31.10.2022
D02	PM Review	AMC / KA	JMC	--	30.11.2022
D03	PM Review	AMC / KA	JMC	--	19.12.2022
D04	PM Review	AMC/ KA	JMC	AGB	17.01.2023
D05	Client Review	AMC/KA	JMC	AGB	18.01.2023
D05	Final	AMC/KA	JMC	AGB	23.02.2023
D06	2023 data added	AMC/KA	JMC	AGB	05/03/2024

Approval for issue

Dr Alan Barr	Alan Barr	2023-03-05

This report was prepared by RPS Ireland Ltd (NI) ('RPS') within the terms of its engagement and in direct response to a scope of services. This report is strictly limited to the purpose and the facts and matters stated in it and does not apply directly or indirectly and must not be used for any other application, purpose, use or matter. In preparing the report, RPS may have relied upon information provided to it at the time by other parties. RPS accepts no responsibility as to the accuracy or completeness of information provided by those parties at the time of preparing the report. The report does not take into account any changes in information that may have occurred since the publication of the report. If the information relied upon is subsequently determined to be false, inaccurate or incomplete then it is possible that the observations and conclusions expressed in the report may have changed. RPS does not warrant the contents of this report and shall not assume any responsibility or liability for loss whatsoever to any third party caused by, related to or arising out of any use or reliance on the report howsoever. No part of this report, its attachments or appendices may be reproduced by any process without the written consent of RPS. All enquiries should be directed to RPS.

Prepared by:

RPS Ireland Ltd (NI)

Elmwood House, 74 Boucher Road
Belfast, Co. Antrim, BT12 6RZ

T 0044 28 9066 7914
E **adam.mcclure@rpsgroup.com**

Prepared for:

Dublin Port Company

Port Centre, Alexandra Rd, North Dock, Dublin, D01 H4C6, Ireland

T 00353 1 887 6000
E

Contents

Appendices

1 INTRODUCTION

The purpose of this Management Plan is to assist Dublin Port Company (DPC) and key stakeholders in forward planning for the future management of an internationally important colony of breeding terns that, each summer, reside within Dublin Port.

DPC recognises the importance of the breeding tern colony within Dublin Port, and their own role both as a leading stakeholder in the Port and in the stewardship of Dublin Bay's rich biodiversity. They are keen to promote and facilitate a sustainable breeding tern population in Dublin Port and Dublin Bay alongside their core remit as a commercial multi-modal port.

In an Irish context, terns are migratory seabirds that overwinter around the coast of the African continent, returning each spring to nest along Irish coasts and large, inland lakes (Hume, 1993).

All species of tern which breed in Ireland are fully protected under Irish and European law and two of the sub-colonies within Dublin Port are covered by statutory designations.

Any management or changes to the environment within which these sub-colonies breed each year should be carried out in consultation with National Parks and Wildlife Service (NPWS), the statutory nature conservation agency in Ireland and part of the Department of Housing, Local Government and Heritage. In that regard, the measures outlined here are 'proposed measures' and will be subject to consultation and approval by NPWS, particularly with respect to works proposed within, or potentially impacting on designated adjacent sites of European interest. All these works will be subject to screening for appropriate assessment as required by the Habitats Directive (92/43/EEC) prior to commencement.

Alexander (2008) sets out the functions of a comprehensive management plan for a nature conservation site, including:

- Help resolve both internal and external conflicts,
- Ensure continuity of effective management,
- Be used to demonstrate that management is appropriate, i.e., effective and efficient,
- Be used to bid for resources, and
- Encourage and enable communication between managers and stakeholders, and within and between sites and organisations.

The provisions of Article 6 of the EU Habitats Directive state that the necessary conservation measures can involve "appropriate management plans specifically designed for sites or integrated into other development plans" (EC, 2000; EC, 2019).

> *The tern colonies in Dublin Port have arisen directly as a consequence of interventions by DPC and demonstrate that the Port, as a busy commercial port, can co-exist alongside a thriving and dynamic natural environment. The success of the Tern Colonies in Dublin Port demonstrates that economic progress and development can be achieved in concert with the protection of the natural environment.*

2 LEGISLATION AND POLICY

2.1 EU Birds Directive

EU Directive 2009/147/EC on the conservation of wild birds, often referred to as the ‘Birds Directive’, recognised that bird conservation needed to be addressed at an international scale. Member States are obliged to take special action for a range of species, which are listed on Annex 1 of the Directive, including the designation of Special Protection Areas (SPAs).

All five species of tern which regularly breed in Ireland are listed on Annex 1 to the Directive.

Article 3 requires Member States to preserve, maintain and re-establish sufficient diversity and area of habitats for all wild birds. This should primarily (but not exclusively) involve the creation of protected areas and recognising the historic losses of wildlife, Article 3 also calls for the appropriate management of habitats both inside and outside protected areas, the re-establishment of destroyed habitats, as well as the creation of new habitats (Williams *et al*, 2005).

2.2 Birds and Natural Habitats Regulations

The European Communities (Birds and Natural Habitats) Regulations 2011 (as amended) transpose the provisions of the EU Habitats and Birds Directives into Irish law.

The Birds and Habitats Directives had previously been transposed into Irish law through *inter alia* the Wildlife Act 1976 and the European Communities (Natural Habitats) Regulations, 1997. The Court of Justice of the EU (CJEU) found, however, that Ireland had not adequately transposed the two Directives. Therefore, the 2011 Regulations consolidate the European Communities (Natural Habitats) Regulations 1997 to 2005 and the European Communities (Birds and Natural Habitats; Control of Recreational Activities) Regulations 2010, as well as addressing transposition failures identified in CJEU judgments (NPWS, 2021).

- Regulation 18 brings the SPA designation cycle into line with that of Special Areas of Conservation (SACs) to ensure that they are subject to the same legal form.
- Regulation 27 reflects an overarching obligation on all agencies of the State, including Local Authorities, to comply with and uphold the requirements of those Directives.
- Regulations 28 and 29 provide for the Minister to prohibit any operation or activity liable to damage a European site and provide for Ministerial Directions requiring a person to take such action or to refrain from taking such action as the Minister considers necessary to prevent damage to a site.

2.3 Wildlife Acts

The Wildlife Act of 1976 has been amended a number of times subsequently, to include for -

- Wildlife Act 1976
- Wildlife (Amendment) Act 2000
- Wildlife (Amendment) Act 2010
- Wildlife (Amendment) Act 2012

- Heritage Act 2018
- Planning and Development, Heritage and Broadcasting (Amendment) Act 2021

All wild birds in the Republic of Ireland are afforded protected status under the Wildlife Act, 1976 (as amended) which states that:

> *Wild birds and their nests and eggs, other than wild birds of the species mentioned in the Third Schedule to this Act, shall be protected.*

2.4 Nature Conservation Policy

2.4.1 National Biodiversity Action Plan 2023-2030

Ireland's 4th National Biodiversity Action Plan (NBAP) was published on 25th January 2024. It sets the national biodiversity agenda for the period 2023-2030 and aims to deliver the transformative changes required to the ways in which we value and protect nature. The NBAP will implement actions within the framework of five strategic objectives, while addressing new and emerging issues:

- Objective 1 - Adopt a Whole of Government, Whole of Society Approach to Biodiversity
- Objective 2 - Meet Urgent Conservation and Restoration Needs
- Objective 3 - Secure Nature's Contribution to People
- Objective 4 - Enhance the Evidence Base for Action on Biodiversity
- Objective 5 - Strengthen Ireland's Contribution to International Biodiversity Initiatives

2.4.2 Dublin City Biodiversity Action Plan 2021-2025

The Dublin City Biodiversity Action Plan 2021-2025 (DCBAP) forms the basis for the policy of the local authority on nature conservation within the jurisdiction and administrative boundaries of Dublin City Council.

The plan includes an objective to "*Protect designated sites for nature conservation in accordance with the Conservation Management objectives for Natura 2000 sites and proposed Natural Heritage Areas in Dublin City"* (DCC, 2021).

Action 2.1 of the above states "*Implement the Conservation Management objectives for the following Natura 2000 sites in Dublin City Council lands: North Bull Island SAC, North Bull Island SPA, South Dublin Bay and River Tolka Estuary SPA, South Dublin Bay SAC"* (DCC, 2021).

2.4.3 Dublin Port Company Masterplan

The Dublin Port Masterplan 2040 – Reviewed 2018 contains a series of commitments made by DPC to ensure the protection of the natural environment and ecological receptors which could be impacted by the development and land use initiatives set out with in their Masterplan (DPC, 2018).

3 TERNS IN IRELAND

3.1 Status

In an Irish context, terns are migratory seabirds which return to Ireland each spring to breed before migrating south in early autumn and spending the winter months off the coast of West Africa or further afield in the Southern Hemisphere (Hume, 1993). There are over 45 species of tern worldwide (Thomas *et al.,* 2004), of which five breed in Ireland, Arctic Tern *Sterna paradisaea*, Common Tern *S. hirundo*, Little Tern *S. albifrons*, Roseate Tern *S. dougallii* and Sandwich Tern *S. sandvicensis* (Mitchell *et al.,* 2004).

All five species of Irish tern are amber-listed in the most recent Birds of Conservation Concern Ireland (BoCCI), a joint publication produced by BirdWatch Ireland and RSPB NI (Gilbert *et al*, 2021).

3.1.1 Arctic Tern

Although considered a coastal species, Arctic Terns are also known to breed on freshwater lakes in Counties Galway and Mayo. More colonies are found on the west coast with Co. Wexford, Co. Kerry, Co. Mayo and Co. Donegal having the largest number of birds (BirdWatch Ireland, 2022a).

This species breeds at Dublin Port.

3.1.2 Common Tern

Colonial nesting species, with largest colonies found in Counties Dublin, Wexford and Galway. Also breeds on islands in freshwater lakes in Counties Galway and Mayo (BirdWatch Ireland, 2022b).

This species breeds at Dublin Port.

Common tern with chick © John Fox

3.1.3 Little Tern

The smallest species of breeding tern in Ireland, Little Terns are exclusively coastal, usually nesting on beaches where their eggs are so well camouflaged, they are almost invisible (Robinson, 2005).

The species is a rare breeder in Ireland, with breeding concentrated on the east coast (Burke *et al*., 2020a).

This species does not breed within Dublin Port.

3.1.4 Roseate Tern

Rockabill, off Skerries in Co. Dublin, is the most important Roseate Tern colony in Europe, holding almost 60% of the breeding population (Piec and Dunn, 2021). Whilst the species does not currently breed within Dublin Port, the recently published International (East Atlantic) Species Action Plan for the Conservation of the roseate tern *Sterna dougallii* (2021-2030) has identified the need to provide safe nesting conditions at large Common Tern colonies to aid Roseate Tern population expansion, either through the growth of the NW European metapopulation or dispersal caused by deterioration of one of the key extant colonies (Piec and Dunn, 2021).

Roseate Terns nest colonially on the ground, Nests are generally hidden in long vegetation, among boulders, in rabbit burrows and in nest boxes, with the Rockabill colony primarily nesting in open nests (698 nesting in boxes, 856 in open nests in June 2019 (Birdwatch Ireland 2019). Therefore, given the proximity of the Dublin Port tern colony to the Roseate Tern colony at Rockabill, and successful open nest breeding records, there is the potential for Dublin Port to attract nesting Roseate Tern, with the provision of adequate nesting sites and suitable protection from predation.

This species does not currently, but has the potential to, breed at Dublin Port.

3.1.5 Sandwich Tern

The largest of the tern species breeding in Ireland, is the Sandwich Tern, which exhibits the widest but patchiest breeding distribution in the British and Irish Isles, preferring low-lying offshore islands or islets in bays and brackish lagoons.

The species does not breed within Dublin Port.

4 TERNS IN DUBLIN BAY

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), and in late summer Dublin Bay, and in particular Sandymount Strand, holds the largest concentration of post-breeding terns in Ireland.

Attracting birds from colonies, not only in Ireland but also further afield, Dublin Bay may be the most important tern staging site in north-west Europe (Burke, 2020).

4.1 History of tern colony at Dublin Port

Common and Arctic Terns are known to breed in the Dublin Port area since the late 1940s (Merne, 2004).

The Seabirds of Britain and Ireland (Cramp *et al,* 1974), which presented the findings of the first census of all coastal breeding seabirds in Britain and Ireland in 1969-70, reported that the Dublin Port area supported a small colony of 32 pairs of Common and 6 pairs of Artic Terns.

The All-Ireland Tern Survey in 1984 recorded an increase to 61 pairs of Common Terns and 30 pairs of Arctic Terns at Dublin Port (Whilde, 1985). During that survey, it was noted that terns were nesting at three locations: the oil terminal jetty at the North Wall, on reclaimed land on the East Wall and on a mooring dolphin at Poolbeg.

There is little or no quantitative information on the Dublin Port tern colony between the 1984 survey and the commencement of the NPWS conservation and research project in the Dublin Port area which began in 1994 (Merne, 2004). Since 2015, Birdwatch Ireland have led monitoring efforts of the Dublin Port tern colony, funded by Dublin Port Company.

Common terns © John Fox

4.2 Current nesting sites

As of 2023, the Dublin Port tern colony breeds on four man-made structures within the Port: two mooring dolphins; the Coal Distribution Limited (CDL) Dolphin and the ESB Dolphin, and also on two specially made nesting platforms; the Tolka Estuary Pontoon and the Great South Wall (GSW) Pontoon.

The CDL Dolphin and the ESB Dolphin are designated as proposed Natural Heritage Areas (pNHAs) and the ESB Dolphin is 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).

4.2.1 CDL Dolphin

The only structure in Dublin Port to currently host nesting Arctic Tern, the CDL Dolphin is retained as a mooring dolphin outside the breeding season. The large, concrete structure is owned by Dublin Port Company and is not sub-divided into compartments, although a wooden perimeter board was erected in 2016 to prevent chicks from falling into the water before they are fully fledged.

4.2.2 SPA Platform

Also referred to as the ESB dolphin in previous reports. It is owned and maintained by ESB who replaced the nesting platform in 2017 with an entirely new and improved structure. The new platform is subdivided into 34 compartments to facilitate monitoring and to minimise disturbance to chicks when the structure is accessed. High perimeter boards have been installed to prevent chicks entering the water before fledging. It is accessed through a hatch door from underneath.

ESB Dolphin in 2004 © Richard Nairn

4.2.3 Tolka Pontoon

The Tolka Pontoon, also referred to as DPC Clontarf Raft and Pontoon No. 1. It was first deployed in the Tolka Estuary by DPC in 2013. It is separated in to three large compartments and has perimeter boards to prevent chicks entering the water before fledging. A metal skirt was fixed to each end of the pontoon in advance of the 2021 season to prevent rats being able to access the structure.

4.2.4 GSW Pontoon

Originally launched at the base of the Great South Wall by DPC in 2015, this structure is also referred to as Pontoon No. 2. The pontoon is subdivided into 18 compartments.

In 2016, the structure was moved adjacent to the SPA Platform to help accommodate any potentially displaced terns from it during its upgrade works.

Following consultation with National Parks and Wildlife Service (NPWS), once works were completed, the pontoon was re-located away from the SPA Platform. It was felt that it had served its purpose in that location and that moving it elsewhere would prevent it from compromising the qualifying interests of the SPA.

In 2018 DPC relocated this pontoon to a suitable location south of the buoyed channel approximately 120m on the north side of the Great South Wall, and approximately 750m east of the base of the GSW.

4.3 Population changes

As set out in Section 4.1 above, the breeding tern population of Dublin Port has been closely monitored for over 25 years, initially by the late Oscar Mearne and subsequently by BirdWatch Ireland. Table 4.1 below sets out the changes in the breeding tern population at Dublin Port since 1995 based on apparently occupied nest counts. The data are also plotted in Figure 4.1.

Common tern chick © John Fox

Table 4.1 Total number of Common and Arctic Tern nests at each of the breeding structures in Dublin Port between 1995 and 2023 (*)

Year	SPA Dolphin		CDL Dolphin		1Tolka Pontoon (**)		GSW Pontoon (***)		Colony Total		
	Comm	Arcti	Comm	Arcti	Comm	Arcti	Comm	Arcti	**Comm**	**Arcti**	**Total**
1995	48	1	14	8	-	-	-	-	62	9	**71**
1996	58	0	14		-	-	-	-	72	0	**72**
1997	75	3	15		-	-	-	-	90	3	**93**
1998	140	2	20		-	-	-	-	160	2	**162**
1999	194	2	22		-	-	-	-	216	2	**218**
2000	172	0	18		-	-	-	-	190	0	**190**
2001	205	0	18		-	-	-	-	223	0	**223**
2002	>238	1	*Unknown*		-	-	-	-	>238	>1	**>239**
2003	>207	6	*Unknown*		-	-	-	-	>207	>6	**>213**
2004	*No visits*				-	-	-	-	*No visits*		
2005	227	0	*No visits*		-		-	-	>227	0	**>227**
2006	320	0	0	27	-	-	-	-	320	27	**347**
2007	410	0	0	33	-	-	-	-	410	33	**443**
2008	435	0	0	36	-	-	-	-	435	36	**471**
2009	*Data unavailable*				-	-	-	-	*Unknown*		
2010	*Data unavailable*				-	-	-	-	*Unknown*		
2011	*Data unavailable*				-	-	-	-	*Unknown*		
2012	*Data unavailable*				-	-	-	-	*Unknown*		
2013	418	0	1	25	1	0	-	-	420	25	**445**
2014	427	1	1	76	50	0	-	-	478	77	**555**
2015	416		58		73		1		*Unknown*		**548**
2016	382		0		7		114		*Unknown*		**503**
2017	(****)		24		84		308		*Unknown*		**416**
2018	156		105		132		203		*Unknown*		**596**
2019	261		97		83		204		*Unknown*		**645**
2020	*No visits (COVID-19)*										
2021	182	0	33	10	103	0	210	0	528	10	**538**

(*) Since 2015, data on breeding tern populations has been collected by BirdWatch Ireland as part of the Dublin Bay Birds Project which is funded by DPC

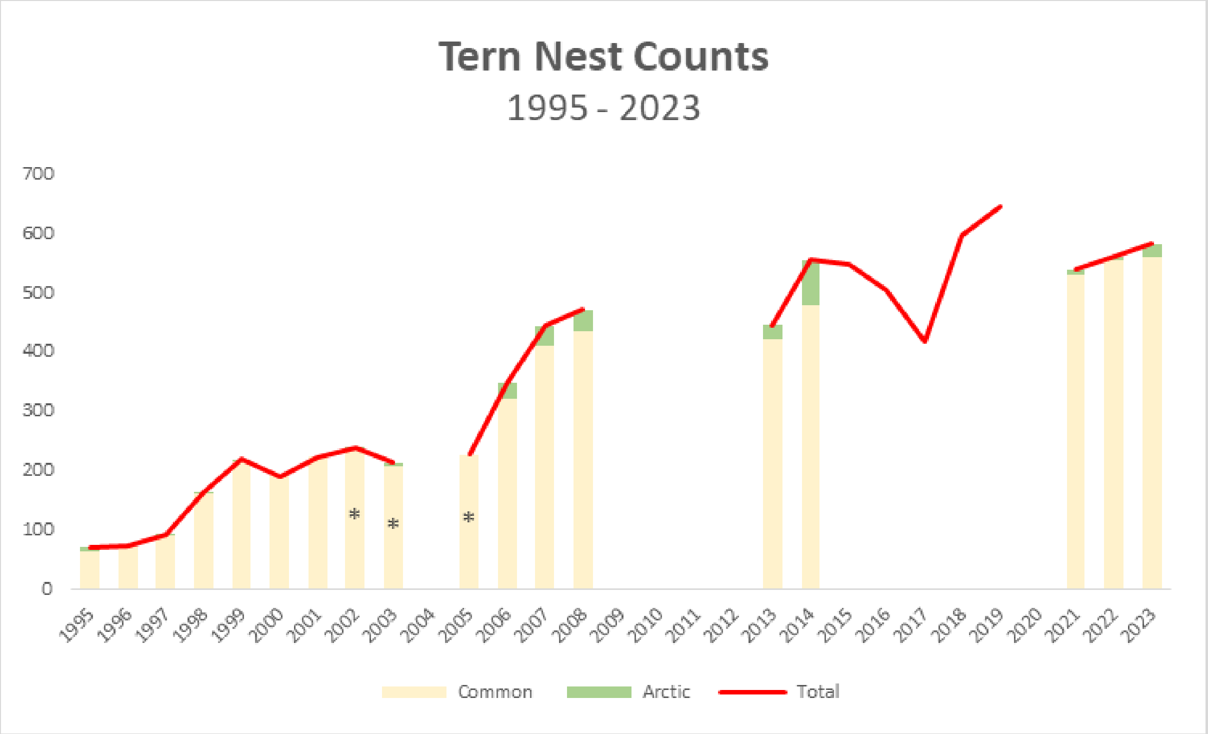
(**) Tolka Pontoon first deployed in 2013

(***) GSW Pontoon first deployed in 2015

(****) ESB Structure replaced in 2017 and no data was gathered from here

Year	SPA Dolphin		CDL Dolphin		1Tolka Pontoon (**)		GSW Pontoon (***)		Colony Total		
	Comm	Arcti	Comm	Arcti	Comm	Arcti	Comm	Arcti	**Comm**	**Arcti**	**Total**
2022	138	0	0	5	169	0	248	0	555	5	**560**
2023	119	0	62	21	151	0	228	0	560	21	**581**

Figure 4.1 Counts of Common and ArcticTern nests at Dublin Port Tern Colony 1995-2023. Note that years 2002, 2003 and 2005 (marked with *) are minimum number estimates. In years 2015 to 2019 only total number of nests were counted.



The Common Tern population has shown an increase over the past three decades, benefitting from increased conservation efforts (including the Roseate Tern colony management plan at Rockabill), nesting habitat creation (tern breeding structures), and habitat protection. However, as with all tern species productivity fluctuates year on year, facing pressures from predation, habitat change, prey availability, disease, and disturbance.

The likely causes of decline in the Arctic Tern populations in Ireland are via acts of predation (raptors taking adults, chicks and eggs; corvids taking chicks and eggs; rats preying on chicks and eggs), and unseasonable weather conditions (increased periods of rainfall leading to nest site flooding), and reduced availability of prey. As above, maintaining and increasing the tern population levels depends on continued conservation management programmes at the breeding sites.

In 2023 avian influenza severely impacted the Dublin Port tern colony, resulting in deaths of adults, fledglings and chicks on all nesting platforms. Between the 4th July and the 3rd August 2023 a total of 195 adult and 358 juvenile carcasses were discovered at the platforms. These represent minimum mortalities, and therefore avian flu resulted in greatly reduced tern colony productivity in 2023.

Nesting pontoon, Tolka Estuary

4.4 Post-breeding aggregations

Late summer is a vital period for migratory terns. Following breeding, adults and recently fledged young must prepare for some of the longest migrations undertaken by any species (Redfern and Bevan, 2020).

The Irish post-breeding tern survey has provided information on some of the important post-breeding sites and results from the survey have identified Dublin Bay, particularly Sandymount Strand, as the most significant staging site in Ireland, and possibly in north-west Europe (Burke *et al*, 2020) for Common Tern, Roseate Tern and Arctic Tern. A peak count of 17,400 terns was recorded here in 2016 (BWI 2022).

5 DESIGNATIONS

5.1 Special Protection Area

Both the SPA Platform and the Tolka pontoon are within the boundary of South Dublin Bay and River Tolka Estuary SPA (see Appendix 1).

This is the highest level of protection available for important bird areas and provides protection under the EU Birds Directive and the European Communities (Bird and Natural Habitat) Regulations, 2011 (see section 2 above).

The Habitat Regulations place an obligation on all agencies of the State, including Local Authorities, to comply with and uphold the requirements of both the EU Birds and Habitats Directives. They also allow the Minister to regulate any operation or activity liable to damage a European site (SPA or SAC).

In addition, Schedule 4 to the European Communities (Conservation of Wild Birds (South Dublin Bay and River Tolka Estuary Special Protection Area 004024)) Regulations 2010 (S.I. No. 212/2010) lists those operations or activities that require the prior written consent of the Minister before they are undertaken.

5.2 Proposed Natural Heritage Area

In 1995, NPWS published proposals on 630 proposed NHAs (pNHAs) on a non-statutory basis, but these have not since been statutorily proposed or designated. These sites are of significance for wildlife and habitats (NPWS, 2022)

Prior to statutory designation, pNHAs are subject to limited protection, in the form of recognition of the ecological value of pNHAs by Planning and Licencing Authorities. This is confirmed by the conditions attached to a grant of planning permission to Ecocem by An Bord Pleanala (ref: PL29S.233158). This required that the applicant should "*submit to and agree in writing with the planning authority a scheme for mitigation measures against potential detriment to colonies of Terns on the adjacent offshore mooring dolphins*".

Under the Wildlife Amendment Act (2000), NHAs are legally protected from damage from the date they are formally proposed for designation.

6 PROPOSED MANAGEMENT PLAN

6.1 Objectives

The objectives of this Management Plan relate to the entire breeding tern colony made up of the various sub-colonies within Dublin Port.

European and national legislation places a collective obligation on Ireland and its citizens to maintain at favourable conservation status the species for which Special Protection Areas are designated.

The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

According to the EU Habitats Directive, favourable conservation status of a species is achieved when all of the following objectives are met:

- The size of the population is maintained or increasing
- The population must be sustainable in the long term
- The natural range of the species is neither being reduced or likely to be reduced for the foreseeable future
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis
- The factors that affect the species or it habitats must be under control.

These objectives must be met for (a) the individual species for which the SPA has been selected and (b) for the overall assemblage of breeding birds in the SPA.

Specific objectives for favourable conservation condition are set in relation to individual qualifying interests of the South Dublin Bay and River Tolka Estuary SPA (NPWS 2012 Conservation Objectives: South Dublin Bay and River Tolka Estuary SPA 004024. Version 1). In relation to terns these objectives are:

- No significant decline in breeding population (apparently occupied nests), or productivity rate (fledged young per breeding pair) – Common Tern
- No significant decline in passage population – Common, Arctic and Roseate Tern
- No significant decline in the number, location or area of breeding colonies – Common Tern
- No significant decline in the number, location or area of roosting areas - Common, Arctic and Roseate Tern
- No significant decline in prey biomass available - Common, Arctic and Roseate Tern
- No significant increase in barriers to connectivity - Common, Arctic and Roseate Tern
- Breeding Site: Human activities should occur at levels that do not adversely affect the breeding population – Common Tern
- Roosting Site: Human activities should occur at levels that do not adversely affect the numbers of terns among the post-breeding aggregation of terns - Common, Arctic and Roseate Tern

6.2 Existing structures

A number of issues relating to tern conservation status have been identified that are considered to warrant management interventions at the existing nesting structures in order to improve conservation prospects. These include avian and mammalian predation of terns, impacts of adverse weather, and fouling of nesting substrate.

Potential measures to address these issues and mitigate potential impacts are proposed below. All of these measures will be subject to liaison with NPWS and screening for appropriate assessment prior to implementation.

6.2.1 Avian Predators

Tern colonies can suffer massive declines as a result of predation (Hume, 1993). As well as direct predation, the mere presence of predators close to a tern colony can have a detrimental impact upon the productivity by causing adults to lift off nests, exposing eggs or young chicks to the elements (Donehower *et al,* 2007 and Palestis, 2005).

Boland *et al* (2022) report how pressure from avian predators in 2022 has resulted in the SPA Platform having its poorest season in a decade, through a combination of stress and direct predation caused by Peregrines *Falco peregrinus*, Buzzards *Buteo buteo* and gulls.

In addition, a pair of Hooded Crow *Corvus cornix,* which nested on a structure near-by, predated the sub-colony on the CDL Dolphin incessantly until their own chicks fledged, resulting in a poor, late season for terns on the dolphin (Boland *et al*, 2022).

Recent modifications to pontoons and the provision of pipe shelters on the sub-colonies have provided chicks with some protection and refuge from avian predation, and also from inclement weather (Boland *et al*, 2021). However, it is recommended that extra, purpose-built shelters to the dimensions set out in Morrison and Gurney (2007) are also provided.

These shelters, although designed as nesting boxes for Roseate Terns *Sterna dougallii*, will provide additional protection for chicks, particularly from gull and corvid predation.

Conservation management should also consider the removal of corvid nests in the immediate vicinity of tern sub-colonies that pose an active and significant threat to breeding terns. Any such measures will require appropriate consents and licences from NPWS.

Pipe shelters on tern platform, Dublin Port

6.2.2 Mammalian Predators

Sub-colonies within Dublin Port have suffered predation from both Otter *Lutra lutra* and Brown Rat *Rattus norvegicus* in recent years as confirmed by monitoring on each nesting platform using trail cameras. However, recent modifications to the sub-colony structures to prevent mammals from accessing them during the tern breeding season appear to have mitigated this predation (Boland *et al*, 2021). Mammalian predation was absent at all four breeding structures in 2023.

Vigilance and ongoing maintenance and improvements must remain at the forefront of management at the colony. DPC and relevant stakeholders should continue to monitor for mammalian predation and ensure the protection measures are adequately maintained to prevent mammals from accessing nesting structures.

Otter pictured on tern platform, Dublin Port, June 2021

6.2.3 Replacement of surface substrate

Boland *et al* (2022) have reported that fouling by tern droppings and weathering has led to surface substrate on nesting platforms becoming unsuitable, and indeed creating a dangerous environment for tern eggs and chicks due to the formation of sticky mud which damages wings and body feathers.

McGeehan and Wyllie (2012) highlight that “the provision of loose, malleable substrate that is a capable of being sculpted by the birds is crucially important”.

It is recommended that the existing fouled surface substrate is removed and replaced in advance of the breeding season. McGeehan and Wyllie (2012) state that “cockleshells are ideal”.

Substrate should be checked at the end of each season and, if found to be unsuitable, replaced as required.

Summary of Measures – Existing Nesting Structures

- *Provide shelters/nest boxes on platforms*
- *Control corvid nest sites in vicinity of sub-colonies that are causing significant impact*
- *Monitor platforms for mammalian predation*
- *Maintain mammalian predation mitigation features as required*
- *Replace existing surface substrate with suitable material such as cockleshells*
- *Conduct annual assessment of surface substrate and replace as required*

6.3 Provision of additional nesting structures

The Common Tern population in Dublin Port has increased over the past three decades, due in part to the provision of additional nesting habitat, and perhaps benefitting from conservation efforts at Rockabill resulting in local recruitment as indicated by ringing data. To be sustainable the size and range of tern populations should be maintained or increased, and providing new nesting habitat can support this conservation objective.

Given that the existing tern colony is largely located within and adjacent to operational areas of Ireland’s busiest Tier 1 Port (DPC, 2022), the potential locations for any new nesting structure(s) are limited by operational requirements, navigational constraints and maritime safety.

6.3.1 Key Requirements

There are several factors which must be taken into consideration when selecting suitable sites for nesting terns within Dublin Port:

- They must be outside of the shipping channel and approaches, and areas used for turning or berthing ships.
- They should not be in areas that have been identified for future port development or capacity expansion.
- They should be sustainable in the long-term with minimal ongoing maintenance requirements.
- They should be surrounded by water at all stages of the tidal cycle.
- They should be far enough from land to deter terrestrial mammalian predators, such as rats, mink, foxes or cats, from gaining access.
- They should be far enough from Peregrine nesting sites on the Poolbeg peninsula to minimise disturbance and predation by these falcons.
- Where feasible and in agreement with key stakeholders and statutory agencies, they should provide opportunities for viewing from public areas.

6.3.2 Potential locations

Two potential locations for new nesting structures have been identified (Figure 6.1) that may meet all key requirements outlined above:

- within the Tolka Estuary; and
- north of the Great South Wall, outside the shipping channel

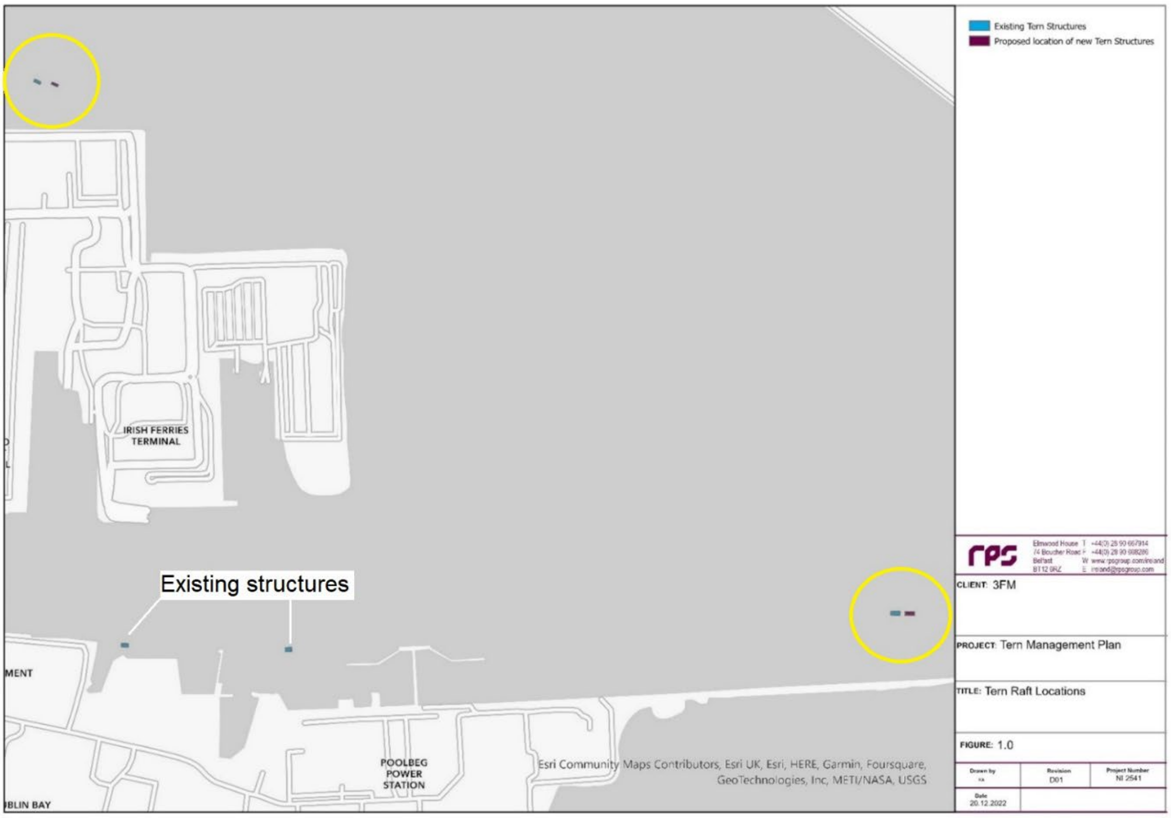


Figure 6.1 Potential locations of additional nesting structures at Dublin Port

6.3.2.1 Tolka Estuary

A pontoon for nesting terns, divided into three compartments has been deployed in the Tolka Estuary since 2013. In 2021, a second, smaller raft was attached to the Tolka pontoon to prevent the original structure from listing. This new extension to the pontoon is sub-divided into two compartments with nesting substrate, wooden perimeter boards and plastic pipe chick shelters added.

The Tolka sub-colony could potentially be increased by the addition of another suitable nesting structure to increase the potential nesting area available, in close proximity to the existing rafts. Observations that terns nested on the smaller raft, deployed to support the original pontoon, illustrates that there is potential for attracting additional birds if suitable nesting habitat is present.

This location is away from areas of main port operations and is located in view of an existing public amenity walkway and cycleway. The area available for additional pontoons is however limited because much of the Tolka Estuary dries out towards Low Water thereby making the pontoon potentially vulnerable to predators.

6.3.2.2 Great South Wall

Nairn (2015) identified this location as a potential site for a suitable nesting structure within Dublin Port Estate. Since 2015, a raft has been deployed here. In 2016 and 2017, it was temporarily relocated close to the SPA Dolphin to facilitate nesting birds during repair and upgrade works to the permanent dolphin but since 2018, it has been located in the channel approximately 120m north of the Great South Wall, approximately 750m east of the base of the Great South Wall (Boland *et al*, 2022).

Advantages of this location include:

- It is outside the main shipping channel;
- It can be located sufficiently far from the land to make it inaccessible to ground predators;
- It is distant enough from Poolbeg Power Station to reduce the risk of disturbance and predation by nesting Peregrines;
- It is relatively close to a publicly accessible area that is already used by a large number of walkers but distant enough for disturbance not to be a concern; and
- Observers standing on the Great South Wall would have good views of the terns with favourable sunlight mainly coming from the south.

6.3.3 Suitable structures

Rafts

Terns will readily take to artificial nesting platforms (Hume, 1993) and rafts have proven to be successful at attracting nesting terns at numerous sites in Ireland and abroad, including Dublin Port, Ringaskiddy Port and inland lake locations. They are however vulnerable to both mammalian predators and storm damage due to their low height above the waterline (c.1-2m). In addition, the GSW Pontoon is also vulnerable to wash from the numerous large vessels which pass by it on approach to Dublin Port.

The principal advantage of using rafts is their low cost, straightforward construction, quick and simple deployment and if necessary, retrieval at the end of the season.

Fixed structures

Although more costly initially, due to elaborate construction and the probable requirement for statutory permissions, in the long-term fixed structures are more cost-effective, sustainable and require less maintenance than rafts.

Possible structures could comprise one or more permanent dolphins. A minimum height of +4.6m OD Malin would mitigate for increasing tidal height to 2100. A proposed area of 14mx14m of potential nesting habitat is 69% larger than the existing GSW floating pontoon (17m x 8m). Other requirements include a hide for observations and a lockable hatch to allow access for monitoring and maintenance, whilst preventing mammalian predators from accessing the platform.

Replication of the eventual design would allow addition of further nesting platforms at this location as colony expansion dictates and if available nesting habitat becomes a limiting factor.

A drawing showing construction details of a typical permanent nesting platform is shown in Appendix 3.

Summary of Measures – Additional Nesting Structures

- *Provide new nesting habitat at potential locations identified using key requirements*
- *Consider use of rafts and permanent pontoons*
- *Allow for future increase in nesting habitat to cater for expansion of tern colony*

6.4 Post-breeding aggregations

Dublin Bay is, potentially, the most important staging site for post-breeding terns in north-west Europe. The South Dublin Bay and River Tolka Estuary SPA (Site Code 004024) includes conservation objectives for the protection of terns on migration (Burke *et al*, 2020). Merne *et al*. (2008) describes the main roosting area as the exposed sand banks in south Dublin Bay primarily between the Martello Towers at Sandymount (X,Y Grid Ref: 319524, 232021) and Williamstown (X,Y Grid Ref: 320796, 229979). Although principally used as a night roost, birds begin to roost at least one hour before sunset during the period July to September with peak activity occurring between mid-August and mid-September (Merne *et al*., 2008; Merne, 2010).

6.4.1 Disturbance of Roosting Terns

Disturbance of Common, Arctic and Roseate terns at the roosting site is addressed in the conservation objectives for the South Dublin Bay and River Tolka Estuary SPA 004024 (NPWS 2012). In terms of the level of impact, human activities should occur at levels that do not adversely affect the numbers of Roseate, Common, or Arctic terns among the post-breeding aggregation of terns.

Merne (2010) recorded significant disturbance events to the roosting terns caused by people with dogs off the leash and kite surfing. Disturbance, particularly by walkers and dogs has also been highlighted as having a major adverse impact on these large roosting flocks and in some cases has resulted in abandonment of the site (Burke et al, 2020).

Whilst the opportunities for Dublin Port Company to influence the management of these areas is limited, given the significance of these sites for migrating terns, relevant stakeholder organisations (see Section 6.6 below) should take appropriate measures in an effort to minimise disturbance, particularly during the key stopover period in late summer and early autumn (August and September). The promotion of relevant measures can be progressed by relevant stakeholders through existing structures such as the Dublin Bay Biosphere Partnership.

6.4.2 Disturbance Mitigation Measures

Suggested management measures include temporary zoning of areas used for roosting to balance recreational and conservation needs (Stigner et al. 2016), and educating beach users and other recreational users of the adverse effects of disturbance on large post-breeding flocks roosting within Dublin Bay (Le Corre et al. 2013). This could be through face-to-face interaction or passive education in the form of interpretation boards at Sandymount Strand.

In relation to disturbance by dogs, there are currently a number of measures in place in Ireland that are aimed at ensuring all dogs are controlled appropriately (Control of Dogs Act 1986, Control of Dogs Regulations 1998, various Local Authority Bye-Laws). In a review of the Control of Dogs Acts (Department of Rural and Community Development, 2022) a number of potential measures were identified that are relevant here. These included the use of dog control notices in specific areas; improved enforcement of legislation through derogation of enforcement powers to park wardens, wildlife rangers and others; and information and educational campaigns relating to the control of dogs and responsible dog ownership.

Relevant legislative controls are already in place through the Dublin City Council Control of Dogs Bye-Laws 1998. Specifically, a person in charge of a dog in an area specified in the First Schedule, including beaches, shall keep the dog on a leash, except during specified times when the dog may be unleashed provided that it is still under the effectual control of the person-in-charge of the dog.

Summary of Measures – Post-Breeding Aggregations

- *Temporary zoning of roosting areas to reduce recreational-use related impacts*
- *Local signage and information boards near roosting sites*
- *Information and educational programmes*
- *Placement of Dog Control Notices*
- *Enhanced enforcement of existing dog control legislation and bye-laws during peak post-breeding roosting period*

Common terns in flight

6.5 Plan Implementation

This Tern Colony Management Plan identifies a series of measures that may be effective in mitigating pressures and potential impacts adversely affecting conservation conditions for terns. Actions to progress the identified measures, and stakeholders that may have a leading role in their development are suggested in Table 6.1 below. Priority of implementation is also suggested in terms of time scales. In addition to conservation needs, priority also considers the need for engagement with agencies with relevant remits, prior consultation, or securing of permits, permissions and licences.

Priority is broadly ranked as:

- Immediate: Actions that are urgently required, and that are achievable within a period of 1 to 3 years
- Short-term: Actions that are pressing but require elaboration, refinement or consultation for delivery within a period of 3 to 5 years
- Long-term: Actions that require extensive planning, assessment and permitting, and will probably take over 5 years to deliver.

Dublin Port Company will consult with the relevant stakeholders to agree measures implementation, and all measures will be subject to screening for appropriate assessment as required by the Habitats Directive (92/43/EEC).

Table 6.1 Actions required for plan implementation, agencies involved and priority for delivery

No.	Action	Agencies	Priority
1	Provide purpose-built shelters on nesting platforms and pontoons	BWI / DPC	Immediate
2	Control corvid nest sites that impact nesting terns	BWI / DPC / ESB	Immediate
3	Monitor platforms and pontoons for mammalian predation	BWI / DPC	Immediate
4	Maintain Mammalian predation mitigation features as required	DPC / BWI	Immediate
5	Replace existing substrate on nesting platforms and pontoons outside nesting season	DPC / BWI	Immediate
6	Assess condition of substrate annually and replace as required outside nesting season	DPC / BWI	Immediate
7	Confirm suitable locations for new nesting habitat	DPC / NPWS / BWI	Short-term
8	Consider use of rafts/pontoons versus permanent structures	DPC / NPWS / BWI	Short-term
9	Allow for future nesting habitat needs	DPC / NPWS / BWI	Long-term
10	Consider appropriate temporary zoning of roosting areas at Sandymount	DCC / DLR / NPWS	Long-term
11	Consider local signage and information boards near roosting areas	NPWS / DCC / DLR	Short-term
12	Consider preparation and implementation of information and educational programmes	DCC / DLR / DHLGH	Short-term to Long-term
13	Consider use of Dog Control Notices	DCC / DLR	Short-term
14	Seek enhanced enforcement of dog control legislation during peak post-breeding period	DCC / DLR	Long-term

6.6 Stakeholder organisations

Organisations listed below (Table 6.2) are stakeholders in various aspects of this Management Plan and their remits are relevant to plan implementation. It is recommended that a joint working group, with representatives of the stakeholders and any other organisations they may identify, be established to progress and oversee the implementation of this Management Plan.

Table 6.2 Stakeholders with remit relevant to the Tern Management Plan

Organisation	Involvement
Dublin Port Company (DPC)	Port Authority
National Parks and Wildlife Service (NPWS)	Statutory authority for nature conservation
Birdwatch Ireland (BWI)	NGO conservation organisation that implements relevant bird monitoring programmes
Dublin City Council (DCC)	Local Authority in the plan area and owner of land at Pigeon House Harbour
Dún Laoghaire Rathdown County Council (DLR)	Local Authority in the plan area
ESB	Owner of ESB dolphin and land adjacent to Pigeon House Harbour
Department of Housing, Local Government and Heritage (DHLGH)	Foreshore licencing authority and parent department of NPWS

REFERENCES

Alexander, M. (2008) *Management Planning for Nature Conservation: A theoretical basis and practical guide*. Springer.

Birdwatch Ireland (2019). *Rockabill Nest Census Results 2019.* Available at: Rockablog: Rockabill Nest Census Results 2019 (rockabillterns.blogspot.com) (Accessed 09 January 2023).

Birdwatch Ireland (2022). *Dublin Bay Birds Project: 2023 Work Program*. Dublin, December 2022.

Birdwatch Ireland (2022a) Available at: https://birdwatchireland.ie/birds/arctic-tern/ (Accessed 28 October 2022)

Birdwatch Ireland (2022b) Available at: https://birdwatchireland.ie/birds/common-tern/ (Accessed 28 October 2022)

Boland, H., Adcock, T. and Burke, B. (2021) *Dublin Bay Birds Project: Dublin Port Tern Conservation Project*. Report for Dublin Port Company.

Boland, H., Adcock, T. and Burke, B. (2022) *Dublin Bay Birds Project: Dublin Port Tern Conservation Project*. Report for Dublin Port Company.

Burke, B., Crowe, O. & Newton, S. F. (2020) Rare and scarce breeding birds in Ireland in 2017 and 2018. *Irish Birds* **42**: 63–70.

Cramp, S., Bourne, W.R.P. & Saunders, D. (1974). *The Seabirds of Britain and Ireland*. Collins, London.

Donehower, C.E., Bird, D.M., Hall, S. and Kress, S.W. (2007) Effects of Gull Predation and Predator Control on Tern Nesting Success at Eastern Egg Rock, Maine. *Waterbirds: The International Journal of Waterbird Biology* 30, No. 1: 29-39.

Dublin City Council (2021) *Dublin City Biodiversity Action Plan 2021-2025*. Dublin.

Dublin Port Company (2018) *Dublin Port Masterplan 2040: Reviewed 2018*. Dublin.

Dublin Port Company (2022) *Annual Report and Financial Statements 2021*. Dublin.

Eaton, M.A., Aebischer, N.J., Brown A.F., Hearn, R.D., Lock, L, Musgrove, A.J., Noble, D.G., Stroud, D.A., and Gregory, R.D. (2015) Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. British Birds 108, 708–746.

European Communities (2000) *Managing Natura 2000 Sites - The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC*. Office for Official Publications of the European Communities, Luxembourg.

European Commission (2019) EC Notice C(2018) 7621 *Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC*. Office for Official Publications of the European Communities, Luxembourg.

Gilbert, G., Stanbury, A. & Lewis, L. (2021) Birds of Conservation Concern in Ireland 4: 2020–2026. *Irish Birds* 43: 1–22.

Hume, R. (1993) *The Common Tern*. Hamlyn, London.

Le Corre, N., Peuziat, I., Brigand, L., Gélinaud, G. & Meur-Férec, C. 2013. Wintering waterbirds and recreationists in natural areas: a sociological approach to the awareness of bird disturbance. *Environmental Management* 52: 780-791.

McGeehan, A. and Wyllie, J. (2012) *Birds Through Irish Eyes*. The Collins Press, Cork.

Merne, O.J. 2004. Common *Sterna hirundo* and Arctic Terns *S. paradisaea* breeding in Dublin Port, County Dublin, 1995-2003. *Irish Birds*. 7: 369-374.

Merne, O.J. 2010. Terns roosting in Dublin Bay, autumn 2010. *Irish Birds* 9: 126-128.

Merne, O.J.; Madden, B.; Archer, E.; Porter, B. (2008). Autumn roosting by terns in south Dublin Bay. *Irish Birds* 8: 335-340.

Mitchell, I., Newton, S.F., Ratcliffe, N. and Dunn, T.E. (Eds.). 2004. *Seabird Populations of Britain and Ireland: results of the Seabird 2000 census (1998-2002)*. Published by T and A.D. Poyser, London.

Morrison, P. and Gurney M. Nest boxes for Roseate Terns *Sterna dougalli* on Coquet Island RSPB reserve, Northumberland, England. *Conservation Evidence.* 4: 1-3.

Nairn, R. (2015) *draft Dublin Port Tern Colony Management Plan 2015-2016*. Dublin Port Company, Dublin.

NPWS (2012) Conservation Objectives: South Dublin Bay and River Tolka Estuary SPA 004024. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2021) Available at: https://www.npws.ie/legislation (Accessed 28 October 2022)

NPWS (2022) Available at: https://www.gov.ie/en/consultation/1566c-public-consultation-on-irelands-4th-national-biodiversity-action-plan/ (Accessed 28 October 2022)

NPWS (2022) Available at: https://www.npws.ie/protected-sites/nha (Accessed 28 October 2022)

Piec, D. & Dunn, E.K. (2021). International (East Atlantic) Species Action Plan for the Conservation of the roseate tern *Sterna dougallii* (2021-2030). Developed under the framework of the Roseate Tern LIFE Project (LIFE14 NAT/UK/000394). European Commission 2021.

Redfern, C.P.F. and Bevan, R.M. (2020). Use of sea ice by arctic terns *Sterna paradisaea* in Antarctica and impacts of climate change. *Journal of Avian Biology*, 51: :. https://doi.org/10.1111/jav.02318

Robinson, R. A. (2005) BirdFacts: profiles of birds occurring in Britain & Ireland. *BTO Research Report* 407, BTO, Thetford.

Stigner, M.G., Beyer, H.L., Klein, C.J. & Fuller, R.A. 2016. Reconciling recreational use and conservation values in a coastal protected area. *Journal of Applied Ecology* 53: 1206-1214.

Thomas, G.H., Wills, W.A. & Székely, T. (2004). A supertree approach to shorebird phylogeny. *BMC Evolutionary Biology* 4:28.

Whilde A. (1985). The 1984 All Ireland Tern Survey. *Irish Birds 3*: 1-32.

Williams G., Pullan D., Dickie I., Huggett D. and Mitchell H (2005) *The European Birds Directive – safeguarding special places for people and wildlife*. The RSPB, Sandy

Appendices

Appendix 1: SITE SYNOPSIS FOR SPECIAL PROTECTION AREA

SITE NAME: SOUTH DUBLIN BAY AND RIVER TOLKA ESTUARY SPA

SITE CODE: 004024

The South Dublin Bay and River Tolka Estuary SPA comprises a substantial part of Dublin Bay. It includes the intertidal area between the River Liffey and Dun Laoghaire, the estuary of the River Tolka to the north of the River Liffey, and Booterstown Marsh. A portion of the shallow marine waters of the bay is also included.

In the south bay, the intertidal flats extend for almost 3 km at their widest. The sediments are predominantly well-aerated sands. Several permanent channels exist, the largest being Cockle Lake. A small sandy beach occurs at Merrion Gates, while some bedrock shore occurs near Dun Laoghaire. The landward boundary is now almost entirely artificially embanked. There is a bed of Dwarf Eelgrass (*Zostera noltii*) below Merrion Gates which is the largest stand on the east coast. Green algae (Ulva spp.) are distributed throughout the area at a low density. The macroinvertebrate fauna is well-developed and is characterised by annelids such as Lugworm (*Arenicola marina*), Nephthys spp., Sand Mason (*Lanice conchilega*), and bivalves, especially Cockle (*Cerastoderma edule*) and Baltic Tellin (*Macoma balthica*). The small gastropod Spire Shell (*Hydrobia ulvae*) occurs on the muddy sands off Merrion Gates, along with the crustacean *Corophium volutator*. Sediments in the Tolka Estuary vary from soft thixotropic muds with a high organic content in the inner estuary to exposed, well-aerated sands off the Bull Wall. The site includes Booterstown Marsh, an enclosed area of saltmarsh and muds that is cut off from the sea by the Dublin/Wexford railway line, being linked only by a channel to the east, the Nutley stream. Sea water incursions into the marsh occur along this stream at high tide. An area of grassland at Poolbeg, north of Irishtown Nature Park, is also included in the site.

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Light-bellied Brent Goose, Oystercatcher, Ringed Plover, Grey Plover, Knot, Sanderling, Dunlin, Bar-tailed Godwit, Redshank, Black-headed Gull, Roseate Tern, Common Tern and Arctic Tern. The E.U. Birds Directive pays particular attention to wetlands, and as these form part of the SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

The site is an important site for wintering waterfowl, being an integral part of the internationally important Dublin Bay complex – all counts for wintering waterbirds are five-year mean peaks for the period 1995/96 to 1999/2000. Although birds regularly commute between the south bay and the north bay, recent studies have shown that certain populations which occur in the south bay spend most of their time there. An internationally important population of Light-bellied Brent Goose (368) occurs regularly and newly arrived birds in the autumn feed on the Eelgrass bed at Merrion. At the time of designation, the site supported nationally important numbers of a further nine species: Oystercatcher (1,145), Ringed Plover (161), Grey Plover (45), Knot (548), Sanderling (321), Dunlin (1,923), Bar-tailed Godwit (766), Redshank (260) and Black-headed Gull (3,040). Other species occurring in smaller numbers include Great Crested Grebe

(21), Curlew (127) and Turnstone (52). Little Egret, a species which has recently colonised Ireland, also occurs at this site.

South Dublin Bay is a significant site for wintering gulls, with a nationally important population of Black-headed Gull, but also Common Gull (330) and Herring Gull (348). Mediterranean Gull is also recorded from here, occurring through much of the year, but especially in late winter/spring and again in late summer into winter.

Both Common Tern and Arctic Tern breed in Dublin Docks, on a man-made mooring structure known as the E.S.B. dolphin – this is included within the site. Small numbers of Common Tern and Arctic Tern were recorded nesting on this dolphin in the 1980s. A survey in 1995 recorded nationally important numbers of Common Tern nesting here (52 pairs). The breeding population of Common Tern at this site has increased, with 216 pairs recorded in 2000. This increase was largely due to the ongoing management of the site for breeding terns. More recent data highlights this site as one of the most important Common Tern sites in the country with over 400 pairs recorded here in 2007.

South Dublin Bay is an important staging/passage site for a number of tern species in the autumn (mostly late July to September). The origin of many of the birds is likely to be the Dublin breeding sites (Rockabill and the Dublin Docks) though numbers suggest that the site is also used by birds from other sites, perhaps outside the state. This site is selected for designation for its autumn tern populations: Roseate Tern (2,000 in 1999), Common Tern (5,000 in 1999) and Arctic Tern (20,000 in 1996).

The South Dublin Bay and River Tolka Estuary SPA is of ornithological importance as it supports an internationally important population of Light-bellied Brent Goose and nationally important populations of a further nine wintering species. Furthermore, the site supports a nationally important colony of breeding Common Tern and is an internationally important passage/staging site for three tern species. It is of note that four of the species that regularly occur at this site are listed on Annex I of the E.U. Birds Directive, i.e., Bar-tailed Godwit, Common Tern, Arctic Tern and Roseate Tern. Sandymount Strand/Tolka Estuary is also a Ramsar Convention site.

30.5.2015

Appendix 2: SITE SYNOPSIS FOR PROPOSED NATURAL HERITAGE AREA

SITE NAME: DOLPHINS, DUBLIN

DOCKS SITE CODE: 000201

This tern breeding site is situated at the entrance to Dublin port just off the old sewage works at Ringsend.

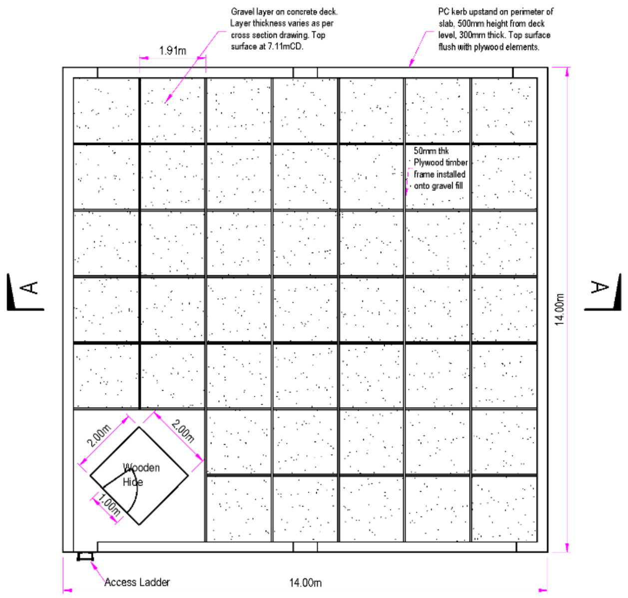
The site comprises two moorings used by Common and Arctic Terns. One of these is derelict and consists of two sections linked by a timber bridge, one section being constructed of concrete, and the other of timber. In June 1994 this dolphin contained 33 tern nests. The other dolphin, with 17 tern nests, is a modern one made entirely of concrete, the deck of which is edged with timber beams and galvanized steel railings.

This site is an important tern colony, especially for Arctic Tern which is a scarce nester on the east coast. With some management both dolphins could be enhanced to attract more terns.

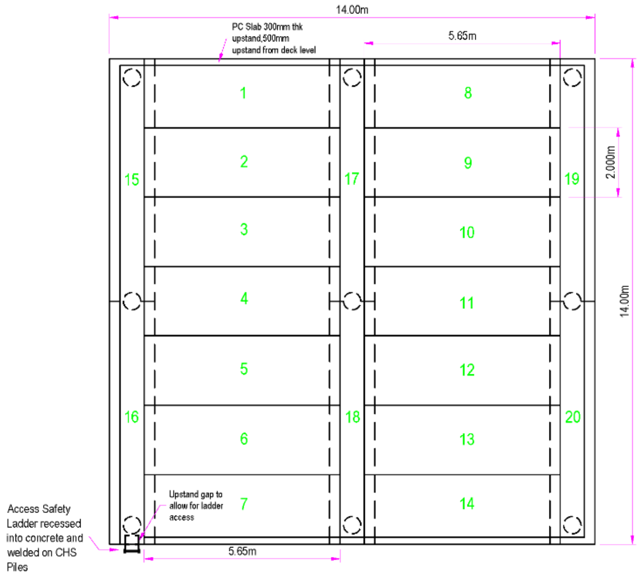
A pair of Kittiwakes attempted to nest on the derelict dolphin in 1994, and Cormorants use it as a roost.

16 February 1995

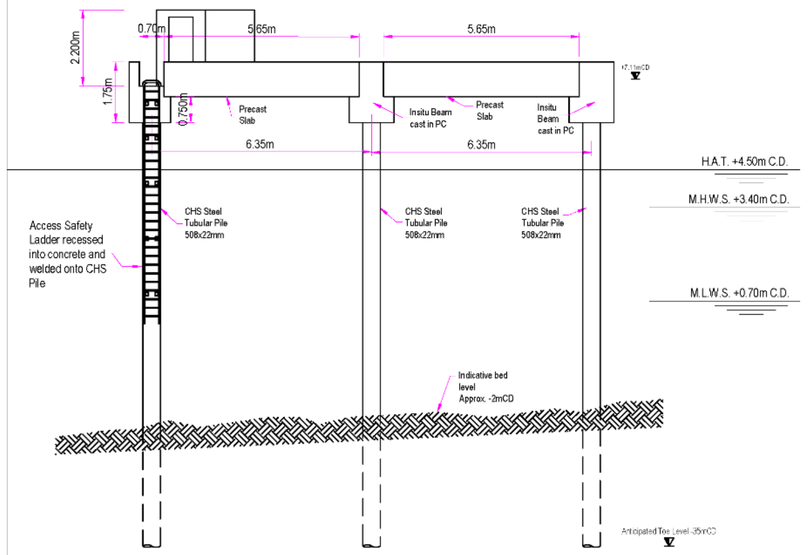
Appendix 3: DRAWING SHOWING THE PROPOSED CONSTRUCTION OF A PERMANENT TERN NESTING PLATFORM



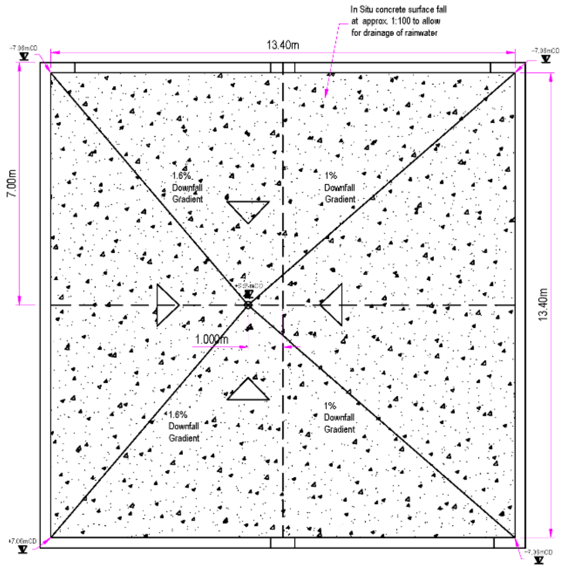
Tern Structure Plan View [1:100]



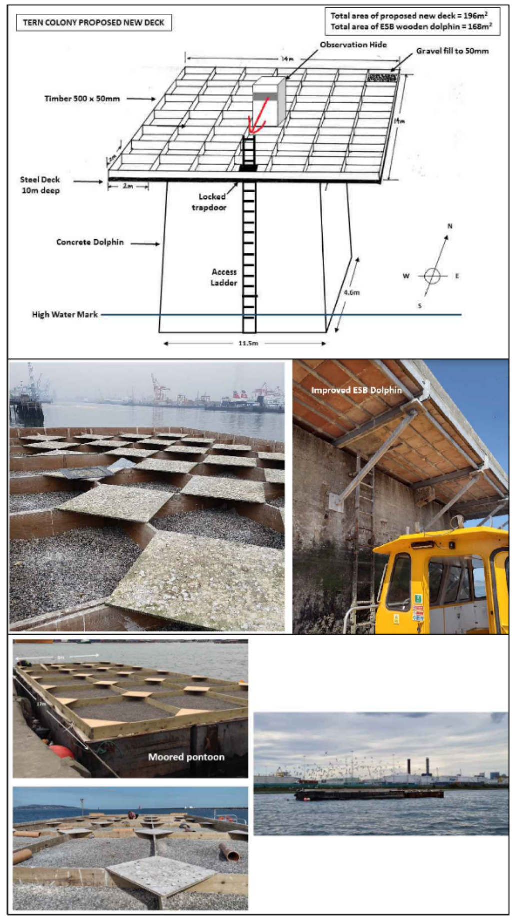
Precast Unit Arrangement Layout [1:100]

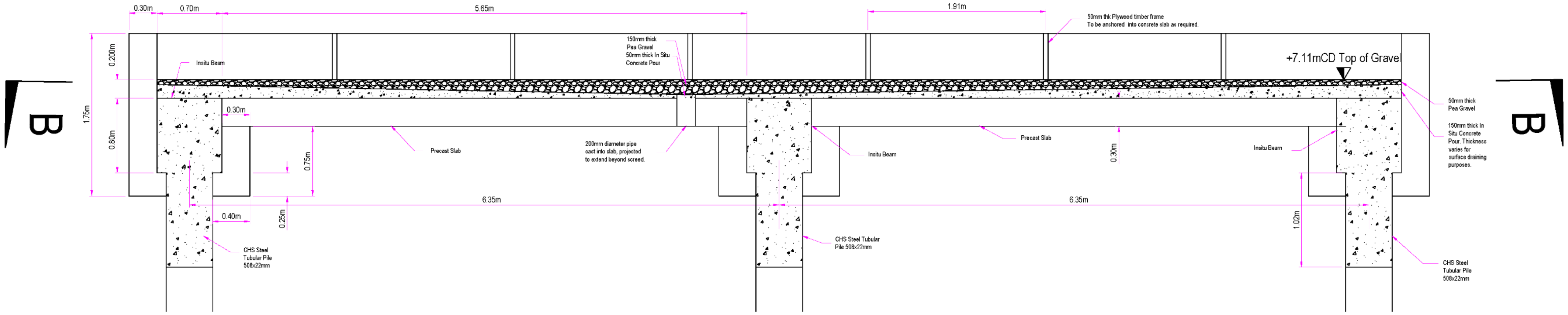


South Elevation [1:100]



Insitu Screed Drainage Levels Section BB [1:100]





Cross Section AA [1:25]

NOTES

1. Verifying Dimensions.
The contractor shall verify dimensions against such other drawings or site conditions as pertain to this part of the work.

2. Existing Services.
Any information concerning the location of existing services indicated on this drawing is intended for general guidance only. It shall be the responsibility of the contractor to determine and verify the exact horizontal and vertical alignment of all cables, pipes, etc. (both underground and overhead) before work commences.

3. Issue of Drawings.
Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg, dxf etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors arising from the use of these files, either by human error by the recipient, listing of un-dimensioned measurements, compatibility issues with the recipient's software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.

4. Datum. 7.11mCD

5. CONCRETE	MIX TYPE	COVER	FINISH
C35/45	IIIA	Varies	Class F1

rev	amendments	check	date

Elmwood House
74 Boucher Road
Belfast
BT12 6RZ
T +44 (0) 28 90 667914
F +44 (0) 28 90 668286
W www.rpsgroup.com/ireland
E ireland@rpsgroup.com

Client
Dublin Port Company

Project
Dublin 3FM Masterplan Planning

Title
Tern Observation Structure

Project Number	Sheet Size	Drawing Scale
IBM0842	A1	As Shown

Drawing Number
M0842-RPS-XX-XX-DR-C-SK01

Drawn By	Status	Revision
TM	S?	-

Checked By	Approved By	Date
EM	-	23/01/2023

Appendix D: Airborne Noise Assessment

12 NOISE & VIBRATION

This chapter of the Environmental Impact Assessment Report (EIAR) assesses the potential impact of the 3FM Project on Noise and Vibration in the receiving environment. The likely significant effects of the project caused by noise and vibration are examined and measures to avoid, prevent, and reduce these likely significant effects are proposed, where they are necessary. The assessment on terrestrial noise and vibration is presented in Section 12.1 and the assessment on underwater noise is presented in Section 12.2.

12.1 Terrestrial Noise and Vibration

12.1.1 Introduction

This section contains an assessment of the predicted terrestrial noise and vibration impacts associated with the proposed 3FM Project. Full details of the proposed 3FM Project are contained in EIAR Chapter 5 – Project Description.

12.1.2 Methodology

12.1.2.1 Noise Guidance Documents

This section includes a summary of Irish and international guidance documents that have been used as reference material for the purposes of completing the Noise and Vibration Assessment.

Environmental Protection Agency (EPA) Office of Environmental Enforcement (OEE) - Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)

This document relates primarily to noise surveys and assessments for EPA licensed facilities but in the absence of any other directly applicable guidance documents, it provides useful reference material for the purposes of completing the noise assessment for the proposed 3FM Project.

The EPA published two earlier documents in relation to the survey, assessment and management of noise emissions from licensed facilities, namely the Environmental Noise Survey Guidance Document (commonly referred to as NG1) and Guidance Note for Noise in Relation to Scheduled Activities - 2nd Edition (commonly referred to as NG2). These two documents have been withdrawn with the publication of NG4.

NG4 provides detailed consideration of a range of noise related issues including basic background to noise issues, various noise assessment criteria and procedures, noise reduction measures, Best Available Techniques (BAT) and the detailed requirements for noise surveys. NG4 provides typical limit values for noise from licensed sites, namely:

- Daytime (07:00 - 19:00) - 55dB $L_{Ar,T}$;
- Evening (19:00 - 23:00) - 50dB $L_{Ar,T}$:
- Night-time (23:00 - 07:00) - 45dB $L_{Aeq,T}$.

In the description of the limits above, the $L_{Aeq,T}$ is the equivalent continuous sound level over the measurement period and $L_{Ar,T}$ is equal to the L_{Aeq} but includes an additional penalty of 5dB(A) to account for any tonal or impulsive characteristics to the noise source.

While consideration is given to these threshold limits in the general context of the noise assessment for the proposed project, the proposed project is located in the context of an urban/suburban environment where existing noise levels regularly exceed the typical noise limits set out in NG4 for EPA licensed sites.

Other EPA guidelines such as Guidelines on the Information to be Contained in Environmental Impact Statements [2022] and Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements) [2003] have been considered also in the preparation of this Noise and Vibration Chapter.

National Roads Authority (NRA) Guidelines for the Treatment of Noise and Vibration in National Road Schemes (2004)

The purpose of this document is to provide guidance on the treatment of noise and vibration during the planning and design of national road schemes. The guidelines are not mandatory but are recommended to achieve appropriate consistency with respect to the treatment of noise and vibration during the various stages of road scheme planning and development.

Construction Phase

The NRA Guidelines list maximum permissible noise levels typically deemed to be acceptable for the construction phase of road schemes (See Table 12.1.1). These values are indicative only and more stringent limits may be applied where pre-existing noise levels are low.

Table 12.1.1 Maximum Permissible Noise Levels at the Façade of Dwellings During Construction

Days & Times	$L_{Aeq\ (1\ hr)}$ dB	$L_{pA(max)slow}$ dB
Monday to Friday **07:00 – 19:00hrs**	70	80
Monday to Friday **19:00 – 22:00hrs**	60*	65*
Saturday **08:00 – 16:30hrs**	65	75
Sunday Bank Holidays **08:00 – 16:30hrs**	60*	65*

** Construction activity at these times. Other than that required in respect of emergency works, will normally require explicit permission of the relevant local authority.*

Operational Phase

There are currently no Irish standards or limits governing the assessment of noise and/or vibration associated with either new or existing roads. Article 77 of the Roads Act (1993) deals with noise. It outlines the powers of the Minister to make regulations in respect of noise limits, measurement and mitigation. No specific guidance in respect of noise or noise limits is contained within the Roads Act.

The NRA Guidelines sets out to establish desirable design goals for new national road schemes having regard to EU Directive 2002/49/EC. The guidelines stipulate that all future national road schemes should be designed to meet the following design goal:

Day-evening-night 60dB L_{den} (free field residential facade criteria).

Mitigation measures are only deemed necessary when the following three conditions are satisfied at designated sensitive receptors:

- The combined expected maximum traffic noise level, i.e. the relevant noise level, from the proposed road scheme together with other traffic in the vicinity is greater than the design goal;
- The relevant noise level is at least 1dB more than the expected traffic noise level without the proposed road scheme in place; and
- The contribution to the increase in the relevant noise level from the proposed road scheme is at least 1dB.

British Standard BS5228:2009+A1:2014 Noise and Vibration Control on Construction and Open Sites

This British Standard consists of two parts and covers the need for protection against noise and vibration of persons living and working in the vicinity of construction and open sites. The standard recommends procedures for noise and vibration control in respect of construction operations and aims to assist architects, contractors and site operatives, designers, developers, engineers, local authority environmental health officers and planners.

Part 1 of the standard provides a method of calculating noise from construction plant, including:

- Tables of source noise levels;
- Methods for summing up contributions from intermittently operating plant;
- A procedure for calculating noise propagation;
- A method for calculating noise screening effects; and
- A way of predicting noise from mobile plant, such as haul roads.

The standard also provides guidance on legislative background, community relations, training, nuisance, project supervision and control of noise and vibration.

The ABC method outlined in Section E3.2 of the British Standard has been used for the purposes of determining whether the predicted noise levels from the construction activities will result in any significant noise impact at the nearest noise sensitive properties.

Table 12.1.2 outlines the applicable noise threshold limits that apply at the nearest noise sensitive receptors. The determination of what category to apply is dependent on the existing baseline ambient (L_{Aeq}) noise level (rounded to the nearest 5dB) at the nearest noise sensitive property. For daytime, if the ambient noise level is less than the Category A threshold limit, the Category A threshold limit (i.e. 65dB) applies. If the ambient noise level is the same as the Category A threshold limit, the Category B threshold limit (i.e. 70dB) applies. If the ambient noise level is more than the Category A threshold limit, the Category C threshold limit (i.e. 75dB) applies.

Table 12.1.2 Noise Threshold Limits at Nearest Sensitive Receptors

	Threshold Limits [dB(A)]		
	Category A	**Category B**	**Category C**
Night-time (23:00 - 07:00)	45	50	55
Evening and Weekends (19:00 - 23:00 Weekdays, 13:00-23:00 Saturdays, 07:00-23:00 Sundays)	55	60	65
Weekday daytime (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75

Dublin City Council (DCC) – Air Quality Monitoring and Noise Control Unit's Good Practice Guide for Construction and Demolition

Prior to the commencement of work on a site within the DCC area, DCC require a construction and demolition plan to be developed in accordance with this guide. The guide is a best practice guidance document aimed at ensuring that demolition and construction work does not have an adverse impact on those living and working near the demolition/construction activities. The guide presents a risk based approach taking into account the locality, nature of the work and the expected duration of work.

The guide contains two risk assessment tables, whereby cells are ticked based on the categories that are most applicable to the project. A total risk assessment table is subsequently completed based on the sub-total numbers from the initial two risk assessment tables. Once the risk category has been determined from the total risk assessment, good practice measures are outlined within the guide for the particular project.

World Health Organisation (WHO) - Guidelines for Community Noise

In 1999, the World Health Organisation (WHO) proposed guidelines for community noise. In this guidance, a L_{Aeq} threshold daytime noise limit of 55dB is suggested for outdoor living areas in order to protect the majority of people from being seriously annoyed. A second daytime limit of 50dB is also given as a threshold limit for moderate annoyance.

The guidelines suggest that an internal L_{Aeq} not greater than 30dB for continuous noise is needed to prevent negative effects on sleep. This is equivalent to a façade level of 45dB L_{Aeq}, assuming open windows or a free-field level of about 42dB L_{Aeq}. If the noise is not continuous, then the internal level required to prevent negative effects on sleep is a $L_{Amax,fast}$ of 45dB. Therefore, for sleep disturbance, the continuous level as well as the number of noisy events should be considered.

While consideration is given to these threshold limits in the general context of the noise assessment for the proposed project, the proposed project is located in the context of an urban/suburban environment where existing noise levels regularly exceed the typical noise limits set out in the WHO Guidelines.

World Health Organisation (WHO) - Night Noise Guidelines for Europe

The *Night Noise Guidelines for Europe* was published in 2009 on the back of extensive research completed by a WHO working group. Considering the scientific evidence on the threshold of night noise exposure indicated by $L_{night,outside}$ as defined in the Environmental Noise Directive (2002/49/EC), an $L_{night,outside}$ of 40dB should be the target of the night noise guideline (NNG) to protect public, including the most vulnerable groups such as children, the chronically ill and the elderly. An interim target of 55dB is recommended where the NNG cannot be achieved. These guidelines are applicable to Member States of the European Region and may be considered as an extension to the previous WHO Guidelines for Community Noise (1999). The guidelines do not expand on the noise limits applicable to non-continuous noise and hence the guidance included in the 1999 guidelines is still applicable in relation to this.

In the context of the existing environment in the vicinity of the proposed project, noise levels in the study area regularly exceed the 40dB night noise limit included in this document.

World Health Organisation (WHO) - Methodological Guidance for Estimating the Burden of Disease from Environmental Noise

In 2012, the WHO published the Methodological Guidance for Estimating the Burden of Disease from Environmental Noise. This document outlines the principles of quantitative assessment of the burden of disease from environmental noise, describes the status in terms of the implementation of the European Noise Directive and reviews evidence on exposure-response relationships between noise and cardiovascular diseases.

World Health Organisation (WHO) – Environmental Noise Guidelines for the European Region

In 2018, the WHO published the Environmental Noise Guidelines for the European Region. The main purpose of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise from various sources. The guidelines set out to define recommended exposure levels for environmental noise in order to protect population health.

The guidelines are intended to be suitable for policymaking in the WHO European Region. They focus on the most used noise indicators L_{den} and/or L_{night}, which are provided for exposure at the most exposed facade, outdoors. The guidelines provide specific recommendations for various noise sources, including road traffic noise.

For average noise exposure, the guidelines recommends reducing noise levels produced by road traffic below 53 dB L_{den}. The guidelines also recommend a night-time exposure value of 45 dB L_{night} for road traffic noise, on the basis that 3% of the participants in studies were highly sleep-disturbed at a noise level of 45.4 dB L_{night}.

UK Department of Transport (Welsh Office) - Calculation of Road Traffic Noise [CRTN]

This Calculation of Road Traffic Noise (CRTN) guidance document outlines the procedures to be applied for calculating noise from road traffic. These procedures are necessary to enable entitlement under the Noise Insulation Regulations (NI) 1995 to be determined but they also provide guidance appropriate to the calculation of traffic noise for more general applications e.g. environmental appraisal of road schemes, highway design and land use planning.

The document consists of three different sections, covering a general method for predicting noise levels at a distance from a highway, additional procedures for more specific situations and a measurement method for situations where the prediction method is not suitable. The prediction method constitutes the preferred calculation technique but in a small number of cases, traffic conditions may fall outside the scope of the prediction method and it will then be necessary to resort to measurement. The prediction method has been used in this instance to determine the likely traffic noise increases as a result of the proposed project.

Environmental Noise Directive (END) 2002/49/EC

END 2002/49/EC was transposed into Irish legislation in the form of the Environmental Noise Regulations, 2006. The legislation sets out the manner by which Strategic Noise Maps must be prepared in Ireland for large agglomerations, major roads, major railways and major airports. Strategic Noise Maps were prepared for the Dublin Agglomeration from 2012 onwards and a Noise Action Plans (NAP) published for consultation.

The proposed project will alter the noise environment in the vicinity of Dublin Port and hence will alter the Strategic Noise Maps in this area. Under the requirements set out under END, the Strategic Noise Maps are required to be updated every five years. The changes brought about by the proposed project will be incorporated into the updated Strategic Noise Maps for the Dublin Agglomeration as part of this ongoing update process.

12.1.2.2 Vibration Guidance Documents

The NRA Guidelines for the Treatment of Noise & Vibration in National Road Schemes is one of the few Irish guidance documents that gives recommendations relating to vibration from construction phase activities in Ireland. The guidelines recommend that vibration is limited to the values set out in Table 12.1.3 in order to ensure that there is little or no risk of even cosmetic damage to buildings. These values and the values indicated in Table 12.1.4 should be used as guidance for monitoring vibration levels from the construction phase of the proposed scheme.

Table 12.1.3 Recommended Vibration Level Thresholds for NRA Schemes

Allowable Vibration Velocity (Peak Particle Velocity) at the Closest Part of Any Sensitive Property to the Source of Vibration, at a Frequency of:		
Less than 10Hz	10 to 50 Hz	50 to 100 Hz (and above)
8mm/s	12.5mm/s	20mm/s

Limits of transient vibration, above which cosmetic damage could occur, are also given numerically in Table 12.1.4 (Ref: BS5228-2:2009+A1:2014). Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 12.1.4, and major damage to a building structure can occur at values greater than four times the tabulated values (definitions of the damage categories are presented in BS7385-1:1990, 9.9).

Table 12.1.4 Transient Vibration Guide Values for Cosmetic Damage (Ref BS5228-2:2009+A1:2014)

Type of Building	**Peak Particle Velocity (PPV) (mm/s) in Frequency Range of Predominant Pulse**	
	4 Hz to 15 Hz	**15 Hz and above**
Reinforced or framed structures. Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
Unreinforced or light framed structures. Residential or light commercial buildings.	15 mm/s at 4 Hz increasing to 20 mm/S at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above.

British Standard BS 7385 (1993) Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration indicates that cosmetic damage should not occur to property if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at 40Hz. These guidelines refer to relatively modern buildings and therefore, these values should reduce to 50% or less for more sensitive buildings.

The human body is an excellent detector of vibration, which can become perceptible at levels which are substantially lower than those required to cause building damage. The human body is most sensitive to vibration in the vertical direction (foot to head). The effect of vibration on humans is guided by British Standard 6472:1992. This standard does not give guidance on the limit of perceptibility, but it is generally accepted that vibration becomes perceptible at levels of approximately 0.15 to 0.3 mm/s.

BS 6472 defines base curves, in terms of rms acceleration, which are used to assess continuous vibration. Table 5 of the Standard states that in residential buildings, the base curve should be multiplied by 1.4 at night and by 2 to 4 during the daytime to provide magnitudes at which the probability of adverse comment is low.

In order to assess human exposure to vibration, ideally, measurements need to be undertaken at the point at which the vibration enters the body, i.e. measurements would need to be taken inside properties. However, various conversion factors have been established to convert vibration levels measured at a foundation to levels inside buildings, depending on the structure of the building.

Where vibration is intermittent or occurs as a series of events, the use of Vibration Dose Values (VDVs) is recommended in BS6472 for the assessment of subjective response to vibration. The VDVs at which it is considered there will be a low probability of adverse comment are drawn from BS 6472 and presented in Table 12.1.5.

Table 12.1.5 Threshold Values for the Evaluation of Disturbance due to Vibration

Place	Daytime 16 Hour VDV ($ms^{-1.75}$)	Night-time 8 Hour VDV ($ms^{-1.75}$)
Critical working Area	0.11	0.09
Residential	0.22 – 0.43	0.13
Office	0.43	0.36[1]
Workshops	0.87	0.73

These VDV thresholds do not apply unless night-time work was a regular activity at these premises.

12.1.2.3 Assessment Methodology for Determining Noise Impacts

General Significance Criteria

Table 12.1.6 contains the general significance criteria that can been used for determining the level of impact associated with a particular aspect of the proposed project. Different aspects of noise from the proposed project (e.g. construction, plant/equipment, traffic etc.) are assessed using the different methodologies as described in the relevant guidance document. Where feasible, the significance criteria have been used in the various assessments included in this chapter having regard to the sensitivity of receptors.

Table 12.1.6 Criteria to Define the Sensitivity of Receptors

Sensitivity	Description	Examples of receptor
High	Receptors where occupants or activities are particularly susceptible to noise	Residential Quiet areas for outdoor recreation Religious institutions (e.g. churches and cemeteries) Schools during the daytime
Medium	Receptors moderately sensitive to noise, where it may cause some distraction or disturbance	Offices Restaurants Sports grounds where noise is not a normal part of the event (e.g. golf courses and tennis courts)
Low	Receptors where distraction or disturbance from noise will have minimal effect	Commercial buildings not occupied during operational hours Factories and working environments with existing high noise levels Sports grounds and facilities where noise levels are a normal part of activity

The majority of receptors expected to be affected by noise and vibration impacts arising due to the proposed development are the residents of dwellings in the vicinity of the existing port. Residents are deemed to be highly sensitive. The significance of the effect is determined as a function of the sensitivity of the receptor and the magnitude of impact it is exposed to. This is set out in Table 12.1.7

Table 12.1.7 Matrix for Determining Significance of Effect for Receptors of High Sensitivity

Magnitude of Impact (beneficial or adverse)	Significance of effect for receptors of high sensitivity
Major	Large or very large
Moderate	Moderate or large
Minor	Slight
Negligible	Slight
No impact	Neutral

Effects are considered to be significant when identified as likely to have a Moderate, Large or Very Large effect.

12.1.2.4 Construction Noise

The NRA Guidelines for the Treatment of Noise & Vibration on National Road Schemes (2004) British Standard BS 5228:2009+A1:2014 Noise and Vibration Control on Construction and Open Sites are the standard noise guidance documents for assessing construction phase noise impacts. Section 12.1.2.1 contains a brief description of these guidance documents.

On account of the temporary nature of construction activities, higher noise threshold limits apply to construction phase activities as compared to permanent operational phase activities. The appropriate noise threshold limits for construction phase activities are outlined in Table 12.1.1 and Table 12.1.2. These guidance documents do not apply significance criteria for noise impacts other than outlining permissible threshold limits for noise as outlined in these tables.

12.1.2.5 Traffic Noise

The NRA guidelines (2004) are the primary guidance used in Ireland for the purposes of assessing road traffic noise and determining conditions where mitigation measures are appropriate. A number of UK guidance documents that are used for the purposes of assessing road traffic noise are detailed below and are useful reference material for the consideration of impact level associated with changes in road traffic noise.

As outlined in Section 12.1.2.1, the CRTN is the standard noise guidance document for predicting traffic noise levels from traffic flow information and other relevant road topographical information. While the CRTN provides a methodology for predicting traffic noise levels, it does not provide significance criteria for assessing changes in traffic noise levels.

The Design Manual for Roads and Bridges (DMRB) is a guidance document which was created for the purpose of assessing noise and vibration impacts from road projects. The classification of magnitude of noise impact tables included in Section 3, Part 7 of DMRB Volume 11 are applicable to the assessment of road traffic changes associated with the proposed project.

Table 12.1.8 and Table 12.1.9 present the magnitude of noise impacts for both short-term changes in traffic noise levels and long-term changes in traffic noise levels. The short-term criteria is used for the purposes of assessing the construction phase noise levels and the commencement of operational phase in the year of opening, while the long term criteria has been used for the purposes of assessing long term operational phase traffic noise levels 10 years after the year of opening. An additional column has been included in Table 12.1.8 and Table 12.1.9 to link the magnitude level defined in the DMRB with the significance criteria outlined in Table 12.1.7.

Table 12.1.8 Classification of Magnitude of Noise Impacts in the Short Term

Noise Change $L_{A10,18hr}$	Magnitude of Impact	Equivalent Significance Criteria (See Table 12.1.7)
0	No Change	Neutral
0.1 - 0.9	Negligible	Neutral
1.0 - 2.9	Minor	Minor Adverse/Beneficial Effect
3.0 - 4.9	Moderate	Moderate Adverse/Beneficial Effect
5.0 +	Major	Major Adverse/Beneficial Effect

Table 12.1.9 Classification of Magnitude of Noise Impacts in the Long Term

Noise Change $L_{A10,18hr}$	Magnitude of Impact	Equivalent Significance Criteria (See Table 12.1.7)
0	No Change	Neutral
0.1 - 2.9	Negligible	Neutral
3.0 - 4.9	Minor	Minor Adverse/Beneficial Effect
5.0 - 9.9	Moderate	Moderate Adverse/Beneficial Effect
10.0 +	Major	Major Adverse/Beneficial Effect

12.1.2.6 Vibration

In terms of significance criteria, BS 5228:2009+A1:2014 provides guidance on the effects of vibration levels on residential receptors. Table B1 of Annex B provides an outline of vibration levels and associated effects; this is reproduced in Table 12.1.10. An additional column has been added to the table to link these vibration levels to the equivalent significance criteria as outlined in Table 12.1.7.

Table 12.1.10 Guidance on Effects of Vibration Levels on Sensitive Receptors

Vibration Level	**Effect**	**Significance Criteria (See Table 12.1.7)**
0.14 - 0.3 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Neutral
0.3 - 1.0 mm/s	Vibration might be just perceptible in residential environments.	Minor Adverse Effect
1.0 - 10.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.	Moderate Adverse Effect
>10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	Major Adverse Effect

12.1.2.7 Operational Plant/Equipment Noise

There are no mandatory noise limits set out in Irish legislation for operational phase plant/equipment noise. There are several Irish and international guidance documents that are listed in Section 12.1.2.1. These documents are used for the purpose of reference material. The EPA NG4 guidance document sets out the requirements for noise compliance on EPA licensed sites, however the 3FM Project will not be an EPA licensed site and this document will not apply to it. The WHO guidelines and BS8233:2014 set out desirable internal/external noise levels at residential properties for good living conditions and are useful reference points for determining the potential for significant noise impacts at residential properties.

A key element of determining likely noise impacts from plant/equipment noise is the existing ambient (LAeq) and background noise levels (LA90) at the relevant property. Section 12.1.3 provides summary details of various noise surveys completed in the vicinity of various noise sensitive properties and Appendix 12.1 provides detailed information on these surveys. The potential for noise impacts associated with plant/equipment noise has been determined in the context of reference noise guidance documents and the existing ambient/background noise levels recorded in the noise surveys.

12.1.2.8 Methodology for Noise Monitoring

A baseline noise survey was completed involving unattended and attended noise measurements to record the existing noise environment at the nearest noise sensitive receptors to the proposed project. Figure 12.1.1 to Figure 12.1.7 illustrate the locations of all baseline noise monitoring locations. These noise monitoring locations are listed below under the separate headings of unattended noise monitoring locations and attended noise monitoring locations.

Unattended Noise Monitoring Locations (U-NMLs)

The unattended noise monitoring locations are permanent noise monitoring locations set up in the vicinity of the port to record existing noise levels in different directions from the port area. These include:

- Marina (U-NML1, Figure 12.1.1) – the marina is located just north of Pigeon House Road / Coastguard Cottages;
- P&O Site (U-NML2, Figure 12.1.2) – this NML is located on the western end of the port site;
- Clontarf (U-NML3, Figure 12.1.3) – this NML is located off Clontarf Road on the grounds of Scoil Ui Chonaill GAA Club.

Attended Noise Monitoring Locations (A-NMLs)

The attended noise monitoring locations were completed over daytime, evening and night-time periods at particular sensitive residential locations that have the potential to be impacted by the proposed project. These include:

- Coastguard Cottages (A-NML1, Figure 12.1.4);
- Glass Bottle site (A-NML2, Figure 12.1.5);
- Sandymount (A-NML3, Figure 12.1.6);
- ESB site (A-NML4, Figure 12.1.7).

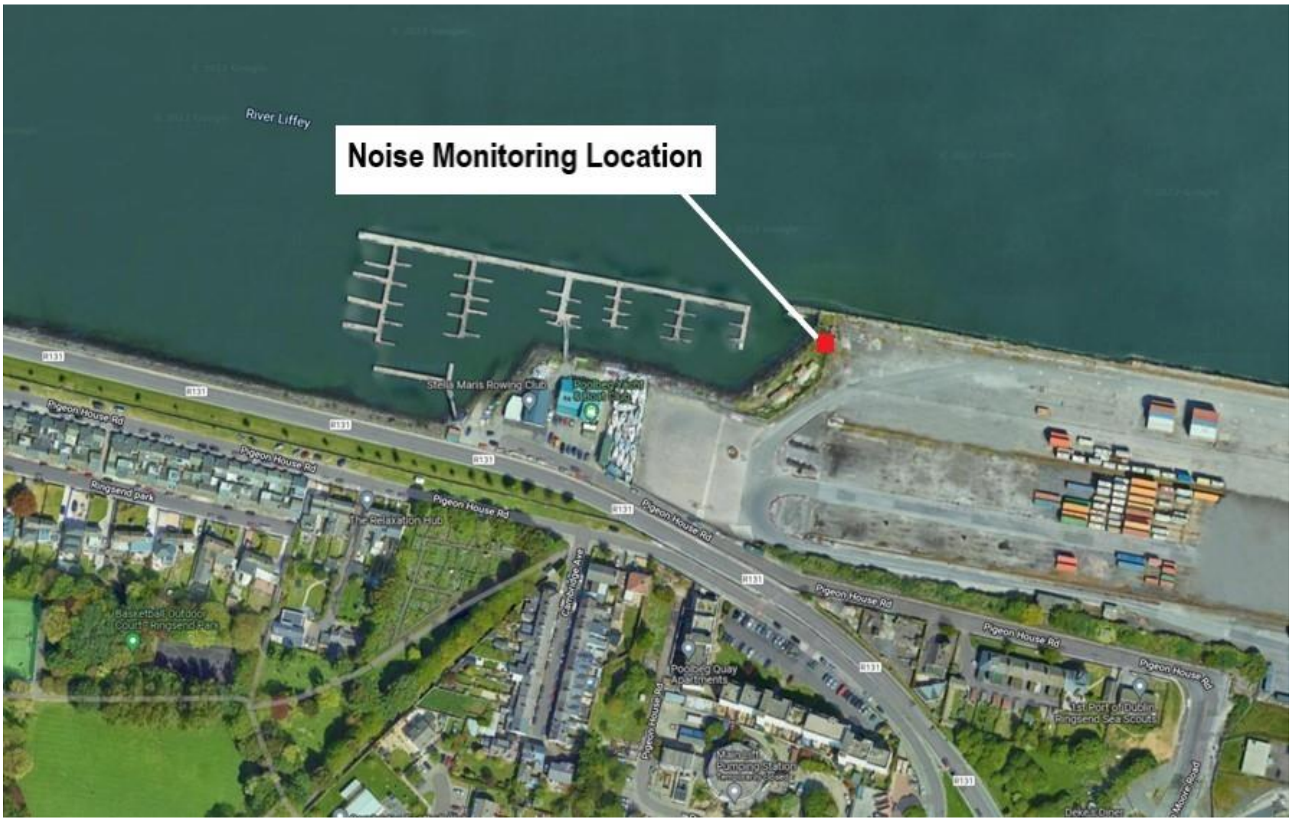


Figure 12.1.1 Marina Noise Monitoring Location (U-NML1)

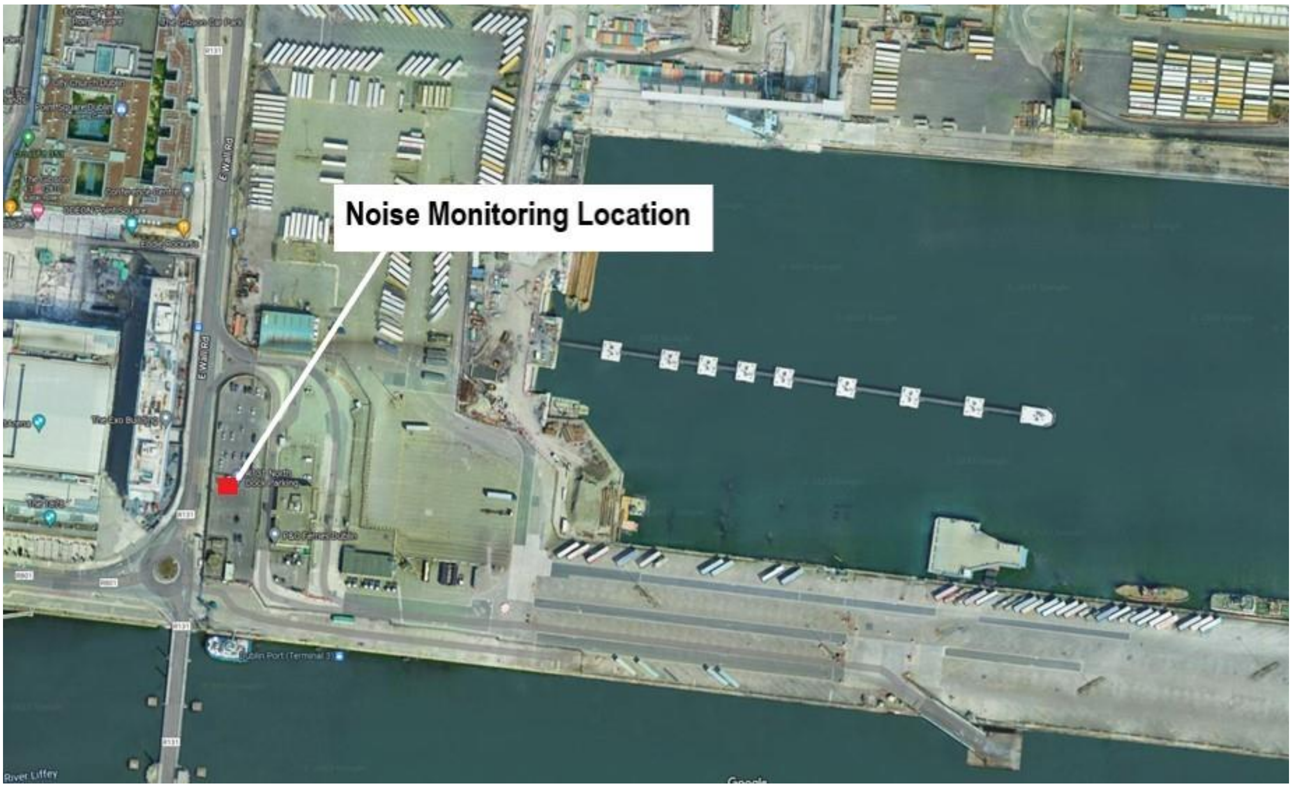


Figure 12.1.2 P&O Noise Monitoring Location (U-NML2)

Figure 12.1.3 Clontarf Noise Monitoring Location (U-NML3)

Figure 12.1.4 Coast Guard Cottages Noise Monitoring Location (A-NML1)

Figure 12.1.5 Glass Bottle Site Noise Monitoring Location (A-NML2)

Figure 12.1.6 Sandymount Noise Monitoring Location (A-NML3)

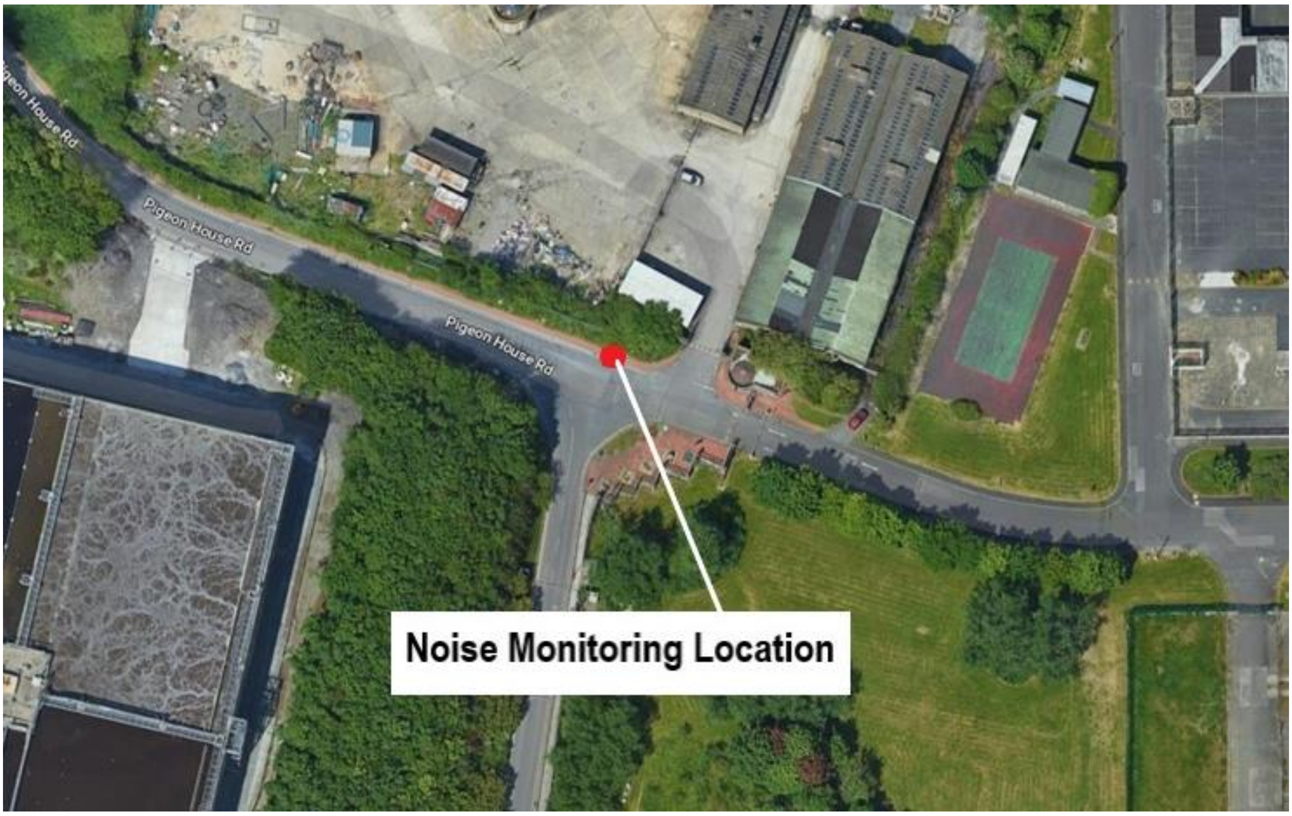


Figure 12.1.7 ESB Noise Monitoring Location (A-NML4)

The baseline noise monitoring survey was completed at various locations and dates between March and June 2023 using the following noise monitoring equipment:

- Norsonic Nor140 Sound Level Meter (BS EN IEC 61672-1:2003 Class 1) [Serial No: 1402995]
- Norsonic Sound Calibrator 1251 [Serial No: 33739]

The microphone was placed at a height of 1.2 - 1.5m above ground level. The sound level meter was accurately calibrated before and after use with no drift observed. The weather conditions during the noise monitoring survey were in accordance with the requirements of BS7445: Description and Measurement of Environmental Noise.

The following parameters were recorded during each monitoring period:

- LAeq The continuous equivalent A-weighted sound pressure level. This is an “average” of the sound pressure level.
- LAmax This is the maximum A-weighed sound level measured during the sample period.
- LAmin This is the minimum A-weighted sound level measured during the sample period.
- LA10 This is the A-weighted sound level that is exceeded for noise for 10% of the sample period.
- LA90 This is the A-weighted sound level that is exceeded for 90% of the sample period.

In addition to the baseline noise monitoring survey described above, an additional short-term noise monitoring survey was completed in the vicinity of those properties most likely to be impacted by the new SPAR road. The SPAR is listed as a national road scheme within the National Development Plan. This short-term noise monitoring survey was completed in accordance with Section 6.3.4 of the NRA Guidelines for the Treatment of Noise & Vibration in National Road Schemes.

Figure 12.1.8 illustrates the location of these short-term noise measurements completed in accordance with the NRA Guidelines. In total, six locations were selected for 15-minute measurements over three consecutive hours between 10:00 – 17:00 as described in Section 6.3.4 of the guidelines. The noise monitoring locations were selected at various distances from the R131 in the vicinity of Pigeon House Road so as to provide valuable existing noise data to validate the noise model used in this impact assessment chapter.

Figure 12.1.8 Short-term Noise Measurement Locations in the Vicinity of Pigeon House Road

Section 12.1.3 provides details of the noise measurement results at locations 1-6 from this short-term noise monitoring survey.

12.1.2.9 Noise Model

The proposed project was modelled using CadnaA noise modelling software. The CadnaA noise modelling software package uses the ISO9613 prediction methodology along with a range of topographical and ordnance data collected on the surrounding area to build up a picture of the noise environment in the vicinity of sensitive receptors in the study area. The software was used to build a 3-dimensional model of all features which may affect the generation and propagation of noise in the vicinity of the existing and proposed Port.

The CadnaA noise model was used for predicting cumulative noise levels at various stage of the construction phase and for predicting the cumulative noise levels from existing and proposed scenarios for the operational phase of the proposed project. The noise model was calibrated using noise measurement data recorded and presented in Section 12.1.3 and the model should good alignment with measurement data from the existing baseline noise environment.

12.1.3 Existing Environment

Section 12.1.2 provides details on the baseline noise monitoring survey completed at various locations and various dates between March and June 2023. The detailed noise monitoring survey measurements are presented in Appendix 12.1.

Using the data included in Appendix 12.1, summary data on the ambient (L_{Aeq}) and background (L_{A90}) noise levels at each noise monitoring location for different periods of the day has been included in Table 12.1.11. This summary data has been presented in the format of a range of recorded noise levels for the relevant time period in question. Where there are significant outlier data measurements within any dataset, these have been disregarded in the context of not presenting a distorted range of noise levels for that measurement period.

Table 12.1.11 Summary of Noise Monitoring Survey

Noise Monitoring Location	Range of Measured Noise Levels dB(A)		
	Daytime (07:00 – 19:00)	Evening (19:00 – 23:00)	Night-time (23:00 – 07:00)
Marina (U-NML1) March 2023)	Ambient Noise Level (LAeq)		
	50-62	47-58	46-62
	Background Noise Level (LA90)		
	44-58	43-54	41-54
P&O (U-NML2) March 2023	Ambient Noise Level (LAeq)		
	53-66	50-62	45-62
	Background Noise Level (LA90)		
	45-60	42-56	37-56
Clontarf (U-NML3) March 2023	Ambient Noise Level (LAeq)		
	49-63	49-59	40-56
	Background Noise Level (LA90)		
	35-55	34-53	28-49
Coastguard Cottages (A-NML1) June 2023	Ambient Noise Level (LAeq)		
	56-62	52-59	48-57
	Background Noise Level (LA90)		
	51-55	49-54	45-52
Glass Bottle Site (A-NML1) June 2023	Ambient Noise Level (LAeq)		
	46-58	43-48	43-47
	Background Noise Level (LA90)		
	42-51	40-43	41-44
Sandymount (A-NML1) June 2023	Ambient Noise Level (LAeq)		
	64-65	65-67	49-63
	Background Noise Level (LA90)		
	51-55	48-53	41-45
ESB (A-NML1) June 2023	Ambient Noise Level (LAeq)		
	54-65	-	47-54
	Background Noise Level (LA90)		
	49-50	-	46-49

As described in Section 12.1.2, a short-term noise monitoring survey was completed in the vicinity of Pigeon House Road in accordance with the methodology described in Section 6.3.4 of the NRA Guidelines for the Treatment of Noise & Vibration in National Road Schemes. Table 12.1.12 presents the measured noise levels recorded during this survey. The noise monitoring locations included within this survey are illustrated in Figure

12.1.8. Section 6.3.4 of the NRA Guidelines describes how these short-term measurements over three consecutive hours can be used to derive values for $L_{A10(18\text{-hour})}$ and L_{den}.

Table 12.1.12 Short-Term Noise Measurement Survey in Accordance with NRA Guidelines

Measurement Time	**Measured Noise Levels dB(A)**		
	L_{Aeq}	**L_{A10}**	**L_{A90}**
Location 1 (See Figure 12.1.8)			
10:16 - 10:31	69.2	71.1	57.2
11:08 - 11:23	69.4	72.3	60.8
12:02 - 12:17	70.5	72.6	62.1
Derived $L_{A10(18\text{-hour})}$	71		
Location 2 (See Figure 12.1.8)			
10:33 - 10:48	80.4	77.4	64.9
11:26 - 11:41	72.5	75.6	61.7
12:20 - 12:35	73.3	76.7	65.6
Derived $L_{A10(18\text{-hour})}$	76		
Location 3 (See Figure 12.1.8)			
10:51 - 11:06	62.3	65	56.3
11:44 - 11:59	64.1	66.1	58.7
12:38 - 12:53	62.6	65.2	57.9
Derived $L_{A10(18\text{-hour})}$	64		
Location 4 (See Figure 12.1.8)			
13:11 - 13:26	60.4	62.7	53.1
14:04 - 14:19	61.4	62.8	53.9
14:56 - 15:11	59.5	61.7	51.2
Derived $L_{A10(18\text{-hour})}$	61		
Location 5 (See Figure 12.1.8)			
13:28 - 13:43	66.5	69.7	58.7
14:21 - 14:36	66.7	70	59.2
15:14 - 15:29	65.1	68.6	57
Derived $L_{A10(18\text{-hour})}$	68		
Location 6 (See Figure 12.1.8)			
13:46 - 14:01	69.2	72.7	61.7
14:38 - 14:53	68.5	72.1	60.2
15:32 - 15:47	68.8	72	59.6
Derived $L_{A10(18\text{-hour})}$	71		

12.1.4 Impact Assessment – Construction Phase

12.1.4.1 Construction Noise - General

A detailed noise model was created of the port and surrounding noise sensitive receptors in order to predict the cumulative noise level associated with construction phase activities at the nearest noise sensitive properties. In order to create the noise model, it was necessary to define the various plant and equipment used as part of the construction phase activities. Table 12.1.13 includes a list of the most significant plant/equipment to be used during the construction phase for the proposed project.

Table 12.1.13 Plant and Equipment to be Used During Construction Phase (Ref: BS5228:2009+A1:2014)

Activity / Plant (Reference from Annex C & D, BS5228:2009+A1:2014)	Power Rating (kW)	Equipment Size, Weight (Mass), Capacity	Sound Power Level (dB)
Breaking Road Surface: Mini Excavator with Hydraulic Breaker (C5 - Ref 2)	-	1.5t	111
Road Planning: Road Planer (C5 - Ref 7)	185	17t	110
Removing Broken Road Surface: Wheeled Excavator (C5 - Ref 11)	112	17t	101
Rolling and Compaction: Vibratory roller (C5 - Ref 27)	20	3t	95
Haulage: Road Lorry - Full (C6 - Ref 21)	270	39t	108
Lifting: Wheeled Mobile Telescopic Crane (C4 - Ref 38)	610	400t	106
Clearing Site: Tracked excavator (C2 - Ref 3)	102	22t	106
Clearing Site: Wheeled backhoe loader (C2 - Ref 8)	62	8t	96
Ground Excavation: Dozer (C2 - Ref 12)	142	20t	109
Ground Excavation: Tracked excavator (C2 - Ref 14)	226	40t	107
Ground Excavation: Wheeled loader (C2 - Ref 27)	193	-	108
Poker Vibrator (C4 - Ref 33)	-	-	106
Power: Diesel Generator (C4 - Ref 83)	3	210kg	93
Distribution of Material: Tipper Lorry (C8 - Ref 20)	-	-	107
Piling: Tubular Steel Piling - hydraulic hammer - (C3 - Ref 3)	-	240mm diameter	116
Piling: Sheet Steel Piling - hydraulic jacking - power pack (C3 - Ref 10)	147	6t	96
Pumping Water: Water pump (C2 - Ref 45)	20	6 in	93
Dredging: Trailing Suction Hopper Dredge			114

The construction activities associated with the 3FM Project will take place over a period of approximately 15 years. Noise construction activity will be located in different areas of the construction site at different times throughout the duration of construction. The potential for construction noise impacts at residential properties will vary year by year depending on the nature and location of construction activities taking place at any one time. A detailed description of the construction phase is contained in Chapter 5.

Section 12.1.4 contains a construction noise impact assessment for the 3FM Project. As detailed in Section 12.1.4.2, this section focuses on areas where there is potential for significant construction noise impacts at residential receptors depending on the location and nature of construction activities in that particular area.

12.1.4.2 Construction Phase Noise Impacts

Before addressing areas where there is potential for significant construction noise impacts, there are areas where there is no potential for significant construction noise impacts. This is based largely on account of the distance between these areas and the nearest worst-case construction activities.

The nearest worst-case construction phase activities to Clontarf will be in approximate year 6 where a range of activities such as dredging and demolition of existing structures will be taking place. Figure 12.1.9 illustrates a model output of noise levels from these activities in the direction of Clontarf.

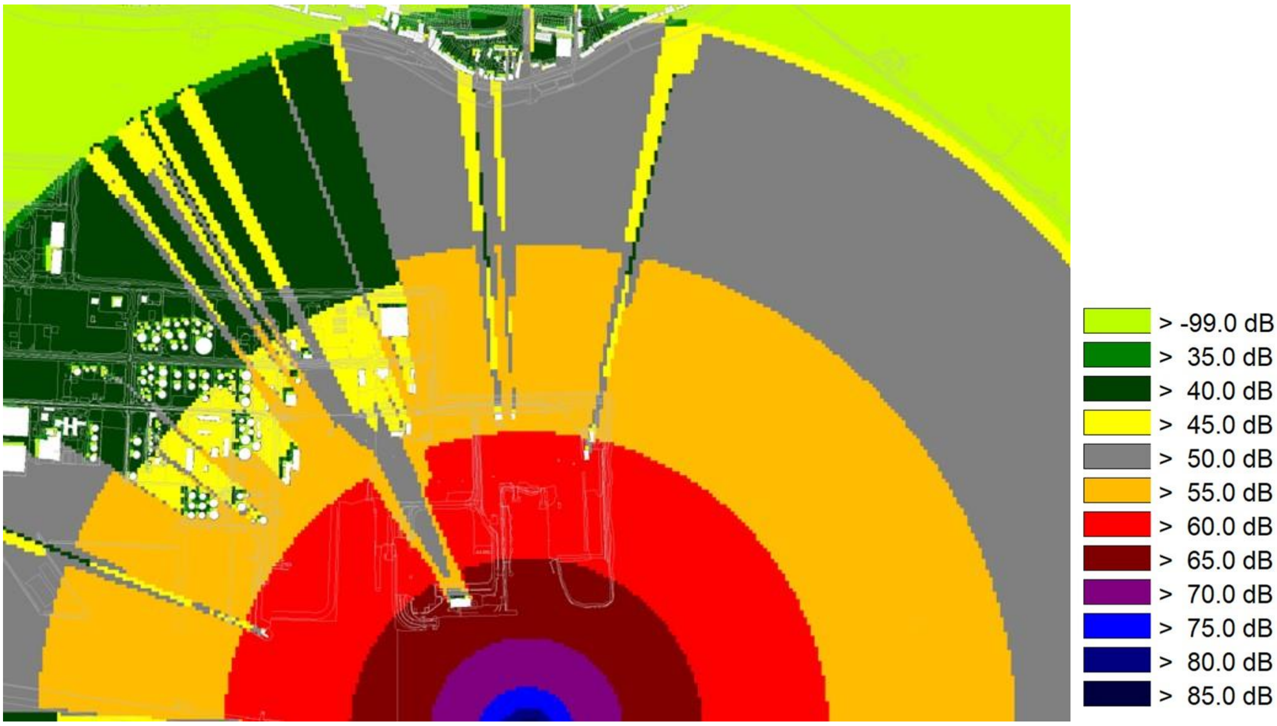


Figure 12.1.9 Noise Model of Construction Noise Levels at Clontarf

Figure 12.1.9 illustrates that worst-case construction noise levels in the direction of Clontarf will be below 50dB(A) at Clontarf, which is significantly below the most onerous construction phase noise threshold limit of 65dB(A) included in BS5228:2009+A1:2014. On this basis, construction phase noise impacts at Clontarf are considered to be negligible.

The nearest worst-case construction phase activities to Sandymount will be in approximate years 7-11 where a range of plant/equipment will be used for the construction of Area O. Figure 12.1.10 illustrates a model output of noise levels from these activities in the direction of Sandymount.

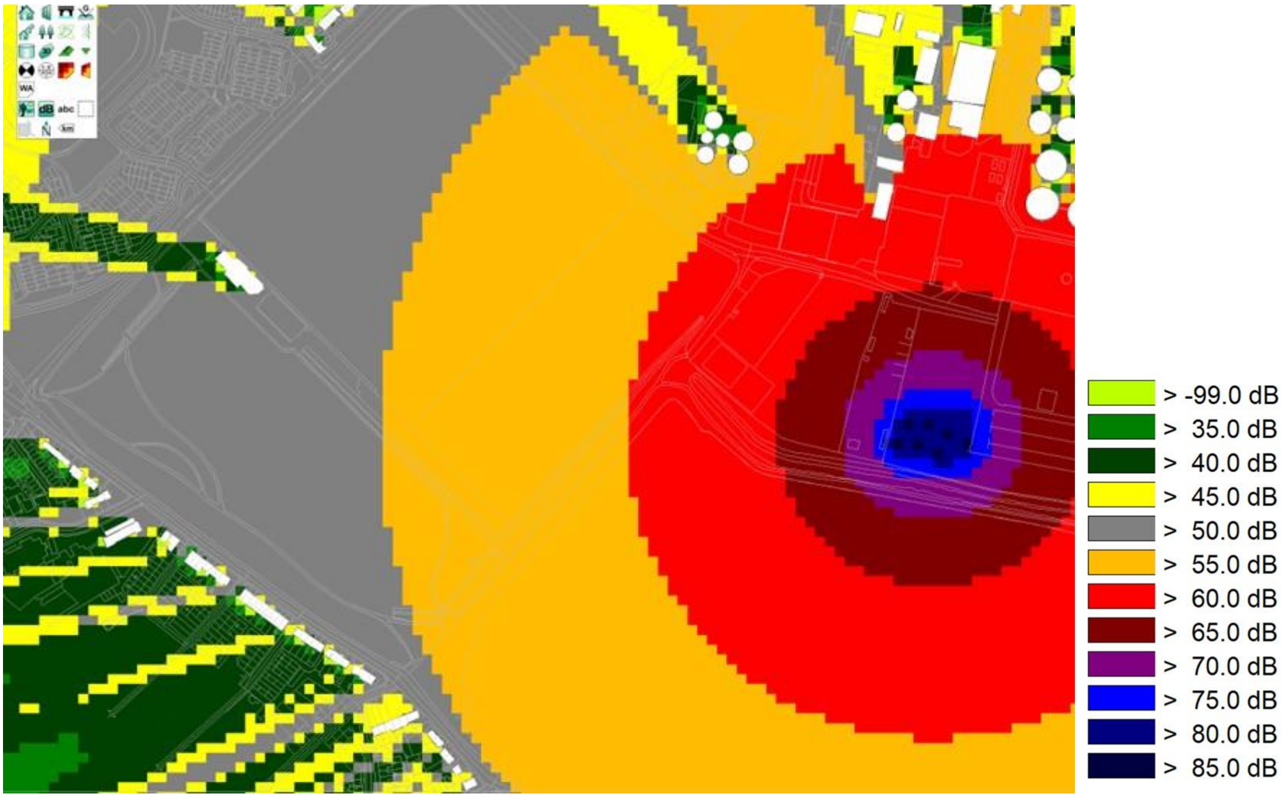


Figure 12.1.10 Noise Model of Construction Noise Levels at Sandymount

Figure 12.1.10 illustrates that worst-case construction noise levels in the direction of Sandymount will be below 50dB(A) at Sandymount, which is significantly below the most onerous construction phase noise threshold limit of 65dB(A) included in BS5228:2009+A1:2014. On this basis, construction phase noise impacts at Clontarf are considered to be negligible.

To the west of the port, the distance between construction activities and the nearest residential receptors and the substantial screening effect of commercial buildings in this area will mean that construction noise levels will be significantly below the most onerous construction phase noise threshold limit of 65dB(A) included in BS5228:2009+A1:2014. On this basis, construction phase noise impacts west of the port are considered to be negligible.

The most significant potential for worst-case construction noise impacts from the 3FM Project will be in the areas around Pigeon House Road and Coastguard Cottages. During construction years 4-8, there is potential for worst-case construction noise levels greater than 65dB(A) for properties in the vicinity of Pigeon House Road and Coastguard Cottages based on worst-case assumptions for construction activity.

Figure 12.1.11 illustrates the noise model outputs for Year 4 at properties on Pigeon House Road and Coastguard Cottages. This is based on worst-case assumptions of plant/equipment active at any one time. Figure 12.1.12 illustrates specific properties in the vicinity of these construction works and Table 12.1.14 presents worst-case predicted construction noise levels at these properties.

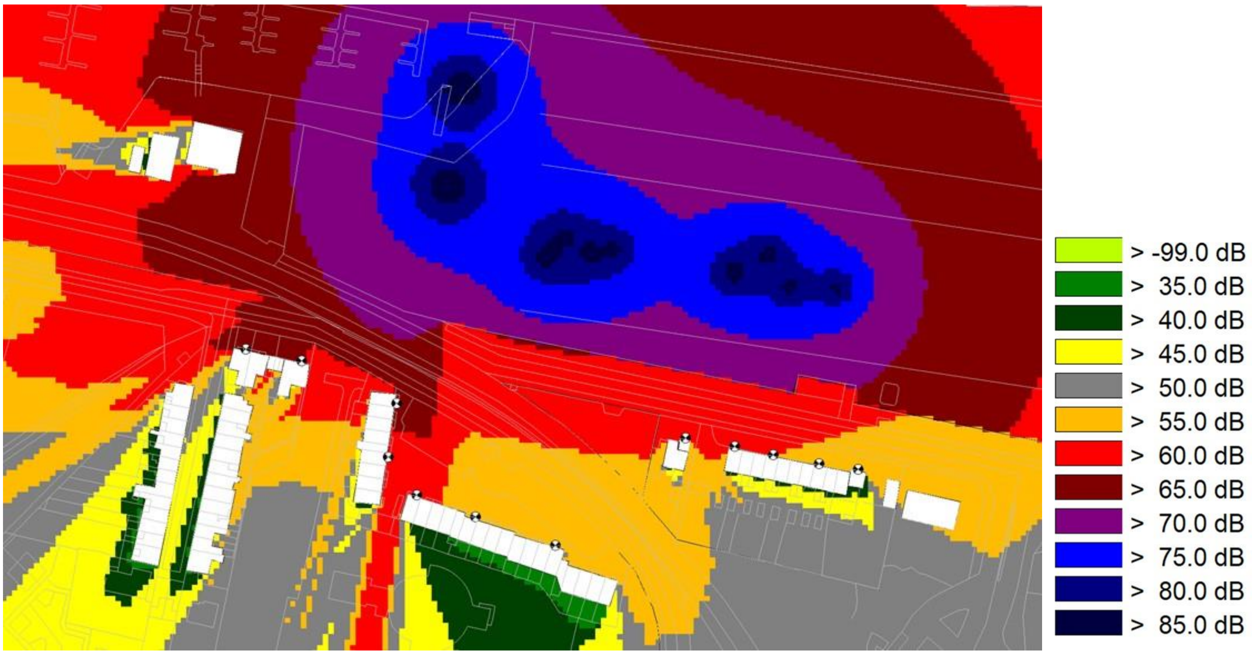


Figure 12.1.11 Noise Model of Worst-Case Construction Noise Levels During Year 4 at Pigeon House Road / Coastguard Cottages

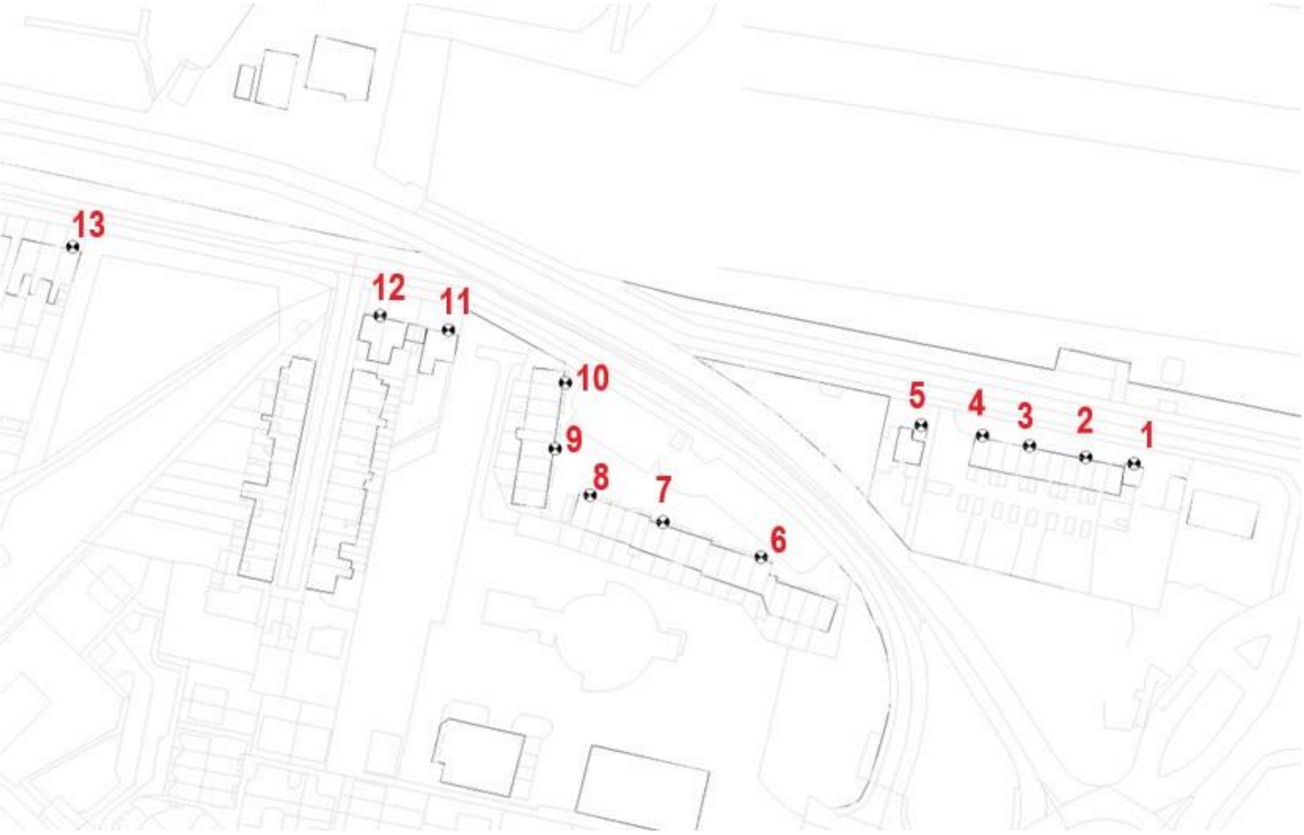


Figure 12.1.12 Location Specific Properties Along Pigeon House Road / Coastguard Cottages to Illustrate Worst-Case Construction Noise Levels in Table 12.1.14

Table 12.1.14 Worst-Case Prediction Noise Levels at Individual Properties Along Pigeon House Road / Coastguard Cottages

Receptor Reference (See Figure 12.1.12)	Worst-Case Predicted Noise Level in Year 4 dB(A)	Applicable BS5228 Noise Threshold Limit dB(A)
1	58.5	65
2	59.2	65
3	59.9	65
4	60.5	65
5	60.8	65
6	59.9	65
7	60.0	65
8	63.6	65
9	64.6	65
10	67.0	65
11	65.0	65
12	66.3	65
13	58.6	65

Figure 12.1.13 illustrates the noise model outputs for Year 6 at properties on Pigeon House Road. This is based on worst-case assumptions of plant/equipment active at any one time. Figure 12.1.14 illustrates specific properties in the vicinity of these construction works and

Table 12.1.15 presents worst-case predicted construction noise levels at these properties.

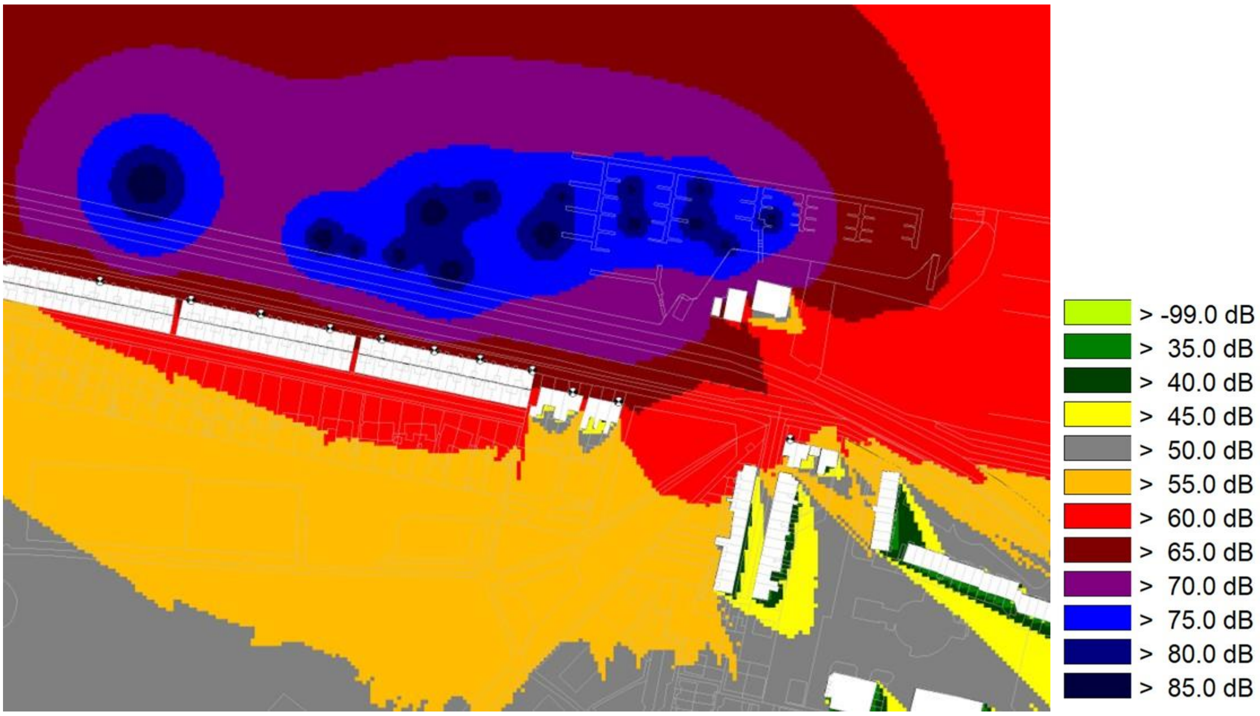


Figure 12.1.13 Noise Model of Construction Noise Levels During Year 6 at Pigeon House Road

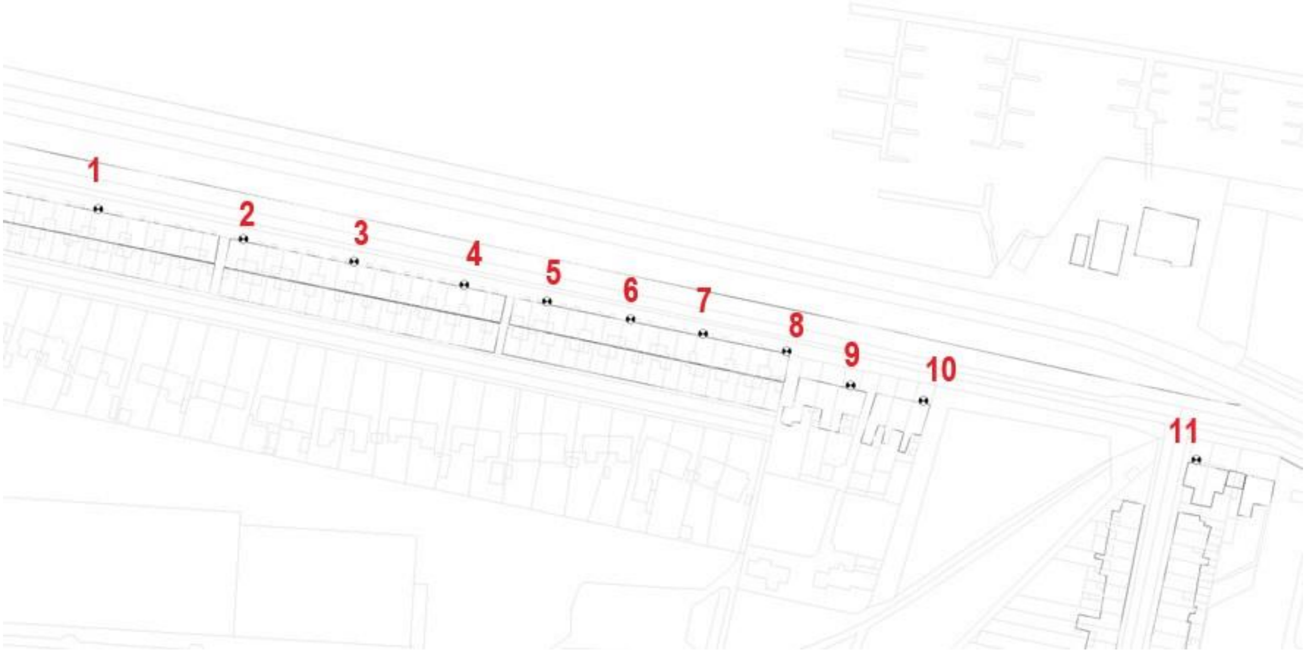


Figure 12.1.14 Location Specific Properties Along Pigeon House Road to Illustrate Worst-Case Construction Noise Levels in

Table 12.1.15 Worst-Case Prediction Noise Levels at Individual Properties Along Pigeon House Road

Receptor Reference (See Figure 12.1.14)	Worst-Case Predicted Noise Level in Year 6 dB(A)	Applicable BS5228 Noise Threshold Limit dB(A)
1	64.7	65
2	65.0	65
3	65.9	65
4	67.4	65
5	68.0	65
6	67.9	65
7	67.0	65
8	65.5	65
9	66.5	65
10	65.6	65
11	60.4	65

On the basis of these worst-case construction noise levels in this area are considered to be significant (Moderate/Major). There will be a requirement for mitigation measures to be in place to ensure that the relevant BS5228:2009+A1:2014 noise threshold limit is not exceeded at the nearest noise sensitive properties. Noise mitigation measures in this area are presented in Section 12.1.7.

12.1.4.3 Construction Phase Traffic Noise Impacts

As part of the construction phase noise impact assessment construction, construction phase traffic flows over the construction period between 2026 and 2040 were assessed. The highest concentration of construction traffic during this period will be in the second half of 2038, primarily related to construction vehicles movements to the works at Areas K, L and O. It is estimated 17,088 construction vehicles movements (two-way movement) will take place during this six-month period, averaging as 2,848 over each month period during this period. This equates to less than 140 construction vehicles movements per day.

The UK Design Manual for Roads and Bridges (DMRB, Volume 11, Section 3, Part 7) states that it takes a 25% increase or a 20% decrease in traffic flows in order to get a 1dB(A) change in traffic noise levels. On this basis of traffic flow levels on the routes by which construction traffic will be travelling to the construction site and worst-case daily construction traffic levels presented above, traffic noise levels associated with the construction phase of the proposed project will be less than 1dB(A) at noise sensitive receptors along these routes. It is generally accepted that it takes an approximate 3dB(A) increase in noise levels to be perceptible to the average person (Ref: NRA *Guidelines for the Treatment of Noise and Vibration in National Road Scheme,* 2004). Based on this reference, traffic noise increases associated with the construction phase on the local road network will have a negligible/minor noise impact at these properties.

12.1.4.4 Construction Phase Vibration Impacts

Some of the construction phase activities associated with the proposed construction phase have the potential to result in vibration impacts at sensitive receptors if sufficiently close to the respective receptor. Activities included in the proposed construction phase that have the potential to result in vibration impacts include piling and to a lesser extent rock armour activities and dredging.

BS5228:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and open Sites - Part 2: Vibration gives pages of reference data relating to measured vibration levels associated with different types of piling activities in different ground strata. BS5228:2009+A1:2014 references vibration levels measured for various types of bored piling / cast-in-situ piling (using hammer), a technique which reflects the type of piling that will be conducted as part of the proposed project.

Reference 11 from Table D1 of BS5228:2009 indicates that bored piling on loose rock over weathered rock over rock, gives a measured PPV of 1.2mm/s at 30m. The nearest piling activity associated with the proposed project will be between the piling activities associated with the construction of the SPAR and the properties on the Pigeon House Road. The nearest properties on Pigeon House Road are approximately 40m from the nearest construction piling activity and on the basis of the reference above, this would indicate that piling vibration levels from piling activities will be less than 1mm/s.

On the basis of the vibration threshold limits outlined in Table 12.1.3 and Table 12.1.4, the vibration impacts during the construction phase will be minor. While there will be a minor vibration impact associated with the construction phase of the proposed project, it would be prudent for vibration monitoring to be completed during the worst-case phase of piling in this area to ensure that there are no significant vibration effects experienced. Section 12.1.7 provides details on proposed construction phase vibration mitigation measures.

Chapter 16 Cultural Heritage provides details on the potential for construction phase activities to impact on cultural heritage locations in the vicinity of proposed 3FM construction works. The chapter contains a range of cultural heritage management measures (including vibration monitoring) for all aspects of the works to minimise potential impacts and maximise potential benefits at these cultural heritage locations. These measures are not repeated in this chapter.

12.1.4.5 Dublin City Council Construction and Demolition Plan

Section 12.1.2.1 summarises the requirement to complete a construction and demolition plan prior to the commencement of work on a site as set out in the DCC Air Quality Monitoring and Noise Control Unit's Good Practice Guide for Construction and Demolition. This guide presents a risk-based approach to be completed taking into account the locality, nature of work and the expected duration of work.

This section contains risk assessment for the 3FM Project. Table 12.1.16 details the Risk Assessment A for locality / site information, while Table 12.1.17 presents the Risk Assessment B for work information. Table 12.1.18 contains the Total Risk Assessment based on Risk Assessments A and B.

Table 12.1.16 DCC Guide Risk Assessment A

	Low	Medium	High
Expected duration of work			
Less than 6 months			
6 months to 12 months			
Over 12 months			x
Proximity of nearest sensitive receptors			
Greater than 50m from site	x		
Between 25m and 50m			
Less than 25m			
Hospital or school within 100m			
Day time ambient noise levels			
High ambient noise levels (>65dB[A])			
Medium ambient noise levels (>65dB[A])		x	
Low ambient noise levels (>65dB[A])			
Working Hours			
7am – 6pm Mon-Fri; 8am-1pm Sat	x		
Some extended evening or weekend work			
Some night time working, including likelihood of concrete power floating at night			
SUBTOTAL A	**2**	**1**	**1**

Table 12.1.17 DCC Guide Risk Assessment B

	Low	Medium	High
Location of works			
Majority within existing building			
Majority external			x
External Demolition			
Limited to two weeks			
Between 2 weeks and 3 months			
Over 3 months			x
Ground works			
Basement level planned			
Non percussive methods only			
Percussive methods for less than 3 months			
Percussive methods for more than 3 months			x
Piling			
Limited to 1 week			
Bored piling only			
Impact or vibratory piling			x
Vibration generating activities			
Limited to less than 1 week			
Between 1 week and 1 month			
Greater than 1 month			x
SUBTOTAL B	**0**	**0**	**5**

Table 12.1.18 DCC Guide Total Risk Assessment

	Low	Medium	High
Risk Assessment A	2	1	1
Risk Assessment B	0	0	5
Total	2	1	6

On the basis of the total risk assessment score, the 3FM Project will be in the high-risk category. Section 12.1.7 provides details on the good practice measures detailed in the DCC guide that are to be applied during the construction phase based on high-risk category.

12.1.5 Impact Assessment – Operational Phase

12.1.5.1 Traffic Noise Impact from SPAR

Sections 12.1.5.2 – 12.1.5.3 contain an assessment of the proposed SPAR during the operational phase.

12.1.5.2 Introduction

Section 12.1.2 describes the recommendations include in the NRA Guidelines for the treatment of noise and vibration in national road schemes for achieving the relevant design goal below on all new national road schemes. These guidelines have been used for the purposes of modelling and assessing the SPAR as the SPAR has been designated as a national road scheme under the National Development Plan 2021-2030.

Day-evening-night 60dB L_{den} (free field residential facade criteria)

Mitigation measures are only deemed necessary when the following three conditions are satisfied at designated sensitive receptors:

- The combined expected maximum traffic noise level, i.e. the relevant noise level, from the proposed road scheme together with other traffic in the vicinity is greater than the design goal:
- The relevant noise level is at least 1dB more than the expected traffic noise level without the proposed road scheme in place;
- The contribution to the increase in the relevant noise level from the proposed road scheme is at least 1dB.

As detailed in Section 2.3 of the NRA Guidelines, the 60dB Lden design goal has been derived from the previously used design standard of 68dB(A) $L_{A10(18hour)}$. Section 12.1.2 provides information on the CadnaA noise modelling software used for the purposes of modelling noise from the SPAR road. The noise models completed in this assessment have been prepared using hourly traffic levels prepared by the traffic consultants for the 3FM Project. The CadnaA noise modelling software provides noise model outputs in the form of $L_{A10(18hour)}$ predicted noise levels and these are transposed to Lden predicted noise levels using the formulae included in Section 3 of the NRA Guidelines.

12.1.5.3 Noise Model Predictions

Detailed noise models were prepared for the 3FM Project for the following scenarios:

- Do Nothing Scenario (R131) – 2040;

- Do Something Scenario (R131 + SPAR) 2040.

Comparison of the Do Nothing 2040 and Do Something 2040 scenarios was used for the purposes of determining the requirement for mitigation measures as detailed in the NRA Guidelines (See Introduction above and Section 12.1.2).

In order to complete noise modelling exercise as described above, a range of noise sensitive receptors along Pigeon House Road / Coastguard Cottages and areas where future residential properties will be located on the Glass Bottle site were selected so as to be representative of property groups most likely to be impact by noise form the proposed SPAR. Figure 12.1.15 to Figure 12.1.17 illustrate the location of properties used in the noise modelling exercise.

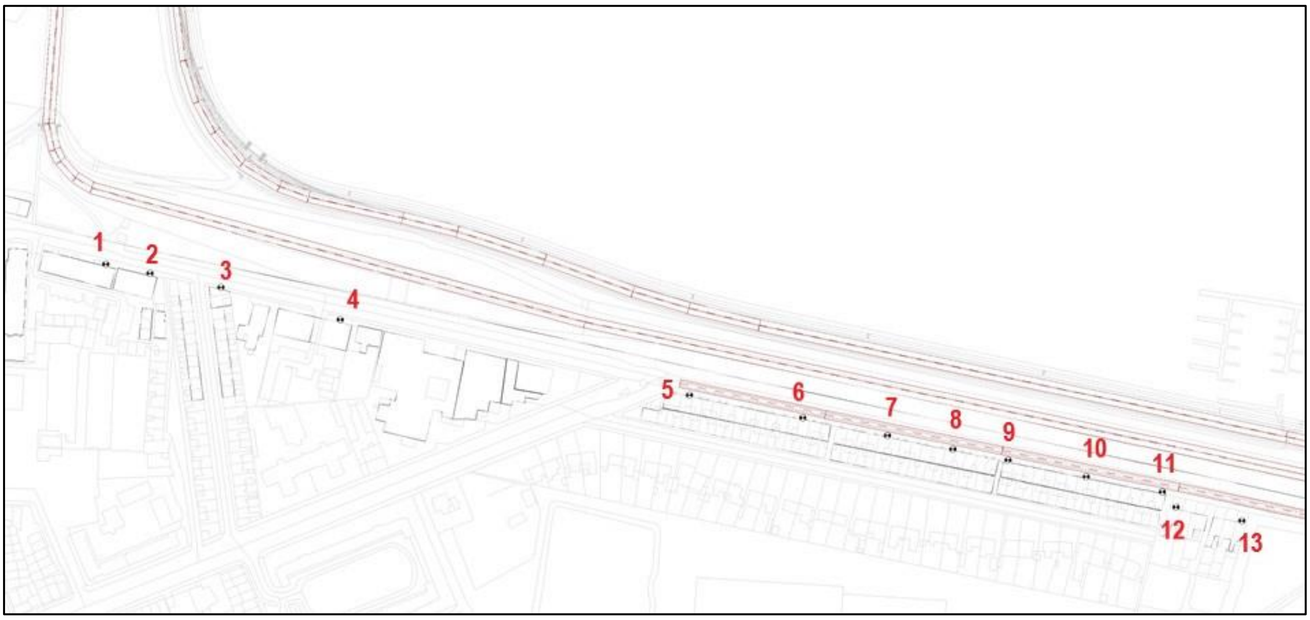


Figure 12.1.15 Noise Sensitive Properties Modelled (Part 1)

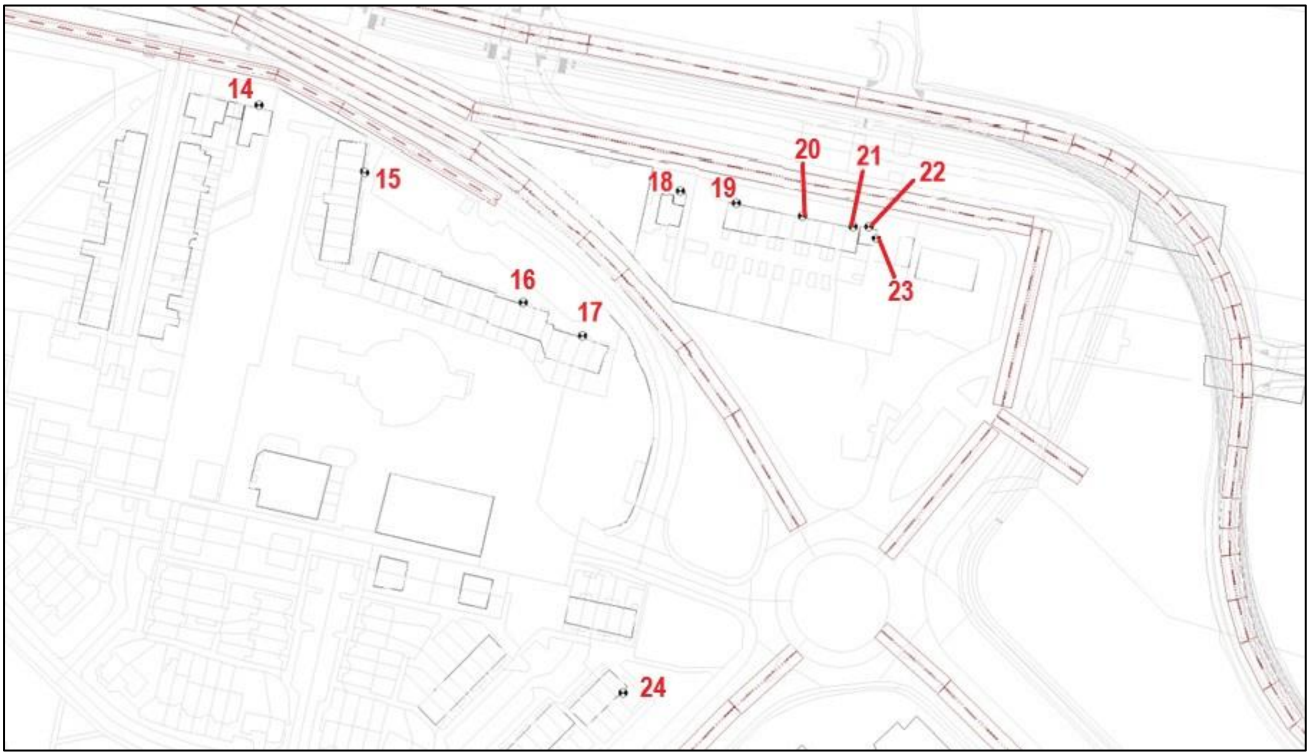


Figure 12.1.16 Noise Sensitive Properties Modelled (Part 2)

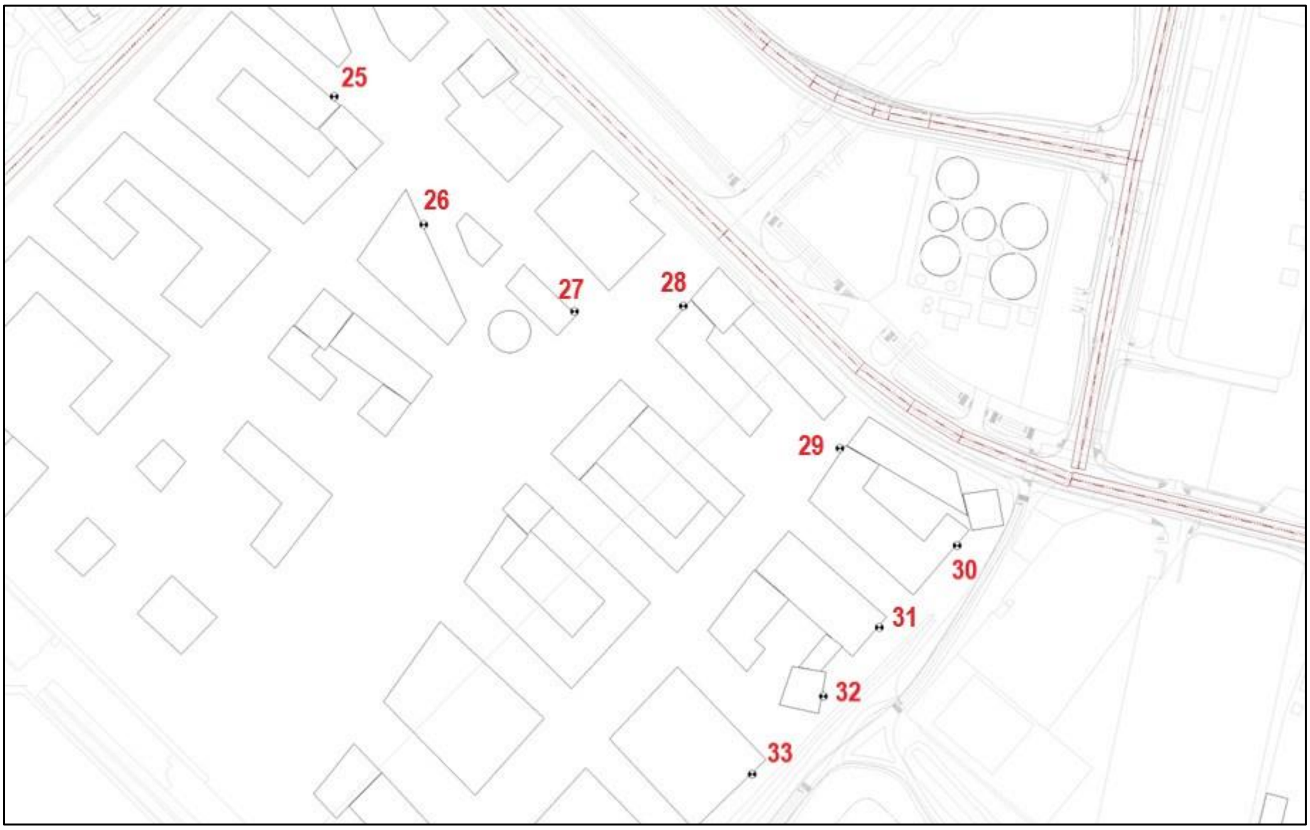


Figure 12.1.17 Noise Sensitive Properties Modelled (Part 3)

Table 12.1.19 presents noise model outputs for the noise sensitive receptors included in Figure 12.1.15 to Figure 12.1.17 for the Do Nothing (2040) and Do Something (R131 + SPAR, 2040) scenarios.

Table 12.1.19 Noise Model Outputs for the SPAR

Receptor Number	**Address [Height modelled]**	**Modelled Scenarios (Lden) dB(A)**		**Mitigation Required**
		Do Nothing 2040	**Do Something (R131 + SPAR) 2040**	
1	York Road (1) [9m]	67.1	64.6	N
2	York Road (2) [9m]	67.5	65.1	N
3	York Road (3) [4m]	67.8	65.6	N
4	York Road (4) [9m]	67.9	66.1	N
5	1 Pigeon House Road [1.5m]	66.4	65.1	N
6	12 Pigeon House Road [1.5m]	66.6	65.3	N
7	19 Pigeon House Road [1.5m]	66.6	65.3	N
8	24 Pigeon House Road [1.5m]	66.6	65.3	N
9	30 Pigeon House Road [1.5m]	66.7	65.4	N
10	37 Pigeon House Road [1.5m]	66.8	65.4	N
11	44 Pigeon House Road [1.5m]	66.8	65.5	N
12	46 Pigeon House Road [4m]	66.8	65.7	N
13	51 Pigeon House Road [4m]	67.4	66.3	N
14	64 Pigeon House Road [4m]	69.1	67.2	N
15	Poolbeg Quay Apartments (1) [11.5m]	67.4	65.0	N
16	Poolbeg Quay Apartments (2) [11.5m]	67.8	64.4	N
17	Poolbeg Quay Apartments (3) [11.5m]	68.5	64.7	N
18	70 Pigeon House Road [4m]	60.8	61.0	N
19	71 Pigeon House Road [4m]	59.3	60.4	Y
20	76 Pigeon House Road [4m]	58.5	59.9	Y
21	79 Pigeon House Road [4m]	58.4	59.1	N
22	80 Pigeon House Road (1) [4m]	58.6	60.4	Y
23	80 Pigeon House Road (2) [5m]	60.0	60.4	N
24	13 Leukos Road [4m]	65.6	65.4	N
25	Glass Bottle Residential (1) [16m]	54.8	55.0	N
26	Glass Bottle Residential (2) [16m]	54.7	52.4	N
27	Glass Bottle Residential (3) [16m]	53.6	54.5	N
28	Glass Bottle Residential (4) [16m]	62.0	60.8	N
29	Glass Bottle Residential (5) [16m]	56.1	57.0	N
30	Glass Bottle Residential (6) [16m]	52.1	56.1	N
31	Glass Bottle Residential (7) [16m]	50.5	54.7	N
32	Glass Bottle Residential (8) [16m]	49.0	53.6	N
33	Glass Bottle Residential (9) [16m]	47.2	52.0	N

The noise model outputs for the Do Nothing (2040) and Do Something (2040) scenarios indicate that the three conditions for the requirement of mitigation measures as detailed in the NRA Guidelines are satisfied for receptors 19, 20 and 22.

On the basis of the noise analysis included in Table 12.1.19, potential noise impacts in the vicinity of Pigeon House Road are considered to be significant (Moderate). There will be a requirement for mitigation measures to be in place for the SPAR. Proposed mitigation measures for the SPAR are detailed in Section 12.1.7.

12.1.5.4 Plant/Equipment Noise Impact

Sections 12.1.5.5 and 12.1.5.6 contain an impact assessment of plant/equipment noise from the proposed 3FM Project when operational. The primary sources of operational plant/equipment noise will be from the proposed new Ro-Ro and Lo-Lo operations at Areas K, L, N and O.

12.1.5.5 Introduction

Section 12.1.5.6 includes an assessment of the potential noise impact associated with the new plant/equipment associated with the 3FM Project. A full description of the operational phase of the proposed project is contained in Chapter 5 Project Description. In summary, new operational phase activities with the potential to generate significant noise levels are proposed in the following areas:

- Area K & O – Area K (Ro-Ro Terminal) and Area O (Ro-Ro Overflow Storage) will operate as a single terminal. Area K operations will be adjacent to Berth 42-45 and will include Ro-Ro operations, trailer parking, limited container stacking and the use of handling equipment. Area O will be utilised as a trailer parking waiting area or storage facility, as well as shunting, in conjunction with Area K.
- Areas N & L – These Lo-Lo Areas will operate as a singe terminal, with Area N to be utilised primarily for container exports and Area O to be utilised primarily for container imports. A new berthing quay at Area N will be utilised for both imports and exports.

Figure 12.1.18 illustrates the location of each of these Areas in the overall context of the port. A new maritime village will be location in the general vicinity of the existing marina but will not generate any significant plant/equipment noise.

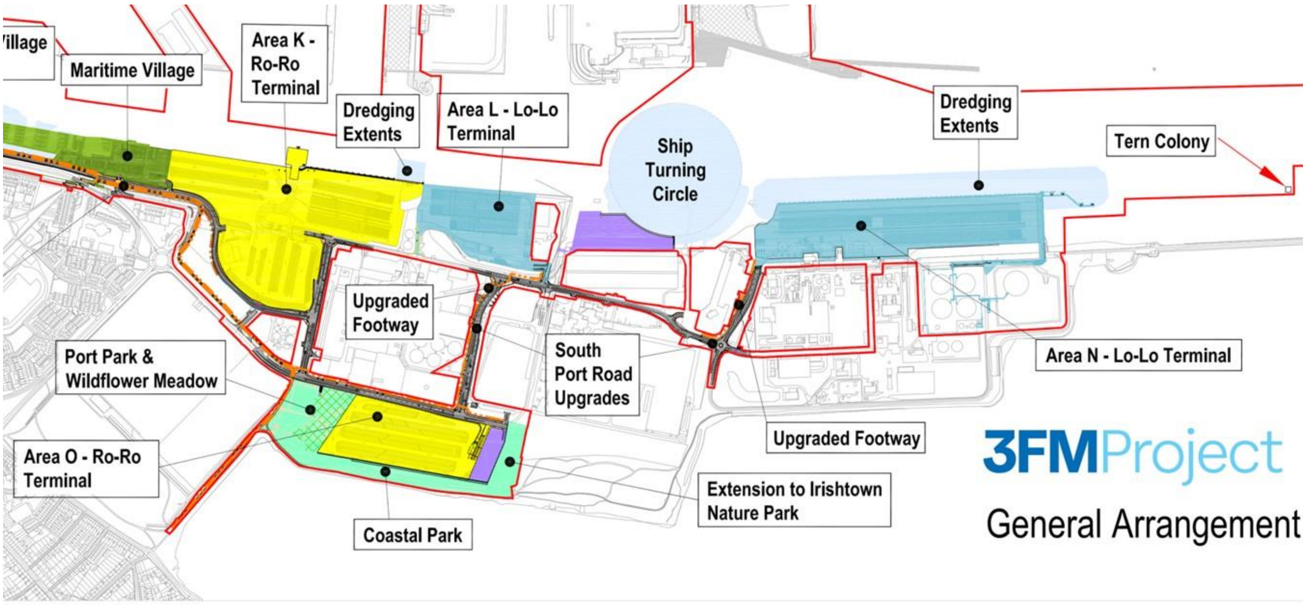


Figure 12.1.18 Location of Areas K, N, L and O

12.1.5.6 Description of Plant/Equipment

Table 12.1.20 provides a description of the various items of plant/equipment that will be in use in each of Areas K, N, L and O. In Area K, the container stacking area has been located in the north-eastern corner of the Area to maximise the distance between this activity and the nearest noise sensitive properties at Coastguard Cottages. Aside from electrified shunters, all handling equipment utilised within this Area will operate in this north-eastern corner of the area.

Table 12.1.20 Description of Plant/Equipment to be Utilised in Areas K, N,L & O

Area	Plant/Equipment
K	• E-Rubber tyred gantries (x4) • Reach stackers (x4) • Refrigerated units • Electrified internal terminal tractors • HGVs
N	• Ship to shore cranes (x6) • E-Rubber tyred gantries (x8) • Reach stackers (x4) • Refrigerated units • Electrified internal terminal tractors • HGVs
L	• E-Rubber tyred gantries (x6) • Refrigerated units • Electrified internal terminal tractors • HGVs
O	• Electrified internal terminal tractors • HGVs

Table 12.1.21 includes reference noise source data (Sound power level – Lw) for the various items of plant/equipment listed in Table 12.1.20. The reference noise source data included in this table has been used for the purposes of generating a detailed CadnaA noise model of the activities in each area to predict noise levels from each area at the nearest noise sensitive properties. This noise source data has been taken from a number of different studies completed in relation to port plant/equipment noise. Shiavoni et al (2022) summarises the recent results and research regarding port noise sources in order to provide a comprehensive database of sources that can be used for purposes such as the noise modelling of port noise. This paper details information regarding the sound power levels of noise sources operating in port areas from an array of port studies including the REPORT project, the EU funded EFFORTS project, the FP7 SILENV project and other relevant papers and reports.

The data included in Shiavoni et al (2022) is based on data that is several years old. There has been a significant recent change in the manufacture and supply of port plant/equipment with several large suppliers (e.g. Konecrane, Terberg) now providing plant/equipment that is fully electrified and a number of ports have already started to deploy this plant/equipment. While the power source change from diesel engine to electrification in itself facilitates a substantial reduction in noise emissions, further significant noise reduction is achieved in container handling with these new items of plant/equipment in the form of a range of features (e.g. automation, sensors, silent gears, silent motors etc.). These new developments make these new items of plant/equipment significantly different from the standard banging noise typical of the majority of existing port container handling operations.

The 3FM Project will be not become operational until post-2035 and advances in the reduction of noise from port plant/equipment that have already become apparent over the past one to two years will be substantially augmented by the time that plant/equipment will be commissioned for the 3FM Project. For the purposes of this assessment, items of electrified plant/equipment that are currently available (i.e. terminal tractors, cranes, reach stackers) are included within the noise model as these items of electrified plant/equipment will be the norm at the stage when plant/equipment will be commissioned for this project.

Table 12.1.21 Source Noise Data Used in Noise Model for the Proposed Areas K, N & O

Item of Plant/Equipment	Sound Power Level (L_W) dB(A)
Ship	101
Ship to Shore Gantry (SSG) Crane	111
Electric Rubber Tyre Gantry (RTG) Crane	101
Electric Rail Mounted Gantry	101
Reefer container	86
Electric Reach Stacker	96
Electric Terminal Tractor	94
HGV	104
Ramp Noise	115*
Container Handling Activity	112*

* *Additional 5dB has been added to these Lw Noise Levels to account for tonal/impulsive nature*

In Table 12.1.21, a 5dB correction has been added to noise sources which have a particular tonal/impulsive nature as recommended in the EPA NG4 guidelines. These noise sources are included in the noise model as additional to the noise from the operation of the particular item of plant/equipment (e.g. crane). A proportionality correction of these items being active for 10% of any daytime period is assumed which is deemed to be very conservative on account of the very short nature of these noise sources.

On the basis of the plant/equipment detailed in Table 12.1.20 and Table 12.1.21, a detailed noise model was generated. The items of plant/equipment active at any one time in all areas for are presented in Table 12.1.22.

Table 12.1.22 Description of Plant/Equipment Active for Noise Model

Area	Plant/Equipment Active at Any Time
	Option1
K	E-Rubber tyred gantries (x4) Reach stackers (x4) Electrified internal terminal tractors (x4) HGVs (x3) Ship (x1) Container handling Ramp (x1)
N	Ship to shore cranes (x6) E-Rubber tyred gantries (x8) Reach stackers (x4) Electrified internal terminal tractors (x4) HGVs (x3) Ship (x1) Container handling
L	E-Rubber tyred gantries (x6) Electrified internal terminal tractors (x3) HGVs (x3) Container handling
O	HGVs (x3) Electrified internal terminal tractors (x3)

Noise levels were modelled at a range of the nearest noise sensitive receptors located in all directions from the port lands. The locations of all of the noise sensitive receptors included within the model are illustrated in Figure 12.1.19 to Figure 12.1.26.

Figure 12.1.19 Nearest Noise Sensitive Receptors Modelled (Overview)

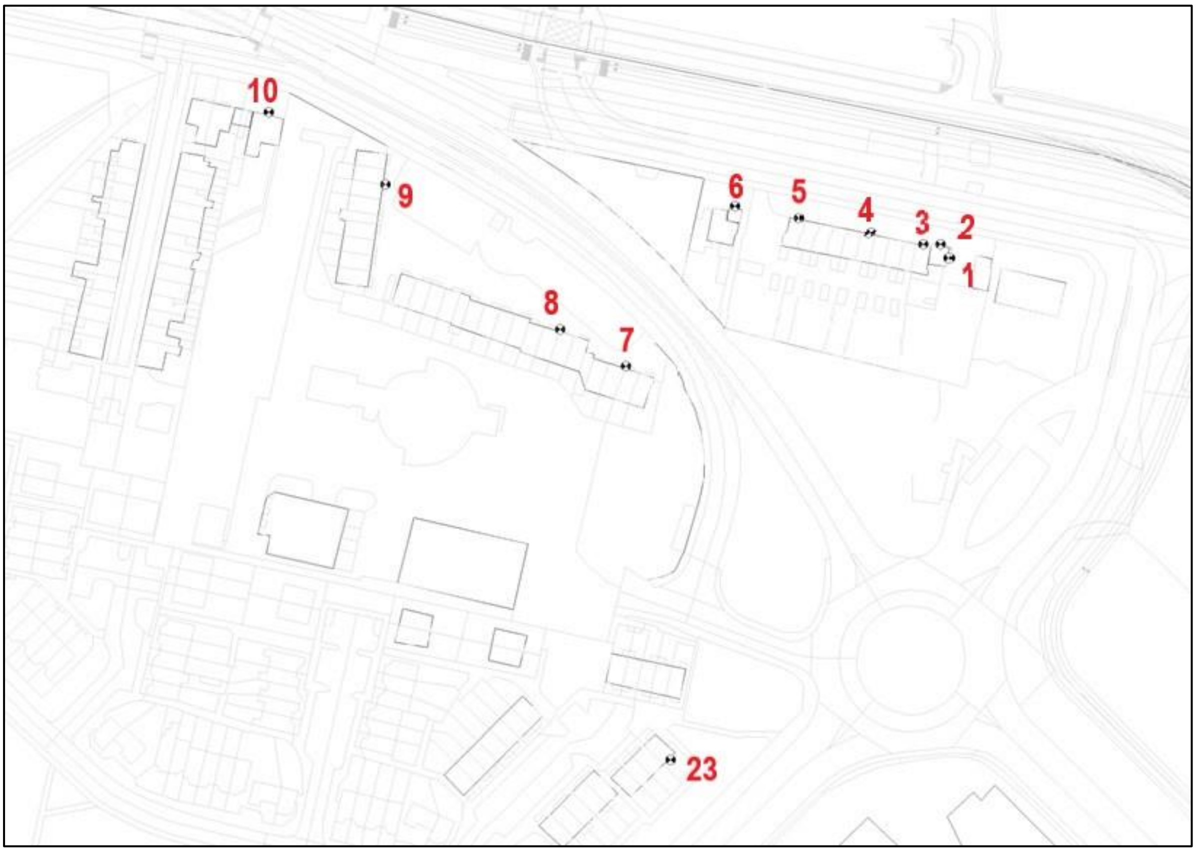


Figure 12.1.20 Nearest Noise Sensitive Receptors Modelled (Part 1 – Coastguard Cottages)

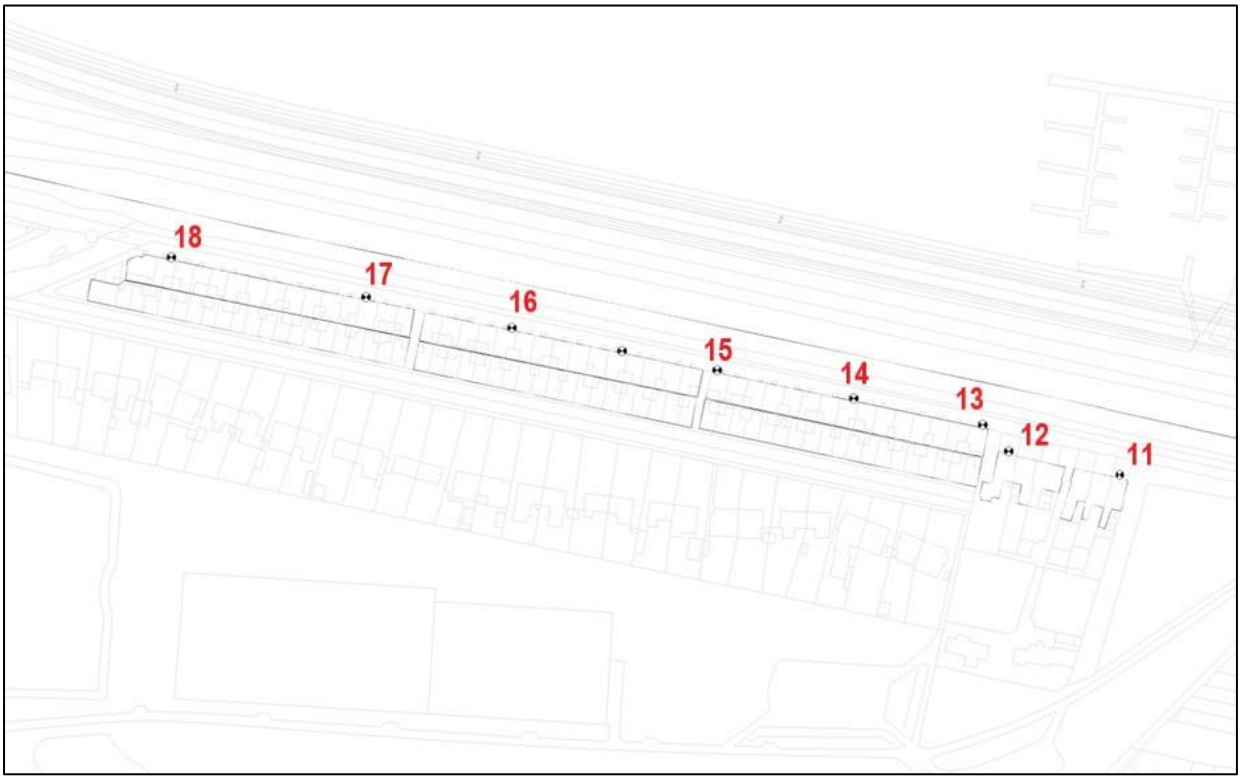


Figure 12.1.21 Nearest Noise Sensitive Receptors Modelled (Part 2 – Pigeon House Road)

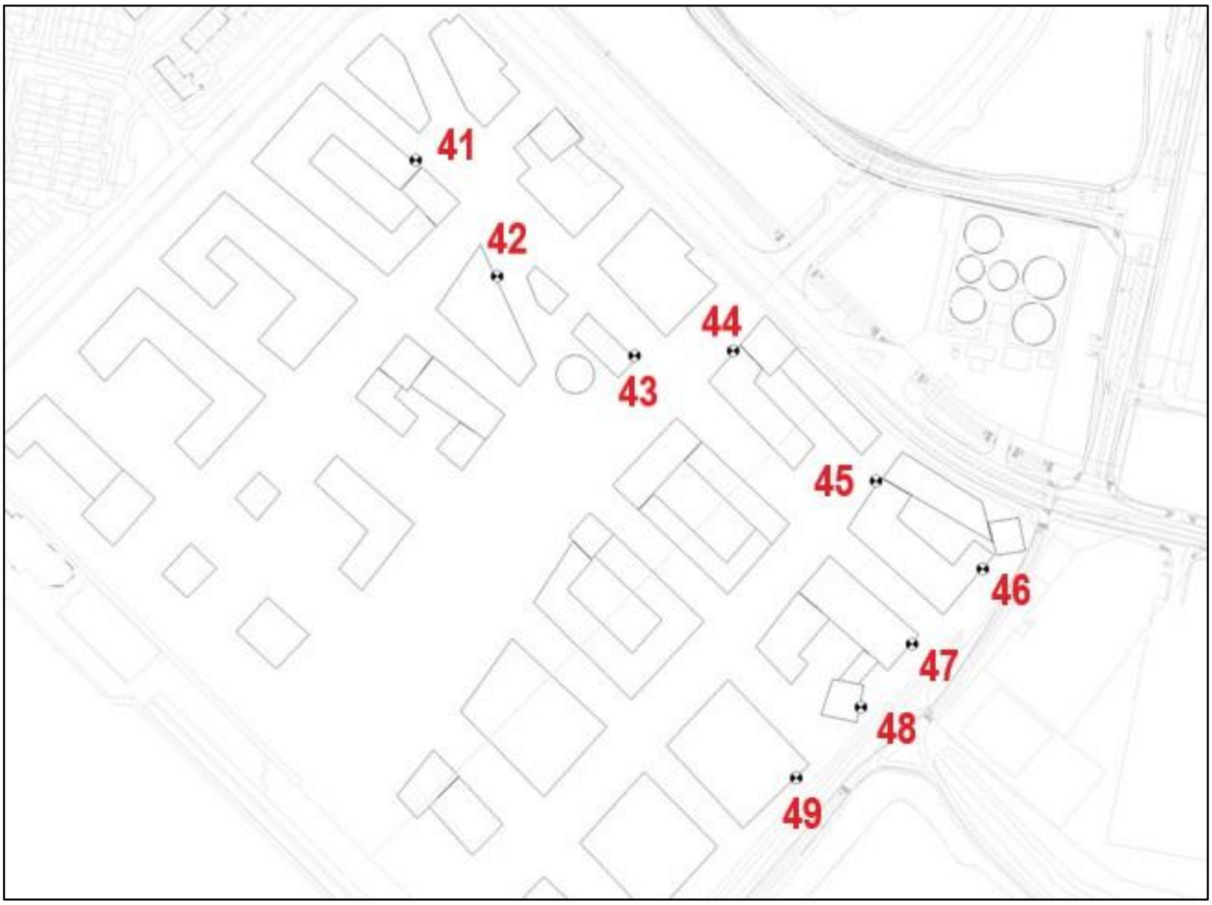


Figure 12.1.22 Nearest Noise Sensitive Receptors Modelled (Part 3 – Glass Bottle Site)

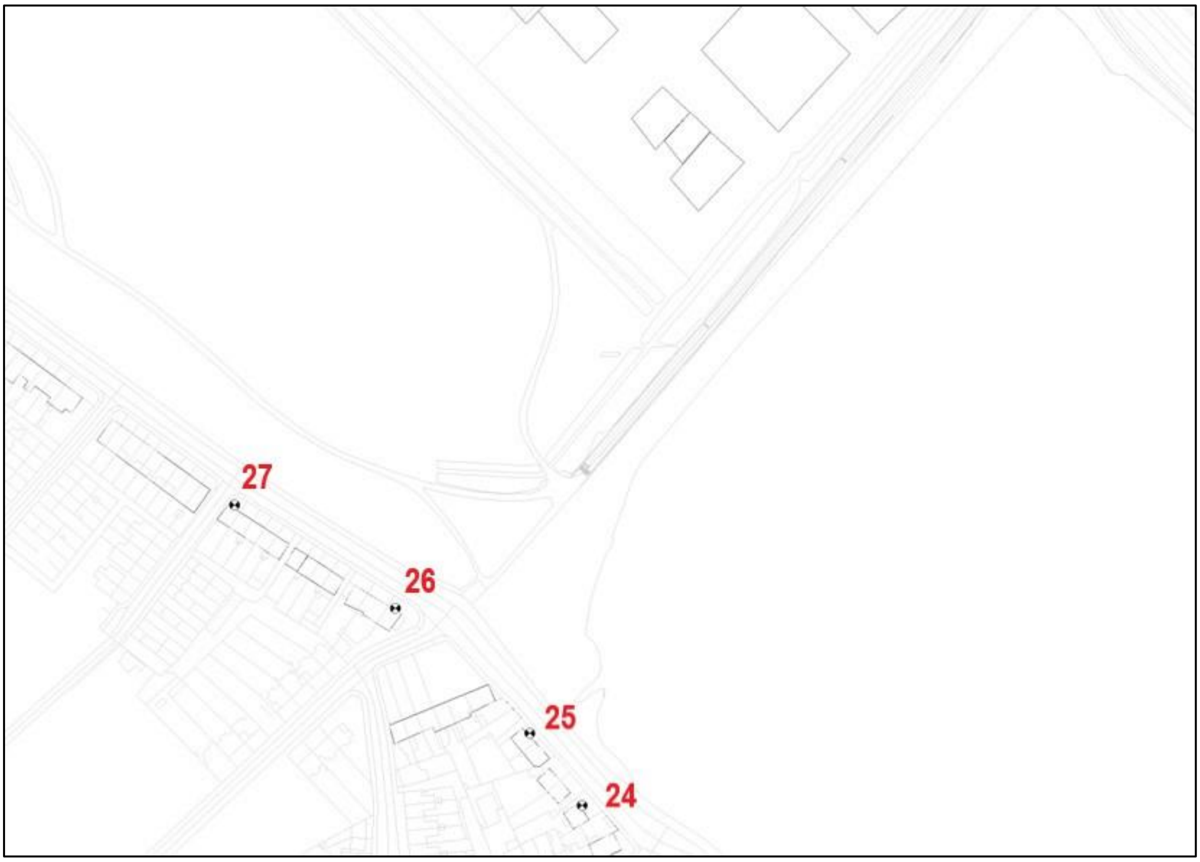


Figure 12.1.23 Nearest Noise Sensitive Receptors Modelled (Part 4 - Sandymount)

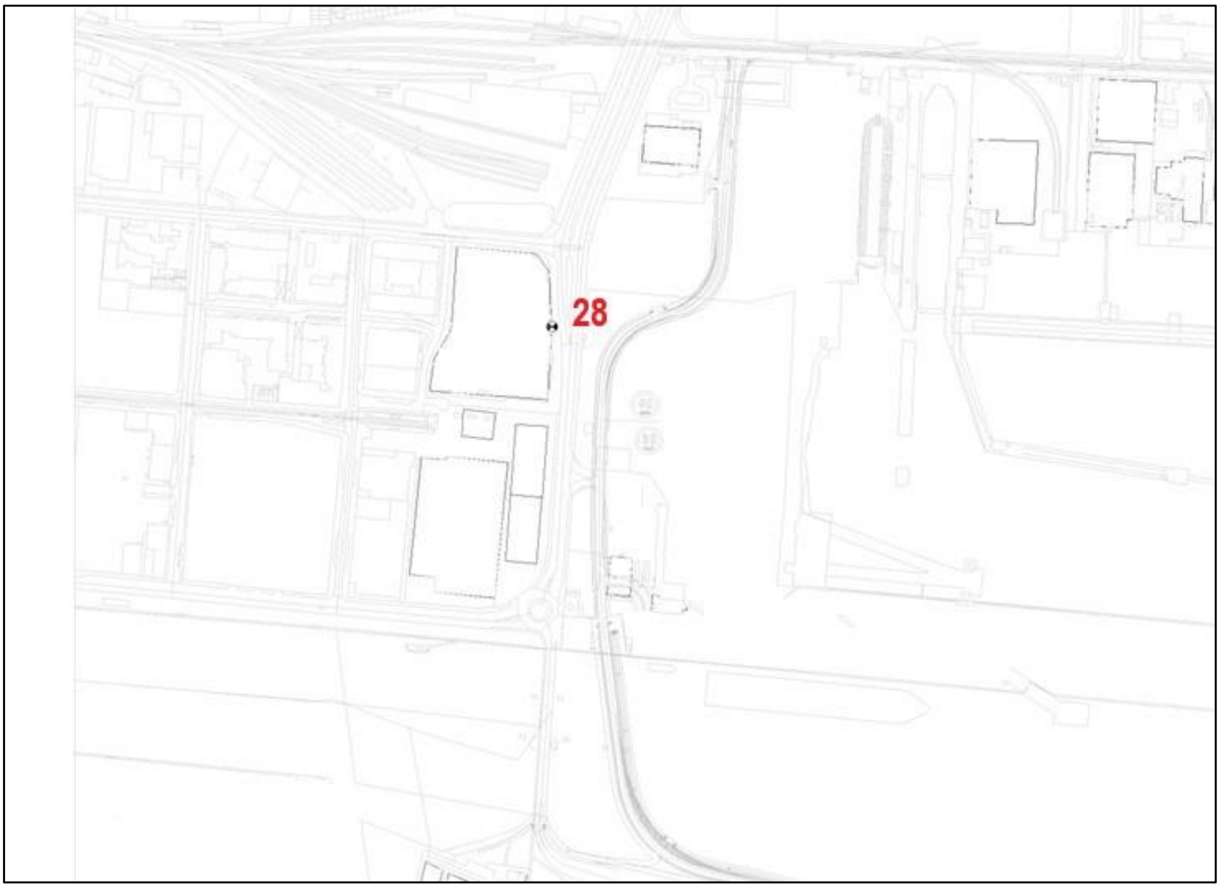


Figure 12.1.24 Nearest Noise Sensitive Receptors Modelled (Part 5 – West of Port)

Figure 12.1.25 Nearest Noise Sensitive Receptors Modelled (Part 6 – Clontarf)

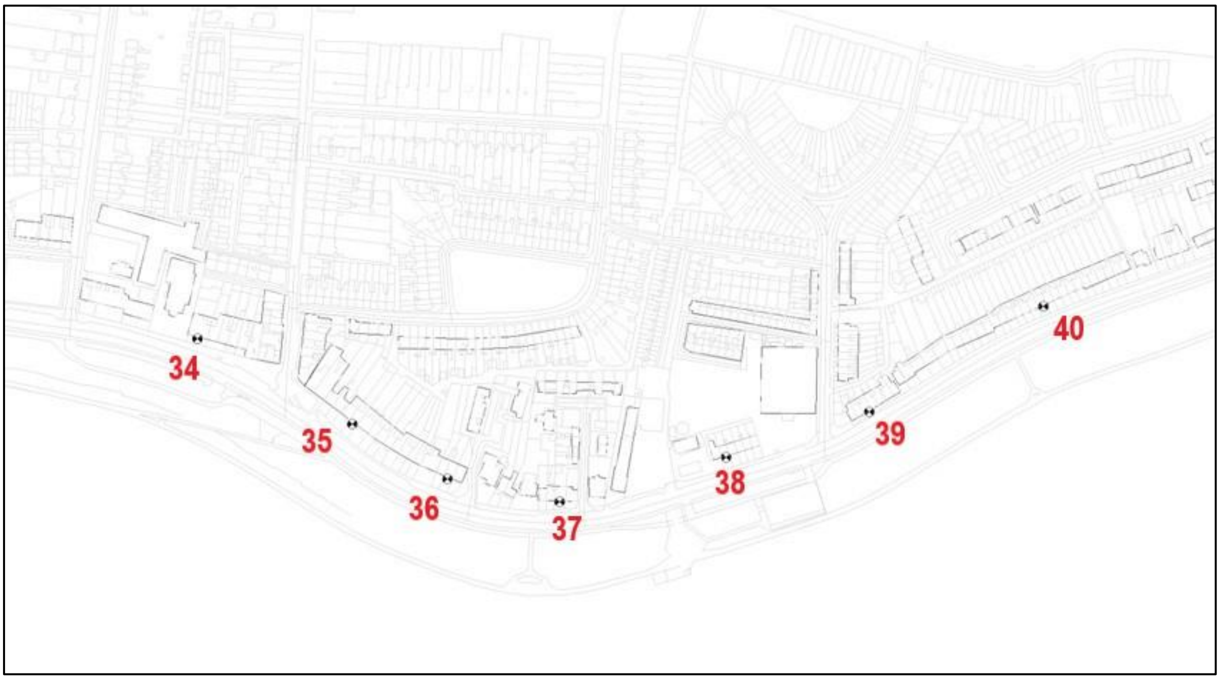


Figure 12.1.26 Nearest Noise Sensitive Receptors Modelled (Part 7 – Clontarf)

Table 12.1.23 contains predicted noise levels derived from the noise model at the nearest noise sensitive properties.

Table 12.1.23 Predicted Noise from Operational Phase Plant/Equipment at Nearest Noise Sensitive Properties

Property Reference	**Predicted Operational Phase Noise dB(A)**
1	43.1
2	42.7
3	37.1
4	42.6
5	42.4
6	42.3
7	44.3
8	44.0
9	42.7
10	40.1
11	38.4
12	37.8
13	34.5
14	33.9
15	32.7
16	32.3
17	31.4
18	30.7
19	33.7
20	32.1
21	33.0
22	32.5
23	42.2
24	37.8
25	35.5
26	37.5
27	35.9
28	31.1
29	<20.0
30	<20.0
31	<20.0
32	<20.0
33	<20.0
34	25.9
35	38.7
36	38.4
37	39.1
38	38.5
39	39.2
40	38.6
41	41.5
42	42.0
43	42.4
44	42.2
45	42.0
46	43.1
47	42.5
48	42.5
49	41.1

Table 12.1.23 contains predicted noise levels from worst-case operational activities from the 3FM Project at the nearest noise sensitive properties to the proposed project. All predicted noise levels are below guideline limits included in the EPA NG4 guidance document for daytime (55dB L_{AeqT}), evening (50dB L_{AeqT}) and night-time (45 L_{AeqT}) periods. All predicted noise levels are below existing ambient noise levels (L_{Aeq}) in all areas and at or below existing background noise levels (L_{A90}) for all periods of day in all areas. On this basis, the noise impact is considered to be negligible/minor in all areas.

At the Glass Bottle site, there is very little activity currently taking place, which is reflected in the lower ambient and background noise levels. When the site is developed and occupied, ambient and background noise levels will increase when activity increases significantly in this area. This will further reduce any potential for plant/equipment noise impacts in this area.

12.1.5.7 Vibration Impact

The proposed project will not result in any vibration generating activities being placed in close proximity to any of the nearest vibration sensitive receptors in the study area. There will be no vibration impact associated with the operational phase of the proposed project.

12.1.6 Cumulative Noise Impact

This section contains an assessment of the potential for cumulative noise and vibration impacts associated with the 3FM Project in tandem with other planning applications which have planning permission approved or pending.

12.1.6.1 Construction Phase

The construction phase for the 3FM Project will extend over a period of approximately 15 years from the design and procurement phase through to overall completion. Within this period, the construction works will take place in different areas of the 3FM construction site, making it difficult to determine the likelihood of when construction works associated with the 3FM Project may be likely to take place in tandem with the construction of other sites that are currently subject to pending/granted planning permission.

Appendix 12.2 contains a summary of pending/granted planning applications in the general vicinity of Dublin Port. This summary is focussed on larger planning applications and omits smaller sites such as individual residential applications.

As detailed in Section 12.1.4, the proposed 3FM Project is not predicted to generate any significant construction phase noise impacts at properties in Clontarf. A review of pending/granted planning applications in the Clontarf area indicates no substantial planning applications likely to generate significant construction phase noise impacts in this area. Even in the event of a new substantive planning application being granted in the Clontarf area, the predicted construction noise levels from such an application in close proximity to properties in Clontarf will be so far in excess of the predicted construction noise levels from the 3FM Project (which will be < 50dB[A]) such that there will be no cumulative construction noise impact from such a planning application in tandem with the 3FM Project.

Similar to Clontarf, Section 12.1.4 indicates that predicted construction noise levels at the nearest properties in the Sandymount area (i.e. < 50 dB[A]) will be substantially below the noise threshold limits for construction noise as outlined in BS5228:2009+A1:2014. No substantive pending/granted planning applications are currently in the planning system in the vicinity of the nearest properties in Sandymount to the 3FM Project. Any new substantive planning application in the vicinity of these properties will generate construction noise levels far in excess of construction noise levels generated by the 3FM Project in this area. On this basis, there is no likelihood of a significant cumulative construction phase noise impact from the 3FM Project in tandem with any other project in this area.

West of Dublin Port, there are a number of substantial commercial/residential planning applications that are pending/granted. Most notable of these are planning applications DSDZ4208/23, DSDZ4304/23, and DSDZ4085/23. On account of the distance and substantial barrier effects between the 3FM Project construction works and the residential properties that are adjacent to these planning application sites, there will be no significant cumulative construction noise impact at these properties from the 3FM Project in tandem with these planning application sites.

Planning application DSDZ4100/23 relates to changes to the ground floor level elevations of the public house with ancillary restaurant at Capital Dock, Sir John Rogerson’s Quay. The nature of this planning application are such that they will not generate any significant construction noise impact at the properties most likely to be impacted by the 3FM Project. On this basis, there will be no significant cumulative construction phase noise impact from this planning application in tandem with the 3FM Project.

There are a number of planning applications within the Dublin Port area on the Poolbeg Peninsula, including 4057/23, 3417/23 and PWSDZ3074/23. These sites are a substantial distance from any of the nearest noise sensitive properties and will not generate any significant cumulative construction noise impact at any residential properties in tandem with the 3FM Project.

There are a number of planning applications associated with the Glass Bottle site that are in various stages of planning, including PWSDZ3207/22, PWSDZ3406/22, PWSDZ4058/22, PWSDZ4380/22, PWSDZ4341/23, and PWSDZ4276/23. A number of these planning applications will result in construction activity taking place adjacent to Sean Moore Road and in relative close proximity to the residential properties west of Sean Moore Road. The EIAR for these planning applications has addressed the potential construction noise impacts associated with these planning applications. The distance of the 3FM Project construction works to these properties is such that it will not result in an additional cumulative construction noise impact at these properties over and above will occur from the Glass Bottle planning application sites.

Section 12.1.4 demonstrates the potential for construction phase noise impacts from the 3FM Project at the nearest properties along York Road / Pigeon House Road / Coastguard Cottages. There are no significant planning application in the vicinity of these properties to generate any additional cumulative construction noise impact over and above what will be produced by the 3FM Project.

Section 12.1.6 details mitigation measures associated with the construction phase for the 3FM Project. The 3FM construction phase Noise & Vibration Management Plan (NVMP) will be an iterative document, which will include for ongoing consideration of future developments and the commencement of new construction processes on sites in the vicinity of the 3FM Project which have the potential to generate cumulative noise impacts.

12.1.6.2 Operational Phase

Section 12.1.5 contains a noise impact assessment of worst-case plant/equipment noise associated with the 3FM Project. As presented in Section 12.1.5, the predicted noise levels from the 3FM Project are below relevant guideline threshold limits and existing ambient (L_{Aeq}) / background (L_{A90}) in the majority of residential areas in the vicinity of the port.

This section contains a consideration of potential cumulative noise impacts associated with the 3FM Project during the operational phase in tandem with any pending/granted planning applications when/if they are operational. Appendix 12.2 contains a summary of pending/granted planning applications in the general vicinity of Dublin Port.

As detailed in Section 12.1.5, the proposed 3FM Project is not predicted to generate any significant operational phase noise impacts at properties in Clontarf. A review of pending/granted planning applications in the Clontarf area indicates no substantial planning applications likely to generate significant operational phase noise impacts in this area. On this basis, there will be no likelihood of a significant cumulative operational phase noise impact from the 3FM Project in tandem with any pending/granted planning applications in this area.

The proposed 3FM Project is not predicted to generate any significant operational phase noise impacts at properties in Sandymount. A review of pending/granted planning applications in the Sandymount area indicates no substantial planning applications likely to generate significant operational phase noise impacts in this area. On this basis, there will be no likelihood of a significant cumulative operational phase noise impact from the 3FM Project in tandem with any pending/granted planning applications in this area.

West of Dublin Port, there are a number of substantial commercial/residential planning applications that are pending/granted. Most notable of these are planning applications DSDZ4208/23, DSDZ4304/23, and DSDZ4085/23. On account of the significant distance and barrier effects between the 3FM operations and the residential adjacent to these planning applications, 3FM operational noise levels will be below existing ambient (L_{Aeq}) and background (L_{A90}) noise levels in this area. On this basis, there will be no significant cumulative operational phase noise impact at these properties from the 3FM Project in tandem with these planning application sites.

Planning application DSDZ4100/23 relates to changes to the ground floor level elevations of the public house with ancillary restaurant at Capital Dock, Sir John Rogerson's Quay. The 3FM Project will not generate any significant noise impact in this area and therefore, there will be no significant cumulative operational phase noise impact from this planning application in tandem with the 3FM Project.

There are a number of planning applications within the Dublin Port area on the Poolbeg Peninsula, including 4057/23, 3417/23 and PWSDZ3074/23. These sites are a substantial distance from any of the nearest noise sensitive properties and will not generate any significant operational noise impact at any residential properties in tandem with the 3FM Project.

There are a number of planning applications associated with the Glass Bottle site that are in various stages of planning, including PWSDZ3207/22, PWSDZ3406/22, PWSDZ4058/22, PWSDZ4380/22, PWSDZ4341/23, and PWSDZ4276/23. This are likely to be supplemented by additional future planning applications. Residential buildings within the Glass Bottle site nearest to the 3FM Project have been included within the noise impact assessment included in this chapter. Portions of the Glass Bottle site are located in relative close proximity to existing residential properties, particularly in the vicinity of Sean Moore Road. The potential operational phase noise impact from the Glass Bottle site has been assessed in the various planning applications associated with the site. The 3FM Project will not generate any significant noise impact at properties in the vicinity of Sean Moore Road or Beach Road and hence will not contribute to any cumulative operational phase noise impact in these areas. In addition, the Glass Bottle site will create substantial barrier effects between the 3FM operations and the properties in this area.

12.1.7 Mitigation Measures

12.1.7.1 Construction Phase – Noise

BS5228:2009+A1:2014

Section 12.1.4 contains an assessment of the noise impact associated with the construction phase of the proposed project at the nearest noise sensitive properties. The assessment of the worst-case predicted construction noise levels using the ABC Method (BS5228:2009+A1:2014) indicates that there is potential for worst-case construction noise levels to exceed the relevant noise threshold limits included in these guidance documents in the vicinity of Pigeon House Road / Coastguard Cottages.

It is proposed that a temporary 4m noise barrier is placed between the construction activities in this area and the nearest noise sensitive properties. Figures 12.1.27 and 12.1.28 illustrate the noise modelled contours with this barrier in place and Tables 12.1.24 and 12.1.25 illustrate worst-case construction noise levels at the nearest noise sensitive properties with this barrier in place. As indicated in Tables 12.1.24 / 12.1.25, the barrier reduces worst-case construction noise levels below the relevant BS5228 noise threshold limit with this barrier in place.

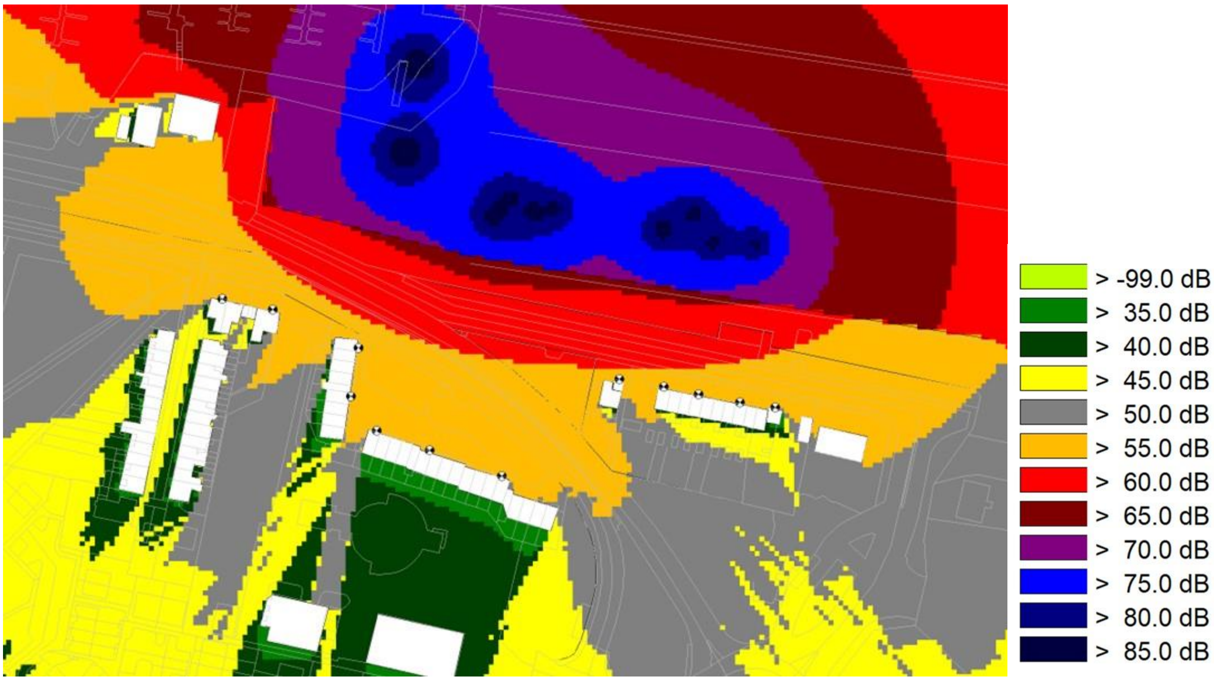


Figure 12.1.27 Noise Model of Worst-Case Construction Noise Levels During Year 4 at Pigeon House Road / Coastguard Cottages with Mitigation

Table 12.1.24 Worst-Case Prediction Noise Levels at Individual Properties Along Pigeon House Road / Coastguard Cottages with Mitigation

Receptor Reference (See Figure 12.1.12)	Worst-Case Predicted Noise Level in Year 4 dB(A) with Mitigation	Applicable BS5228 Noise Threshold Limit dB(A)
1	57.7	65
2	58.2	65
3	58.7	65
4	59.2	65
5	59.5	65
6	58.2	65
7	58.6	65
8	58.8	65
9	60.1	65
10	62.3	65
11	58.4	65
12	57.6	65
13	53.7	65

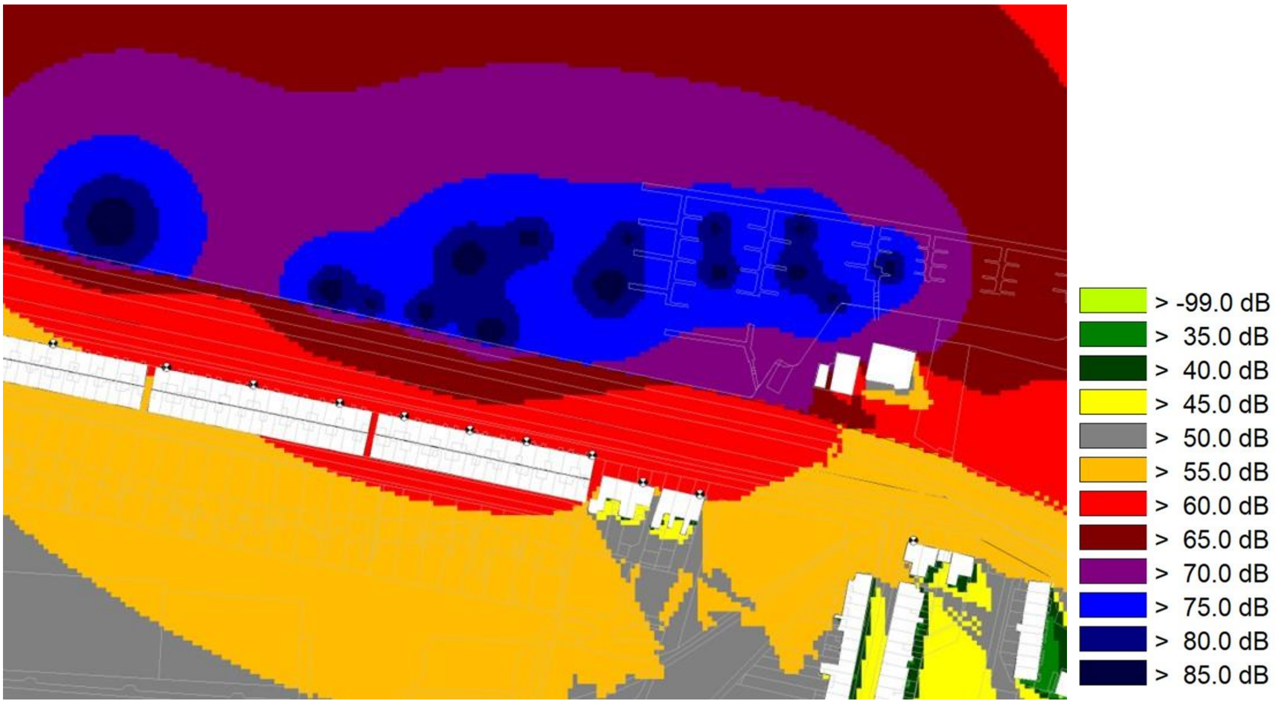


Figure 12.1.28 Noise Model of Construction Noise Levels During Year 6 at Pigeon House Road with Mitigation

Table 12.1.25 Worst-Case Prediction Noise Levels at Individual Properties Along Pigeon House Road with Mitigation

Receptor Reference (See Figure 12.1.14)	Worst-Case Predicted Noise Level in Year 6 dB(A)	Applicable BS5228 Noise Threshold Limit dB(A)
1	58.5	65
2	59.4	65
3	60.3	65
4	61.2	65
5	61.5	65
6	61.5	65
7	61.0	65
8	60.3	65
9	60.9	65
10	60.3	65
11	56.0	65

British Standard BS5228:2009+A1:2014 – Noise and vibration control on construction and open sites: Part 1 - Noise outlines a range of measures that can be used to reduce the impact of construction phase noise on the nearest noise sensitive receptors. These measures should be applied by the contractor where appropriate during the construction phase of the proposed development. Examples of some of the best practice measures included in BS5228:2009+A1:2014 are listed below:

- ensuring that mechanical plant and equipment used for the purpose of the works are fitted with effective exhaust silencers and are maintained in good working order;
- careful selection of quiet plant and machinery to undertake the required work where available;
- all major compressors should be 'sound reduced' models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use;
- any ancillary pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers;
- machines in intermittent use should be shut down in the intervening periods between work;
- ancillary plant such as generators, compressors and pumps should be placed behind existing physical barriers, and the direction of noise emissions from plant including exhausts or engines should be placed away from sensitive locations, in order to cause minimum noise disturbance.
- Handling of all materials should take place in a manner which minimises noise emissions;
- Audible warning systems should be switched to the minimum setting required by the Health & Safety Authority;

A detailed Construction Environmental Management Plan (CEMP) will be prepared in advance of the construction and will detail all aspects of controlling noise emissions at the nearest noise sensitive properties to the 3FM Project. The CEMP will include various sub-plans which will address specific environmental disciplines, including a Noise & Vibration Management Plan (NVMP). The NVMP will be an iterative document, which will be updated on an ongoing basis and the requirement for temporary noise barriers to reflect the changing nature of the works will be recorded in the NVMP on an ongoing basis in consultation with DCC. The document will detail the requirements for compliance noise monitoring to be completed during each stage of the construction process. A complaints procedure should continue to be operated by the Contractor throughout the construction phase and all efforts should be made to address any noise issues at the nearest noise sensitive properties.

As outlined above, a temporary noise barrier is proposed to ensure the relevant BS5228:2009+A1:2014 noise threshold limit will not be exceeded in years 4-8 in the vicinity of Pigeon House Road / Coastguard Cottages. The NVMP will provide specific details on temporary noise barriers to be deployed in this area during this period and the monitoring requirements to ensure that the appropriate compliance noise monitoring is completed. As the works progress in different areas, the requirement for temporary noise barriers in this area will change to reflect the changing natures of the works.

Section 12.1.9 provides further details on aspects of noise and vibration monitoring which will be required during the construction phase for the 3FM Project.

DCC Air Quality Monitoring and Noise Control Unit's Good Practice Guide for Construction and Demolition

Section 12.1.4 includes the total risk assessment completed for the 3FM Project based on the details included within this guide. As stated in Section 12.1.4, the 3FM Project falls into the high risk category in the total risk assessment. Table 12.1.26 to Table 12.1.32 provides details of the good practice measures outlined in the guide for high risk projects. These measures only include the noise-related elements included within the guide.

Table 12.1.26 General considerations

General Considerations	
All site staff shall be briefed on noise mitigation measures and the application of best practicable means to be employed to control noise.	All sites
Good Quality site hoarding should be erected to maximise the reduction in noise levels.	Medium and high risk sites
The contact details of the contractor and site manager shall be displayed to the public, together with the permitted operating hours, including any special permissions given for out of hours work.	Medium and high risk sites
The site entrance shall be located to minimise disturbance to noise sensitive receptors.	Medium and high risk sites
Internal haul routes shall be maintained and steep gradients shall be avoided.	Medium and high risk sites
Material and plant loading and unloading shall only take place during normal working hours unless the requirement for extended hours is for traffic management (i.e. road closure) or health and reasons (application must be made to DCC a minimum of 4 days prior to proposed works).	All sites
Use rubber linings in chutes, dumpers and hoppers to reduce impact noise.	Medium and high risk sites
Minimise opening and shutting of gates through good coordination of deliveries and vehicle movements.	Medium and high risk sites

Table 12.1.27 General considerations

Plant	
Ensure that each item of plant and equipment complies with the noise limits quoted in the relevant European Commission Directive 2000/14/EC.	All sites
Fit all plant and equipment with appropriate mufflers or silencers of the type recommended by the manufacturer.	All sites
Use all plant and equipment only for the tasks for which it has been designed.	All Sites
Shut down all plant and equipment in intermittent use in the intervening periods between work or throttle down to a minimum.	All sites
Power all plant by mains electricity where possible rather than generators.	Medium and high risk sites
Maximise screening from existing features or structures and employ the use of partial or full enclosures for plant.	Medium and high risk sites
Locate movable plant away from noise sensitive receptors.	All sites

Table 12.1.28 Mitigation for vehicle activity

Vehicle Activity	
Ensure all vehicle movements (on site) occur within normal working hours. (Other than where extension of work requiring such movements has been granted in cases of required road closures or for health and safety reasons).	All sites
Plan deliveries and vehicle movements so that vehicles are not waiting or queuing on the public roads. If unavoidable engines should be turned off.	Medium and high risk sites
Minimise the opening and closing of the site access through good coordination of deliveries and vehicle movements.	Medium and high risk sites
Plan the site layout to ensure that reversing is kept to a minimum.	Medium and high risk sites
Where reversing is required use broadband reverse sirens or where it is safe to do so disengage all sirens and use banksmen.	Medium and high risk sites
Rubber/neoprene or similar non-metal lining material matting to line the inside of material transportation vehicles to avoid first drop high noise levels.	Medium and high risk sites

Table 12.1.29 Mitigation for demolition

Demolition Phase	
Employ the use of acoustic screening; this can include planning the demolition sequence to utilise screening afforded by buildings to be demolished.	Medium and high risk sites
If working out of hours for Health and Safety reasons (following approval by DCC) limit demolition activities to low level noise activity unless absolutely unavoidable.	All sites
Use low impact demolition methods such as non-percussive plant where practicable.	Medium and high risk sites
Use rotary drills and ‘bursters’ activated by hydraulic or electrical power or chemically based expansion compounds to facilitate fragmentation and excavation of hard material.	High risk sites
Avoid the transfer of noise and vibration from demolition activities to adjoining occupied buildings through cutting any vibration transmission path or by structural separation of buildings.	Medium and high risk sites
Consider the removal of larger sections by lifting them out and breaking them down either in an area away from sensitive receptors or off site.	High risk sites

Table 12.1.30 Mitigation for ground works and piling

Ground Works and Piling Phase	
The following hierarchy of groundwork/piling methods should be used if ground conditions, design and safety allows: • Pressed in methods, e.g., hydraulic jacking • Auger/bored piling; • Diaphragm walling; • Vibratory piling or vibro-replacement; • Driven Piling or dynamic consolidation.	Medium and high risk sites
The location and layout of the piling plant should be designed to minimise potential noise impact of generators and motors.	Medium and high risk sites
Where impact piling is the only option utilise a non-metallic dolly between the hammer and driving helmet or enclose the hammer and helmet with an acoustic shroud.	Medium and high risk sites
Consider concrete pour sizes and pump locations. Plan the start of concrete pours as early as possible to avoid overruns.	Medium and high risk sites
Where obstructions are encountered, work should be stopped and a review undertaken to ensure that work methods that minimise noise are used.	Medium and high risk sites
When using an auger piling rig do not dislodge material from the auger by rotating it back and forth. Use alternate methods where safe to do so.	Medium and high risk sites
Prepare pile caps using methods which minimise the use of breakers, e.g., use hydraulic splitters to crack the top of the pile.	Medium and high risk sites

Table 12.1.31 Monitoring

Monitoring	
Establish pre-existing levels of ambient noise by baseline monitoring or use of the noise maps.	Medium and high risk sites
Carry out regular on-site observation monitoring and checks/audits to ensure that BPM is being used at all times. Such checks shall include; • Hours of work • Presence of mitigation measures • Number and type of plant • Construction methods • Site reviews must be recorded and made available for inspection.	High risk sites
Monitor noise and vibration continuously during demolition, piling, excavation and sub and superstructure works at agreed locations and report to DCC at agreed intervals and in an agreed format. To comply with this the following must take place. The monitoring locations for existing sites as agreed with officers of DCC must remain in situ. If additional monitoring is required this will be provided and the new locations will be agreed with DCC. For all new sites the monitoring locations must be agreed with DCC. The results of the monitoring must be forwarded to officers of the Air Quality Monitoring and Noise Control Unit every two weeks in the following format: Provide the construction noise level as defined in British Standard 5228 and the peak particle velocity readings for the hours of operation of the site. This will include the construction noise level for any overtime period worked outside of normal working hours. Provide a report detailing and discussing the noise and vibration levels over the reporting period. If a breach is recorded the follow up action that took place to prevent any further breaches must be included in the report. This information must be provided in electronic format. If results are required owing to complaints the results will be provided as soon as possible by the contractor to DCC.	High risk sites
Appraise and review working methods, processes and procedures on a regular basis to ensure continuous development of BPM	Medium and high risk sites
The 'ABC' Method detailed in Paragraph E.3.2 of BS 5228-1:2009 shall be used to determine acceptable noise levels for day, evening and night time work.	Medium and high risk sites
Vibration levels must be kept below 1.0 mm/sec (PPV) where possible. Where levels are expected to exceed this value residents must be warned and an explanation given.	Medium and high risk sites
Contact details for the site manager and liaison officer should be displayed prominently on the site hoarding.	Medium and high risk sites
All staff should be briefed on the complaints procedure and the mitigation requirement and their responsibilities to register and escalate complaints received.	Medium and high risk sites
Send regular updates at appropriate intervals to all identified affected neighbours/ businesses via a newsletter and post relevant information on the site hoarding. Also make the information available via email/website including weekly noise monitoring reports.	Medium and high risk sites
Arrange regular community liaison meetings at appropriate intervals including prior to commencement of the project.	High risk sites
Meet regularly with neighbouring construction sites to ensure activities are coordinated to minimise any potential cumulative issues.	High risk sites

Table 12.1.32 Working hours

Extensions of Working Hours (in Exceptional Circumstances)	
Ensure at least 4 days notice is given to DCC Planning Department when applying for extensions to normal working hours. Do not undertake out of hours work unless permission to do so has been granted.	All sites
The applicant must demonstrate in writing that the works required cannot be carried out during normal working hours. The documentation sent in must be accompanied by a detailed engineering or/and traffic management or/and safety case as to why the works are required outside normal hours. Power floating after 6pm is the only activity that will be permitted during the extensions where they relate to required large concrete pours. All reasonable and appropriate measures to minimise noise associated with these works must be put in place and no works other than those approved may be carried out during extended working hours. The Developer/his agent must give the times and dates of the proposed work, and the mitigation measures that are to be used to minimise noise/disturbance	All sites
Advise neighbours about requirement for and duration of any permitted works outside of normal working hours, and associated environmental mitigation measures being put in place during the course of the extended works, following receipt of approval from DCC	All sites
All complaints will be referred directly to the site liaison person and a reply must issue to the complaint within 3 hours of receipt of the complaint.	All sites
A log of all complaints and a summary of how they were dealt with should be kept and be made available to DCC, as required.	All sites
Any breaches of permitted working hours or permitted extended working hours or developers or subcontractors not carrying out their requirements under this protocol may lead to enforcement action and may also result in the withdrawal of any extension of hours of works for a period that will be at the discretion of DCC.	All sites

12.1.7.2 Operational Phase – Noise

SPAR

Section 12.1.5.1 includes the impact assessment of the SPAR in accordance with the NRA Guidelines for treatment of noise and vibration in national road schemes. Table 12.1.33 presents noise model outputs for the nearest noise sensitive receptors to the proposed SPAR for scenarios with and without the proposed SPAR (i.e. Do Nothing 2040 v Do Something 2040). The noise model outputs indicated that there is a requirement for mitigation measures on the basis of the three conditions for mitigation measures included with the NRA Guidelines.

On the basis of the assessment included in Section 12.1.5.1, a further detailed noise model was prepared which included proposed mitigation measures in the form of a noise barrier in the vicinity of Coastguard Cottages (4m acoustic barrier) and between the SPAR.

Figure 12.1.29 illustrates the location of the proposed noise barrier for the SPAR. In addition to the noise barrier, it is proposed that a low noise road surface (LNRS) is used on the SPAR from its crossing point on the River Liffey to the T-Junction with Pigeon House Road. The extent of LNRS is illustrated in Figure 12.1.30 and Figure 12.1.31 Such a road surface will provide a minimum 3dB(A) additional noise reduction on noise levels generated on the SPAR. Table 12.1.33 provides updates noise model outputs for the Do Something scenario with mitigation measures in place, illustrating that the proposed SPAR will not generate any significant impact at the nearest noise sensitive properties when compared with the Do Nothing scenario.

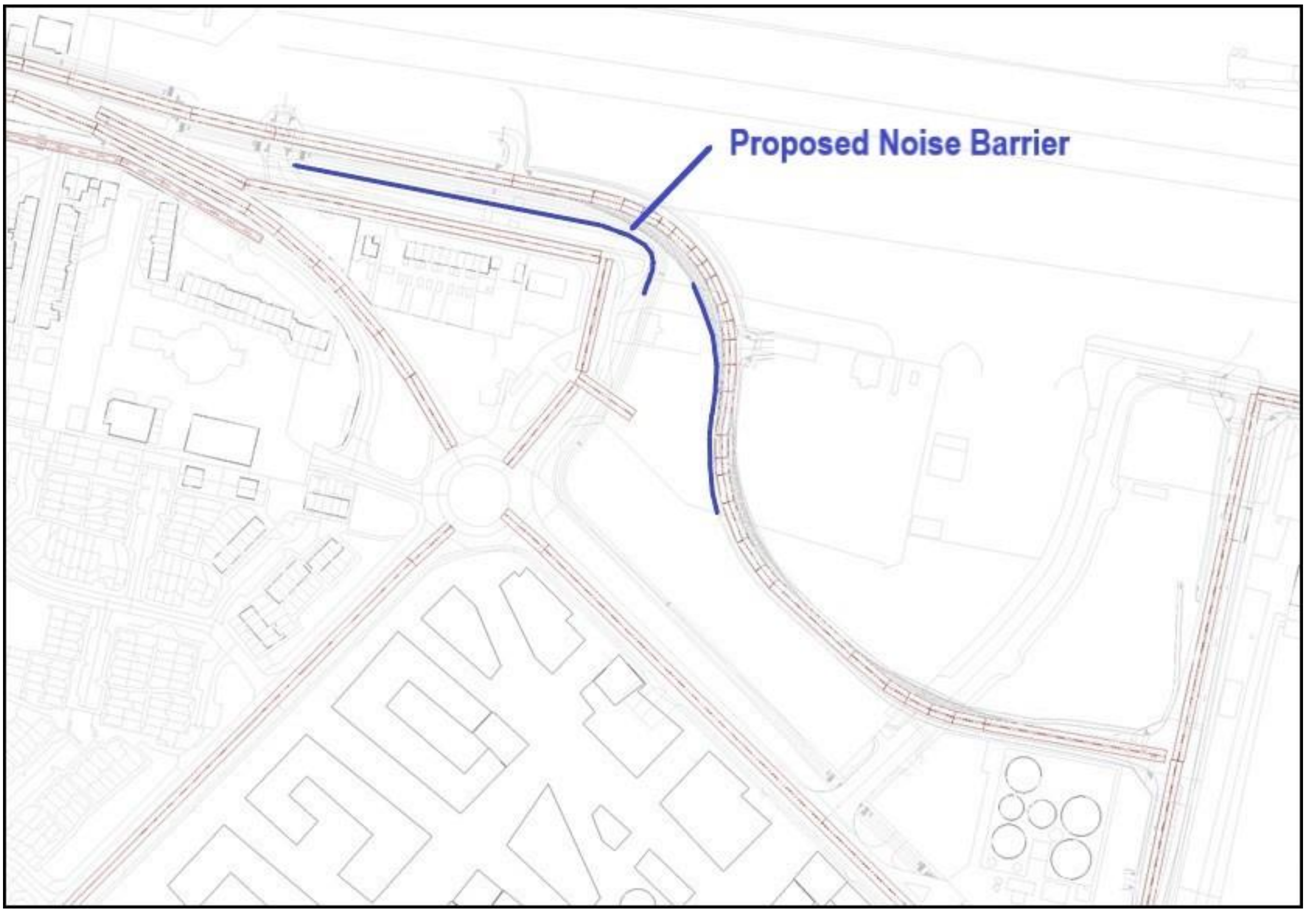


Figure 12.1.29 Proposed Noise Barrier Adjacent to Coastguard Cottages

Figure 12.1.30 Proposed LNRS Along SPAR (Part 1)

Figure 12.1.31 Proposed LNRS Along SPAR (Part 2)

Table 12.1.33 Noise Model Outputs for the SPAR with Mitigation Measures in Place

Receptor Number	Address [Height modelled]	Modelled Scenarios (Lden) dB(A)		
		Do nothing 2040	Do Something (R131 + SPAR) 2040	Do Something (R131 + SPAR) With Mitigation 2040
1	York Road (1) [9m]	67.1	64.6	63.6
2	York Road (2) [9m]	67.5	65.1	64.1
3	York Road (3) [4m]	67.8	65.6	64.5
4	York Road (4) [9m]	67.9	66.1	64.9
5	1 Pigeon House Road [1.5m]	66.4	65.1	63.9
6	12 Pigeon House Road [1.5m]	66.6	65.3	64.1
7	19 Pigeon House Road [1.5m]	66.6	65.3	64.1
8	24 Pigeon House Road [1.5m]	66.6	65.3	64.1
9	30 Pigeon House Road [1.5m]	66.7	65.4	64.2
10	37 Pigeon House Road [1.5m]	66.8	65.4	64.2
11	44 Pigeon House Road [1.5m]	66.8	65.5	64.3
12	46 Pigeon House Road [4m]	66.8	65.7	64.4
13	51 Pigeon House Road [4m]	67.4	66.3	65.0
14	64 Pigeon House Road [4m]	69.1	67.2	66.1
15	Poolbeg Quay Apartments (1) [11.5m]	67.4	65.0	64.0
16	Poolbeg Quay Apartments (2) [11.5m]	67.8	64.4	63.7
17	Poolbeg Quay Apartments (3) [11.5m]	68.5	64.7	64.2
18	70 Pigeon House Road [4m]	60.8	61.0	59.1
19	71 Pigeon House Road [4m]	59.3	60.4	58.1
20	76 Pigeon House Road [4m]	58.5	59.9	57.6
21	79 Pigeon House Road [4m]	58.4	59.1	57.2
22	80 Pigeon House Road (1) [4m]	58.6	60.4	57.3
23	80 Pigeon House Road (2) [5m]	60.0	60.4	57.1
24	13 Leukos Road [4m]	65.6	65.4	65.2
25	Glass Bottle Residential (1) [16m]	54.8	55.0	54.2
26	Glass Bottle Residential (2) [16m]	54.7	52.4	51.8
27	Glass Bottle Residential (3) [16m]	53.6	54.5	53.6
28	Glass Bottle Residential (4) [16m]	62.0	60.8	59.6
29	Glass Bottle Residential (5) [16m]	56.1	57.0	56.5
30	Glass Bottle Residential (6) [16m]	52.1	56.1	56.1
31	Glass Bottle Residential (7) [16m]	50.5	54.7	54.6
32	Glass Bottle Residential (8) [16m]	49.0	53.6	53.6
33	Glass Bottle Residential (9) [16m]	47.2	52.0	51.9

With the proposed mitigation measures in place, the noise impact associated with the SPAR will be reduced to minor adverse to moderate beneficial at the nearest noise sensitive properties.

Plant/Equipment Noise

Section 12.1.5.4 contains an assessment of operational phase plant/equipment noise associated with the 3FM Project. The assessment has been completed on the basis of all areas operating at full capacity and all plant operating simultaneously.

Table 12.1.30 contains predicted noise levels from worst-case operational activities from the 3FM Project at the nearest noise sensitive properties to the proposed project. As stated in Section 12.1.5.6, all predicted noise levels are below existing ambient noise levels (L_{Aeq}) and background noise levels (L_{A90}) for all periods of day in all areas.

The assessment in Section 12.1.5 includes a level of electrification of plant/vehicles that is currently available and in use in the UK and globally for port-related plant/vehicles. There has been significant improvement on a global level in the area of port plant electrification, including the application automation and sensors for reducing noise associated with stacking activity. On the basis of the significant improvement in reducing noise from such activity that has taken place in recent years, it would be anticipated that there will be further improvements in reducing noise from port-related plant and vehicles in the years between now and when the proposed 3FM Project will be operational in 2040. Such improvements in port-related plant/vehicles are over and above anything assumed or incorporated into this noise impact assessment.

12.1.7.3 Vibration

As outlined in section 12.1.4.4, the construction phase of the proposed project is not likely to result in any significant vibration impacts at the nearest sensitive receptors. Section 12.1.5.4 clarified how there will be no operational phase activities likely to give rise to vibration impacts at any of the nearest sensitive receptors.

BS5228:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and open Sites - Part 2: Vibration includes a range of measures for the reduction of vibration associated with piling activities and for general surface-based activities. The contractor will adhere to the mitigation measures included in BS5228:2009+A1:2014 where practicable to reduce vibration levels from general and piling activities to the lowest possible levels.

As a precautionary measure, it is recommended that vibration monitoring is conducted at the nearest properties on Pigeon House Road to the proposed piling works for the SPAR as a verification measure to ensure that no unusual sub-strata features generate unanticipated vibration effects at these properties.

12.1.8 Residual Impact

Sections 12.1.4 and 12.1.5 contain detailed noise impact assessments for the construction and operational phases of the proposed 3FM Project. These assessments indicate that there is potential for significant adverse noise impacts in particular locations without mitigation measures in place.

Section 12.1.7 provides details on specific noise mitigation measures to be applied during the construction and operational phases. With the proposed mitigation measures in place, all residual noise impacts associated with the 3FM Project will be reduced to minor adverse or lower.

12.1.9 Monitoring

Annex IV of Directive 2014/52/EU (Part 7) states that the information requirements under Article 5(1) of the Directive include “a description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements (for example the preparation of a post-project analysis). That description should explain the extent to which significant adverse effects on the environment are avoided, prevented, reduced or offset, and should cover both the construction and operational phases.”

Section 8.2 of the EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (2022) provides specific commentary on the monitoring requirements under the Directive. This section highlights the role of monitoring in ensuring that the project in practice conforms to the predictions made during the EIA and in demonstrating that the proposal operates as intended.

The guidance also cautions against excessive reliance on monitoring on the basis that this may lead to operational changes that fall outside the scope of the project that was subject to scrutiny during the consent process. It is also states that monitoring post consent should not be used to allow the deferral of the gathering of information that is necessary for the assessment/consent.

The guidelines highlight the importance of ensuring that monitoring is described within the context of the operation of the project processes. On this basis, monitoring descriptions should refer to remedial actions to be taken, responsible parties and should be expressed as ‘if-then’ scenarios.

12.1.9.1 Construction Phase

Section 12.1.4 includes the noise impact assessment during the construction phase of the 3FM Project. This assessment highlighted the potential for the relevant BS5228:2009+A1:2014 noise threshold limit to be exceeded by the construction works in the vicinity of noise sensitive properties at Pigeon House Road/York Road and Coastguard Cottages. Mitigation measures are included in Section 12.1.7 to ensure these noise threshold limits are not exceeded.

The noise predictions included in Section 12.1.4 are worst-case assumptions of plant/equipment active simultaneously at any one area of construction works. In practice, construction plant/equipment activity will vary continuously throughout the construction works in this area.

As construction activities in the area of Pigeon House Road / Coastguard Cottages will vary in different areas at different times, the properties most likely to be impacted by construction noise will alter on the basis of these changes to the construction works.

There will be a requirement for continuous noise monitoring to be completed in the vicinity of the properties on York Road / Pigeon House Road / Coastguard Cottages during the construction phase. The exact noise monitoring location will change throughout the construction process to be representative of the nearest properties to the proposed works at that particular stage of the works in this area.

The initial noise monitoring location will be agreed in advance of the commencement of the construction phase in consultation with Dublin City Council (DCC). This noise monitoring location will be detailed within the Noise & Vibration Management Plan (NVMP) as part of the Construction Environmental Management Plan (CEMP). The NVMP will remain an iterative live document throughout the construction process and as the works move to different areas in the vicinity of York Road / Pigeon House Road / Coastguard Cottages, the noise monitoring location will remain under review. As the requirement to alter the noise monitoring location becomes apparent on the basis of work changes in this area, a new representative location will be determined and agreed in consultation with DCC.

As part of the NVMP, all granted/pending/new planning applications will remain under review so that the requirement for noise monitoring for the 3FM Project is continuously reviewed where any new construction activities are likely to take place in relative close proximity to properties in the vicinity of the 3FM Project. Any review of noise monitoring requirements associated with potential cumulative construction noise impacts will be completed in consultation with Dublin City Council (DCC).

As detailed in Section 12.1.6, it is recommended that vibration monitoring is conducted at the nearest properties on Pigeon House Road to the proposed piling works for the SPAR as a verification measure to ensure that no unusual sub-strata features generate unanticipated vibration effects at these properties.

Any vibration monitoring locations will be agreed in advance of the commencement of the construction phase in consultation with Dublin City Council (DCC). This vibration monitoring location will be detailed within the Noise & Vibration Management Plan (NVMP) as part of the Construction Environmental Management Plan (CEMP).

12.1.9.2 Operational Phase

Section 12.1.5 presents the assessment of operational noise from the proposed 3FM Project. Section 12.1.7 presents mitigation measures to be included within the proposed 3FM Project to ensure that there are no significant noise impacts at the nearest noise sensitive properties.

As stated in Section 8.2 of the EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (2022), noise monitoring must be completed to ensure that the project in practice conforms to the predictions made during the EIA and in demonstrating that the proposal operates as intended.

In order to ensure that the noise predictions and the proposed mitigation measures included in the EIAR accurately reflect a worst-case scenario for the operating scheme, it is proposed that a programme of noise monitoring is undertaken when the 3FM Project is operational.

12.1.10 Conclusion

This chapter contains a detailed terrestrial noise and vibration impact assessment for the proposed 3FM Project. The assessment has been completed for the construction and operational phases of the proposed project and has been completed with reference to a range of relevant noise and vibration guidance documents.

Detailed noise monitoring surveys were completed at various locations in the general vicinity of Dublin Port in order to characterise the existing noise environment at various noise sensitive properties in the vicinity of the port. These surveys provided context for the purposes of completing the impact assessment.

Without mitigation measures in place, there is potential for noise and vibration impacts during construction and operational phases at the most sensitive properties in the vicinity of the port. A range of mitigation measures have been included within this chapter in order to ensure that there will be no significant noise or vibration impact associated with the 3FM Project.

Appendix 12.1

Noise Survey Data for Noise Monitoring A-NML1

Noise Monitoring A-NML1 (Coastguard Cottages) – Daytime – 1st June 2023

Map of Noise Monitoring Location	Photo of Noise Monitoring Location
	

Time	Measured Noise Levels dB(A)				
	L_{Aeq}	L_{AMax}	L_{AMin}	L_{A10}	L_{A90}
09:32 – 09:47	58.9	77.6	51.4	60.4	54.5
09:47 – 10:02	58.7	75.7	52.3	61.1	54.6
10:02 – 10:17	59.2	74.8	53.2	61.1	54.7
10:17 – 10:32	59.5	81.9	52.3	58.3	53.3
10:32 – 10:47	56.4	73.8	50.1	58.1	52.1
10:47 – 11:02	58.6	77.8	50.6	56.6	51.7
11:02 – 11:17	58.1	75.4	49.8	60.1	52.7
11:17 – 11:32	57.4	77.0	49.9	58.5	51.0
11:32 – 11:47	57.8	72.6	51.0	60.3	53.7
11:47 – 12:02	62.3	79.1	51.0	64.9	53.5
12:02 – 12:17	60.1	77.0	52.1	60.8	54.8
12:17 – 12:32	59.7	79.4	51.5	61.2	54.1
12:32 – 12:47	59.0	75.6	51.7	60.2	54.4
12:47 – 13:02	58.1	73.6	53.0	60.2	54.4
13:02 – 13:17	59.1	75.4	51.1	61.3	53.3
13:17 – 13:32	60.8	77.6	51.6	61.8	54.2
13:32 – 13:47	59.6	78.8	51.9	61.8	54.1
13:47 – 14:02	59.3	74.9	51.0	61.2	53.1
14:02 – 14:17	59.3	77.5	51.2	61.0	53.3
14:17 – 14:32	59.1	75.5	51.3	60.7	54.4

14:32 – 14:47	59.3	75.7	53.7	61.5	55.6
14:47 – 15:02	57.8	69.6	52.1	60.7	54.0
15:02 – 15:17	56.3	73.7	51.0	57.5	53.0
15:17 – 15:32	57.6	72.8	51.8	59.2	53.6
15:32 – 15:47	58.1	74.6	51.3	59.7	53.4

L_{Aeq} Range – 56.3 – 62.3

L_{A90} Range – 51.0 – 55.6

Survey Notes:

MTL / Port noise dominant (an array of plant noise, clacks/bangs, air release, beacons, tonal/impulsive elements). Road traffic noise sporadic along Pigeon House Road / Coastguard Cottages. Rare helicopter movement. Human activity. Bird noise.

Noise Monitoring A-NML1 (Coastguard Cottages) – Evening-time – 15th June 2023

Map of Noise Monitoring Location

Photo of Noise Monitoring Location

Time	Measured Noise Levels dB(A)				
	L_{Aeq}	L_{AMax}	L_{AMin}	L_{A10}	L_{A90}
19:04 – 19:19	54.5	76.4	48.3	53.6	49.7
19:19 – 19:34	56.0	73.7	49.5	57.5	51.0
19:34 – 19:49	56.4	78.4	49.7	56.6	50.8
19:49 – 20:04	56.7	76.4	48.9	57.7	51.0

20:04 – 20:19	59.2	77.8	51.0	60.6	53.5
20:19 – 20:34	59.5	78.4	51.2	61.0	53.9
20:34 – 20:49	58.1	74.4	51.3	59.9	54.1
20:49 – 21:04	58.1	77.4	49.9	60.2	52.0
21:04 – 21:19	57.6	72.0	50.5	60.2	52.4
21:19 – 21:34	55.6	65.5	49.4	58.4	51.6
21:34 – 21:49	55.2	71.1	49.2	57.1	51.9
21:49 – 22:04	55.2	75.6	48.6	56.8	50.4
22:04 – 22:19	53.3	75.1	48.3	51.8	49.3
22:19 – 22:34	51.8	72.5	48.4	52.1	49.4
22:34 – 22:49	53.5	64.6	49.6	55.8	51.0

L_{Aeq} Range – 51.8 – 59.5

L_{A90} Range – 49.3 – 54.1

Survey Notes:

MTL / Port noise dominant (an array of plant noise, clacks/bangs, air release, beacons, crane movements, tonal/impulsive elements). Road traffic noise sporadic along Pigeon House Road / Coastguard Cottages very sporadic.

Noise Monitoring A-NML1 (Coastguard Cottages) – Night-time – 31st May – 1st June 2023

Map of Noise Monitoring Location

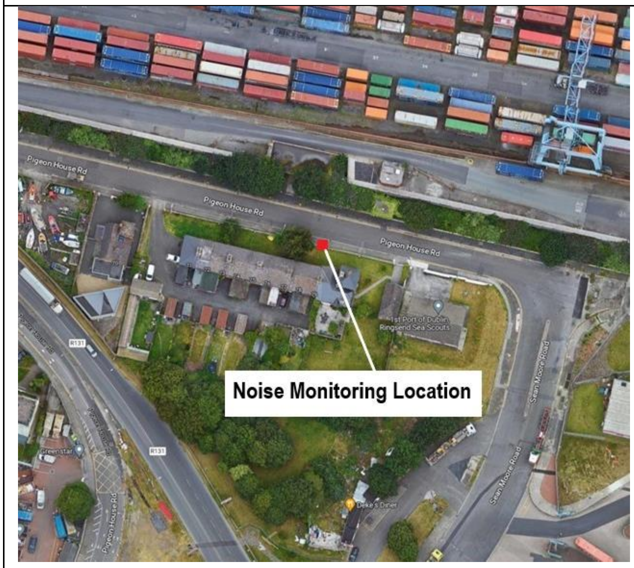


Photo of Noise Monitoring Location

	Measured Noise Levels dB(A)				

Time	L_{Aeq}	L_{AMax}	L_{AMin}	L_{A10}	L_{A90}
23:02 – 23:17	51.0	74.3	45.3	48.6	46.5
23:17 – 23:32	48.0	57.6	45.9	48.7	46.9
23:32 – 23:47	48.1	58.6	45.7	48.8	47.0
23:47 – 00:02	49.1	62.3	46.5	49.8	47.7
00:02 – 00:17	49.6	59.4	46.9	50.6	48.3
00:17 – 00:32	49.6	60.5	41.7	50.7	48.2
00:32 – 00:47	49.2	63.9	46.8	50.1	47.9
00:47 – 01:02	49.3	57.7	46.6	50.3	48.1
01:02 – 01:17	49.1	57.6	46.5	50.1	47.9
01:17 – 01:32	50.2	65.3	46.8	51.8	48.0
01:32 – 01:47	50.3	61.4	46.9	52.5	48.0
01:47 – 02:02	49.0	59.4	46.6	50.0	47.7
02:02 – 02:17	48.5	55.6	46.2	49.4	47.5
02:17 – 02:32	56.9	81.0	46.8	51.5	48.3
02:32 – 02:47	49.5	54.3	47.3	50.4	48.5
02:47 – 03:02	49.0	61.1	46.7	49.8	47.8
03:02 – 03:17	47.6	58.6	44.7	48.7	46.0
03:17 – 03:32	48.8	73.0	43.8	48.0	45.1
03:32 – 03:47	57.7	84.7	44.3	50.5	45.7
03:47 – 04:02	51.4	65.5	45.1	53.0	49.3
04:02 – 04:17	52.6	62.1	46.7	55.2	49.3
04:17 – 04:32	55.7	73.5	49.1	57.5	51.7
04:32 – 04:47	57.5	71.2	48.7	60.1	52.4
04:47 – 05:02	54.6	69.4	48.2	56.9	50.0
05:02 – 05:17	55.4	67.6	45.6	58.0	48.0

L_{Aeq} Range – 47.6 – 57.7

L_{A90} Range – 45.1 – 52.4

Survey Notes:

MTL / Port noise dominant (an array of plant noise, clacks/bangs, air release, beacons, tonal/impulsive elements). Road traffic noise sporadic along Pigeon House Road / Coastguard Cottages very sporadic. Rare helicopter movement. Human activity.

Noise Survey Data for Noise Monitoring A-NML2

Noise Monitoring A-NML2 (Adjacent Glass Bottle Site) – Daytime – 25th May 2023	
Map of Noise Monitoring Location	**Photo of Noise Monitoring Location**

Time	Measured Noise Levels dB(A)				
	L_{Aeq}	L_{AMax}	L_{AMin}	L_{A10}	L_{A90}
09:25 – 09:40	51.7	64.5	45.4	54.1	47.3
09:40 – 09:55	50.8	66.9	45.3	52.8	47.3
09:55 – 10:10	52.1	63.6	45.2	54.7	47.7
10:10 – 10:25	53.7	69.9	45.2	56.5	47.8
10:25 – 10:40	58.5	73.4	46.3	60.4	48.6
10:40 – 10:55	55.9	70.0	46.9	57.2	50.8
10:55 – 11:10	48.3	61.9	43.8	50.2	45.6
11:10 – 11:25	48.1	72.7	42.9	48.9	44.5
11:25 – 11:40	48.0	63.1	41.9	50.2	43.8
11:40 – 11:55	45.6	60.3	42.3	47.1	43.7
11:55 – 12:10	48.9	63.0	42.1	51.8	43.8
12:10 – 12:25	46.7	60.1	41.8	48.8	43.5
12:25 – 12:40	48.0	62.8	42.1	49.6	43.8
12:40 – 12:55	48.4	66.6	43.3	50.6	44.9
12:55 – 13:10	48.3	62.6	43.0	50.1	44.8
13:10 – 13:25	49.4	66.4	43.5	51.3	45.2
13:25 – 13:40	48.5	65.4	42.1	50.6	44.4
13:40 – 13:55	48.0	66.7	41.9	49.1	43.6
13:55 – 14:10	46.0	58.7	41.3	47.8	43.2
14:10 – 14:25	47.6	65.4	41.5	48.9	43.5
14:25 – 14:40	49.2	63.1	41.5	52.6	43.6
14:40 – 14:55	46.5	61.1	40.6	48.3	43.1
14:55 – 15:10	47.6	66.1	41.5	49.7	43.2
15:10 – 15:25	48.4	68.2	40.5	48.9	42.1
15:25 – 15:40	50.1	69.9	40.6	49.2	42.3
15:40 – 15:55	47.8	60.6	41.0	50.6	42.6

L_{Aeq} Range – 46.0 – 58.5

L_{A90} Range – 42.1 – 50.8

Survey Notes:

Plant noise from port dominant, constant source from Covanta plant. Sporadic movements from HGVs on main road. Occasional movement into / off road close to meter. Occasional cars / human movements on / off road. Sporadic activity from excavator at glass bottle site.

Noise Monitoring A-NML2 (Adjacent Glass Bottle Site) – Evening-time – 19th June 2023

Map of Noise Monitoring Location

Photo of Noise Monitoring Location

Time	Measured Noise Levels dB(A)				
	L_{Aeq}	L_{AMax}	L_{AMin}	L_{A10}	L_{A90}
19:07 – 19:22	43.7	66.5	38.1	44.7	39.7
19:22 – 19:37	46.6	66.0	39.2	47.7	41.1
19:37 – 19:52	46.1	62.6	38.6	49.0	40.8
19:52 – 20:07	47.3	66.6	38.7	47.6	40.6
20:07 – 20:22	43.2	60.1	38.8	45.0	40.5
20:22 – 20:37	43.6	62.3	38.6	45.1	40.2
20:37 – 20:52	47.6	60.8	39.8	49.5	43.2
20:52 – 21:07	45.8	61.6	39.5	47.8	41.1
21:07 – 21:22	46.3	62.3	38.7	48.6	40.5
21:22 – 21:37	45.8	62.0	38.2	49.3	40.2

21:37 – 21:52	46.3	63.2	38.3	49.4	39.7
21:52 – 22:07	44.9	58.2	38.7	47.7	40.3
22:07 – 22:22	43.2	56.7	38.4	45.8	40.1
22:22 – 22:37	43.4	59.1	38.4	45.7	39.8

L_{Aeq} Range – 43.2 – 47.3

L_{A90} Range – 39.7 – 43.2

Survey Notes:

Plant/equipment noise from port. Sporadic/occasional traffic movements. Brief helicopter pass over. Birdsong. Car idling for short period.

Noise Monitoring A-NML2 (Adjacent Glass Bottle Site) – Night-time – 24-25th May 2023

Map of Noise Monitoring Location

Photo of Noise Monitoring Location

Time	Measured Noise Levels dB(A)				
	L_{Aeq}	L_{AMax}	L_{AMin}	L_{A10}	L_{A90}
23:04 – 23:19	43.7	57.8	39.8	44.9	41.5
23:19 – 23:34	43.1	59.0	38.8	44.6	41.0
23:34 – 23:49	42.9	52.7	39.1	44.3	41.3
23:49 – 00:04	43.6	52.4	40.2	45.1	41.9
00:04 – 00:19	43.5	52.1	40.2	45.1	41.6

00:19 – 00:34	46.2	64.4	41.0	47.7	43.1
00:34 – 00:49	53.0	78.8	41.6	49.5	43.3
00:49 – 01:04	45.3	58.6	41.4	47.0	43.1
01:04 – 01:19	45.3	56.8	41.5	46.7	43.5
01:19 – 01:34	45.1	53.9	41.5	46.4	43.6
01:34 – 01:49	45.3	54.8	42.5	46.6	43.8
01:49 – 02:04	55.0	74.3	42.1	52.8	44.1
02:04 – 02:19	45.1	55.2	42.1	46.3	43.6
02:19 – 02:34	45.5	57.5	42.0	46.8	43.7
02:34 – 02:49	46.9	64.4	41.7	49.1	43.8
02:49 – 03:04	46.3	59.8	42.2	47.8	44.1
03:04 – 03:19	46.7	60.0	42.5	48.1	44.3
03:19 – 03:34	46.4	56.7	42.2	47.8	44.3
03:34 – 03:49	46.2	59.4	42.1	47.6	44.0
03:49 – 04:04	46.7	59.1	42.3	48.1	44.4
04:04 – 04:19	46.4	61.0	41.8	48.2	44.1

L_{Aeq} Range – 42.9 – 55.0

Taking out outliers (43 – 47)

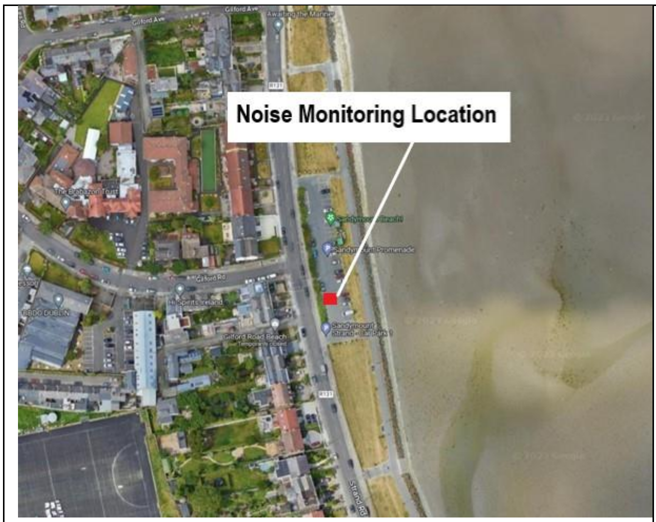
L_{A90} Range – 41.0 – 44.3

Survey Notes:

Existing port noise / Covanta plant/equipment noise. Isolated helicopter movement.

Noise Survey Data for Noise Monitoring A-NML3

Noise Monitoring A-NML3 (Sandymount) – Daytime – 8th June 2023	
Map of Noise Monitoring Location	**Photo of Noise Monitoring Location**



Time	Measured Noise Levels dB(A)				
	L_{Aeq}	L_{AMax}	L_{AMin}	L_{A10}	L_{A90}
09:27 – 09:42	64.3	78.5	49.4	68.0	53.3
09:42 – 09:57	64.1	74.3	47.5	67.9	52.4
09:57 – 10:12	64.6	76.1	47.6	68.0	53.1
10:12 – 10:27	64.2	79.2	47.3	68.2	52.0
10:27 – 10:42	64.4	77.1	46.9	68.1	52.0
10:42 – 10:57	64.5	75.4	47.5	67.9	54.5
10:57 – 11:12	64.7	73.0	46.8	68.3	52.6
11:12 – 11:27	64.3	72.6	46.8	68.3	51.0
11:27 – 11:42	64.7	82.4	47.8	68.6	51.4
11:42 – 11:57	64.7	79.3	49.4	68.2	53.3
11:57 – 12:12	64.8	74.6	47.8	68.8	52.1
12:12 – 12:27	64.7	72.3	47.2	68.3	52.9
12:27 – 12:42	64.3	76.2	47.4	67.8	50.8
12:42 – 12:57	64.4	80.4	45.3	68.0	51.4
12:57 – 13:12	64.6	74.4	47.5	67.9	53.3
13:12 – 13:27	64.8	74.5	49.5	68.4	54.5
13:27 – 13:42	64.2	74.0	47.5	68.3	52.6
13:42 – 13:57	64.2	72.7	46.4	68.0	52.7
13:57 – 14:12	64.7	74.9	47.2	68.4	51.6
14:12 – 14:27	64.6	74.8	47.9	68.3	52.5
14:27 – 14:42	64.3	74.6	47.9	67.9	53.3
14:42 – 14:57	64.5	76.6	48.3	68.3	51.8
14:57 – 15:12	64.7	78.2	50.6	68.0	54.2
15:12 – 15:27	64.8	77.8	49.4	68.0	53.4
15:27 – 15:42	64.2	73.7	49.1	68.3	51.7

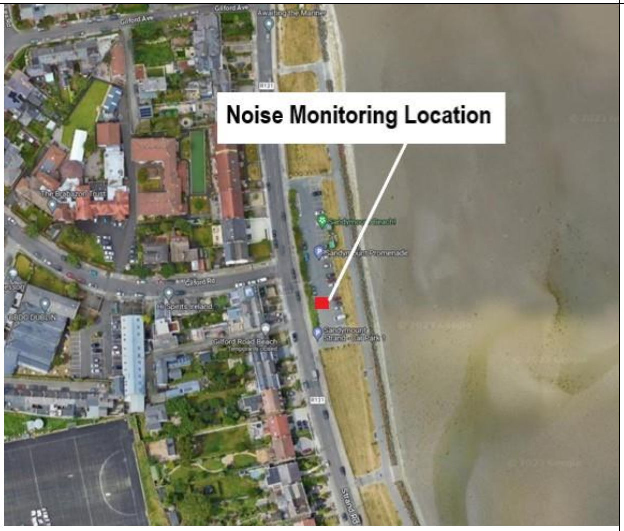
L_{Aeq} Range – 64.1 – 64.8

L_{A90} Range – 50.8 – 54.5

Survey Notes:

Road traffic noise dominant. Car movements in car park, occasional idling vehicles, human activity (passing individuals). Bird song. Tide movement.

Noise Monitoring A-NML3 (Sandymount) – Evening-time – 21st June 2023

Map of Noise Monitoring Location	**Photo of Noise Monitoring Location**
	

Time	**Measured Noise Levels dB(A)**				
	L_{Aeq}	**L_{AMax}**	**L_{AMin}**	**L_{A10}**	**L_{A90}**
19:06 – 19:21	64.9	75.8	45.9	69.3	51.7
19:21 – 19:36	66.0	76.4	43.5	69.9	51.1
19:36 – 19:51	65.0	74.6	39.6	69.6	48.2
19:51 – 20:06	65.0	80.2	43.4	69.0	51.7
20:06 – 20:21	65.2	77.6	44.3	69.4	52.3
20:21 – 20:36	64.6	76.5	41.2	69.0	50.4
20:36 – 20:51	65.0	79.1	45.4	69.0	53.3
20:51 – 21:06	64.9	75.7	43.9	69.1	49.7
21:06 – 21:21	65.6	77.0	41.4	70.0	50.8
21:21 – 21:36	65.0	79.9	39.4	69.3	49.6
21:36 – 21:51	67.1	93.6	41.9	69.6	48.9
21:51 – 22:06	66.9	87.4	39.8	69.8	50.4
22:06 – 22:21	64.9	82.5	38.9	69.4	45.7
22:21 – 22:36	65.8	85.8	41.5	69.5	49.6
22:36 – 22:51	65.7	84.0	41.2	69.4	50.8

L_{Aeq} Range – 64.6 – 67.1

L_{A90} Range – 48.2 – 53.3

Survey Notes:

Road traffic noise dominant. Car movements and human activity in car park area.

Noise Monitoring A-NML3 (Sandymount) – Night-time – 7-8th June 2023

Map of Noise Monitoring Location

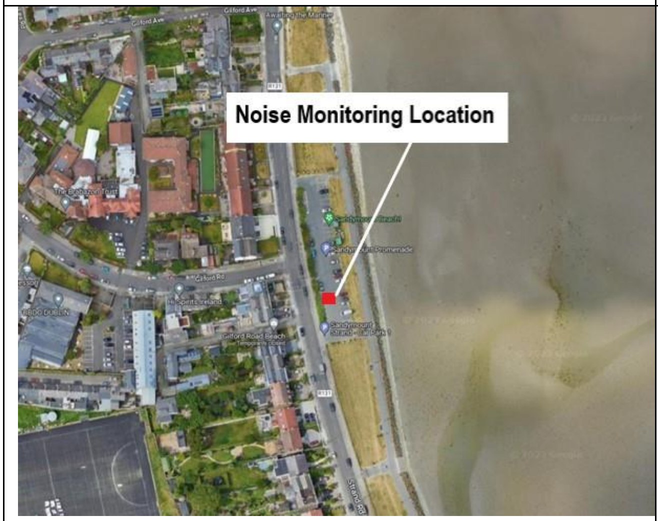


Photo of Noise Monitoring Location

Time	Measured Noise Levels dB(A)				
	L_{Aeq}	L_{AMax}	L_{AMin}	L_{A10}	L_{A90}
23:07 – 23:22	62.7	77.6	41.2	67.8	44.1
23:22 – 23:37	62.1	74.6	40.3	67.5	42.6
23:37 – 23:52	60.3	73.7	40.0	65.8	42.9
23:52 – 00:07	62.2	75.2	41.9	67.2	45.1
00:07 – 00:22	60.1	75.3	39.5	64.6	41.4
00:22 – 00:37	60.5	72.9	39.7	65.9	41.5
00:37 – 00:52	59.5	77.2	39.6	63.9	40.7
00:52 – 01:07	57.1	74.1	38.8	57.1	41.3
01:07 – 01:22	59.2	78.6	40.0	63.4	41.7
01:22 – 01:37	56.8	75.5	39.9	54.6	41.1
01:37 – 01:52	54.7	73.9	40.4	52.0	41.5
01:52 – 02:07	55.8	73.5	41.2	52.7	42.5
02:07 – 02:22	57.0	75.9	42.5	57.9	43.5
02:22 – 02:37	57.0	73.7	43.7	59.3	44.8
02:37 – 02:52	56.9	78.6	44.0	56.0	45.4

02:52 – 03:07	52.2	75.2	43.5	49.5	44.7
03:07 – 03:22	55.1	76.6	43.5	50.9	45.2
03:22 – 03:37	58.1	74.3	43.6	60.8	45.6
03:37 – 03:52	57.4	74.0	43.6	60.8	45.4
03:52 – 04:07	49.1	72.5	43.1	47.2	44.7
04:07 – 04:22	57.8	74.9	42.8	57.4	44.4
04:22 – 04:37	53.4	72.5	43.6	49.9	45.3
04:37 – 04:52	53.9	74.1	43.0	50.3	45.1

L_{Aeq} Range – 49.1 – 62.7

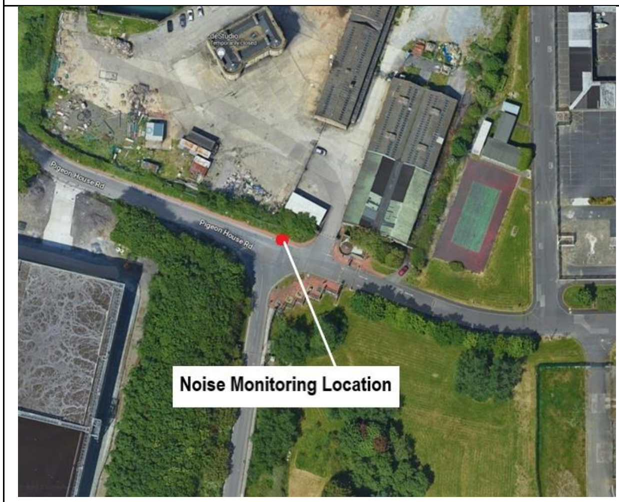
L_{A90} Range – 40.7 – 45.6

Survey Notes:

Road traffic noise dominant. Occasional movements in/out of car park. Occasional human activity, passing individuals talking etc. Tide coming.

Noise Survey Data for Noise Monitoring A-NML4

Noise Monitoring A-NML4 (Adjacent ESB Site Entrance) – Daytime – 13th June 2023

Map of Noise Monitoring Location	**Photo of Noise Monitoring Location**
	

Time	**Measured Noise Levels dB(A)**				
	L_{Aeq}	L_{AMax}	L_{AMin}	L_{A10}	L_{A90}
09:13 – 09:28	53.3	69.3	48.2	56.3	49.2
09:28 – 09:43	55.7	75.9	48.4	58.4	49.3
09:43 – 09:58	57.9	73.6	48.6	62.0	49.8

09:58 – 10:13	54.8	69.9	47.1	57.9	48.5
10:13 – 10:28	62.5	83.5	47.8	61.6	49.0
10:28 – 10:43	58.9	73.5	47.6	62.0	49.0
10:43 – 10:58	59.1	74.3	47.8	62.3	49.4
10:58 – 11:13	59.1	76.2	48.6	61.9	50.4
11:13 – 11:28	60.1	79.6	48.0	62.8	50.2
11:28 – 11:43	58.6	76.8	48.3	62.9	49.7
11:43 – 11:58	58.7	75.2	47.9	61.1	49.8
11:58 – 12:13	55.8	72.1	48.5	58.5	49.6
12:13 – 12:28	61.0	77.8	48.6	64.0	50.1
12:28 – 12:43	54.6	68.3	48.9	58.0	50.0
12:43 – 12:58	58.0	78.3	48.9	60.9	49.9
12:58 – 13:13	55.6	69.3	48.5	58.2	49.7
13:13 – 13:28	56.2	69.2	48.7	59.3	49.9
13:28 – 13:43	54.0	68.8	48.2	56.2	49.5
13:43 – 13:58	62.6	83.0	47.8	61.1	49.1
13:58 – 14:13	56.8	73.2	47.4	59.5	49.1
14:13 – 14:28	59.3	78.1	47.0	62.3	49.1
14:28 – 14:43	62.4	87.3	47.8	60.0	49.4
14:43 – 14:58	63.1	82.1	48.3	62.5	49.9

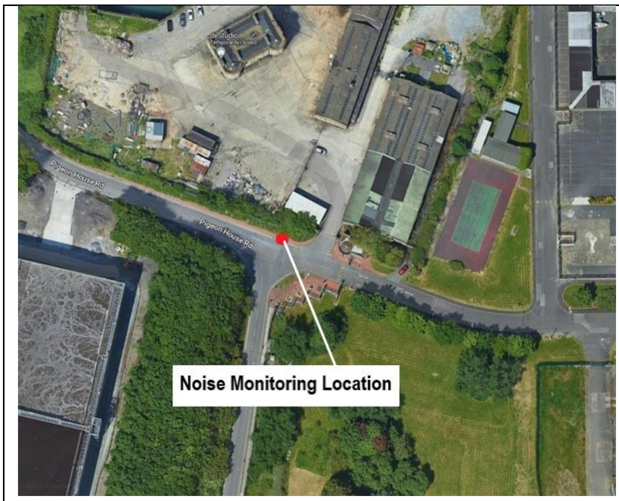
L_{Aeq} Range – 53.3 – 63.1

L_{A90} Range – 48.5 – 50.4

Survey Notes:

An array of plant/equipment noise sources from surrounding plots. Regular traffic on road. Regular traffic entering ESB site, including idling while awaiting security access. Regular traffic entering plot entrance beside noise meter location.

Noise Monitoring A-NML4 (Adjacent ESB Site Entrance) – Night-time – 12-13th June 2023	
Map of Noise Monitoring Location	**Photo of Noise Monitoring Location**



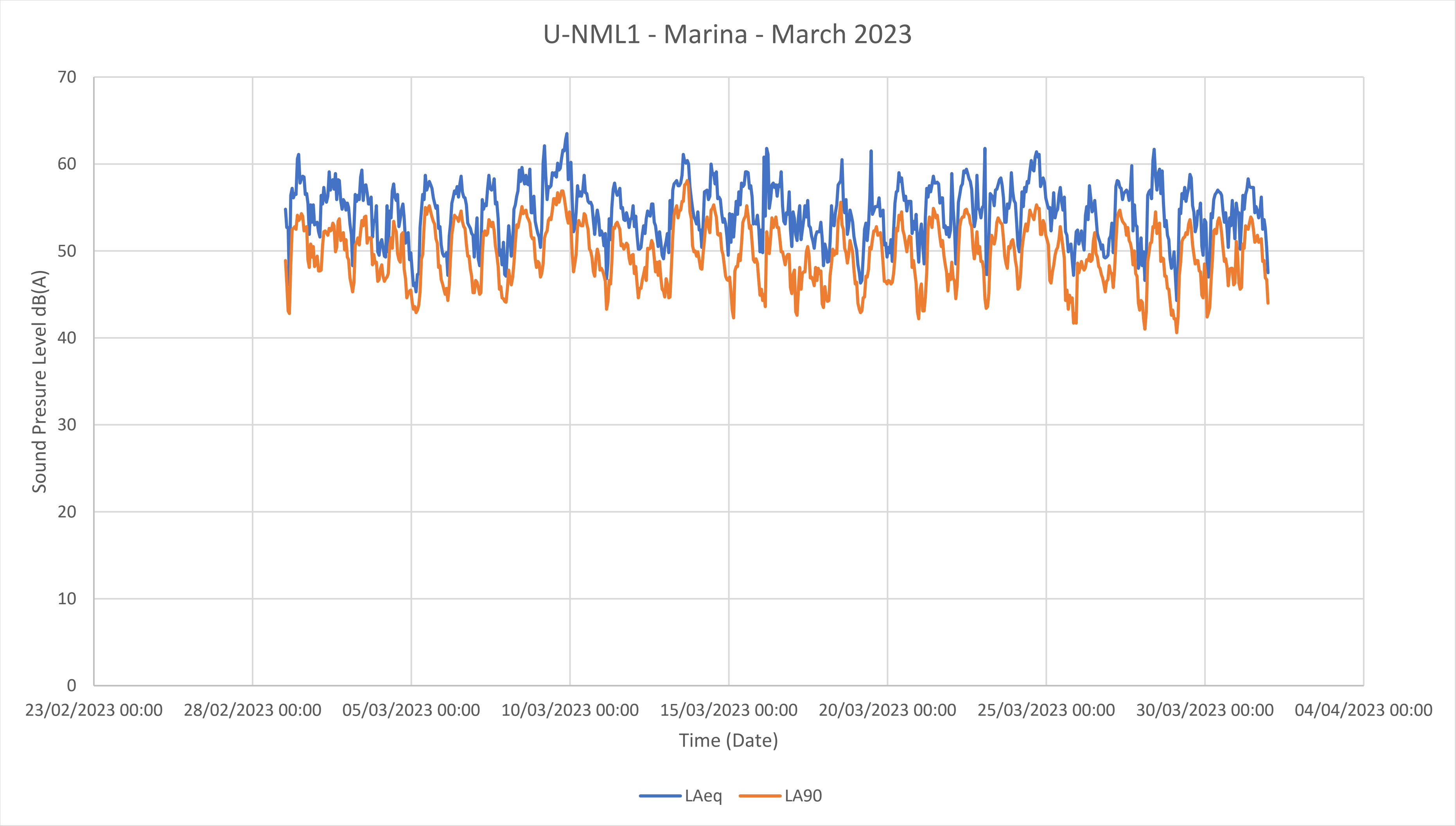
Time	Measured Noise Levels dB(A)				
	L_{Aeq}	L_{AMax}	L_{AMin}	L_{A10}	L_{A90}
23:11 – 23:26	51.6	64.3	48.1	52.8	48.8
23:26 – 23:41	49.6	59.7	47.8	50.0	48.6
23:41 – 23:56	50.3	58.6	47.8	52.0	48.6
23:56 – 00:11	53.7	65.5	48.3	58.1	49.2
00:11 – 00:26	66.5	97.9	47.2	65.6	48.2
00:26 – 00:41	47.6	64.6	46.2	48.1	46.9
00:41 – 00:56	47.3	52.3	46.0	47.8	46.8
00:56 – 01:11	49.6	64.1	45.5	48.0	46.3
01:11 – 01:26	48.8	63.3	45.7	48.6	46.8
01:26 – 01:41	49.1	55.5	41.7	49.7	48.6
01:41 – 01:56	51.6	68.4	47.6	51.9	48.6
01:56 – 02:11	49.4	61.4	47.7	49.8	48.5
02:11 – 02:26	50.1	66.0	45.6	51.4	46.8
02:26 – 02:41	52.7	73.2	46.5	54.5	47.8
02:41 – 02:56	50.2	65.2	47.9	50.4	48.6
02:56 – 03:11	51.6	77.0	47.6	50.0	48.5
03:11 – 03:26	50.5	60.5	48.5	51.5	49.5

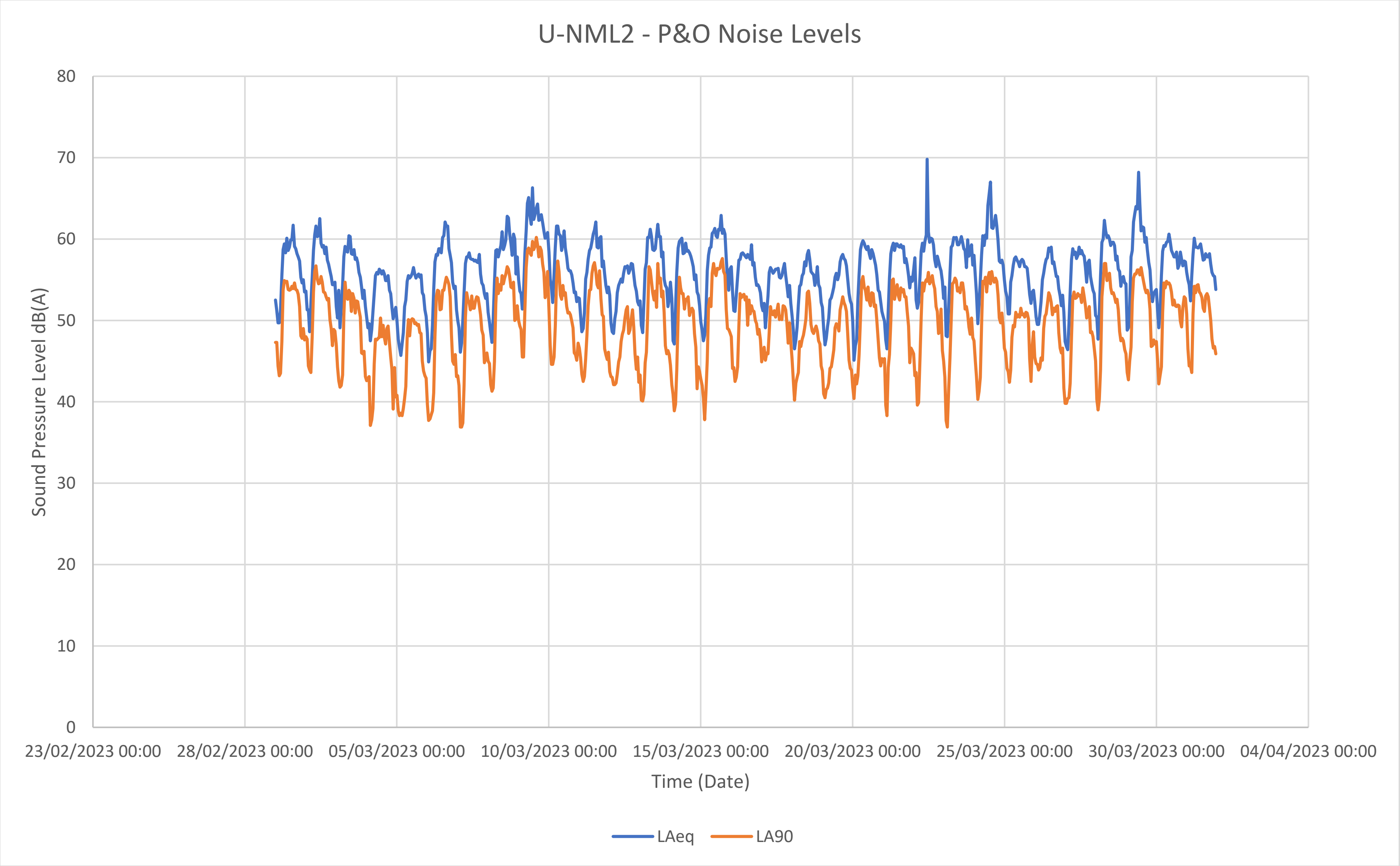
L_{Aeq} Range – 47.3 – 53.7 [66.5 not considered as it is a significant outlier]

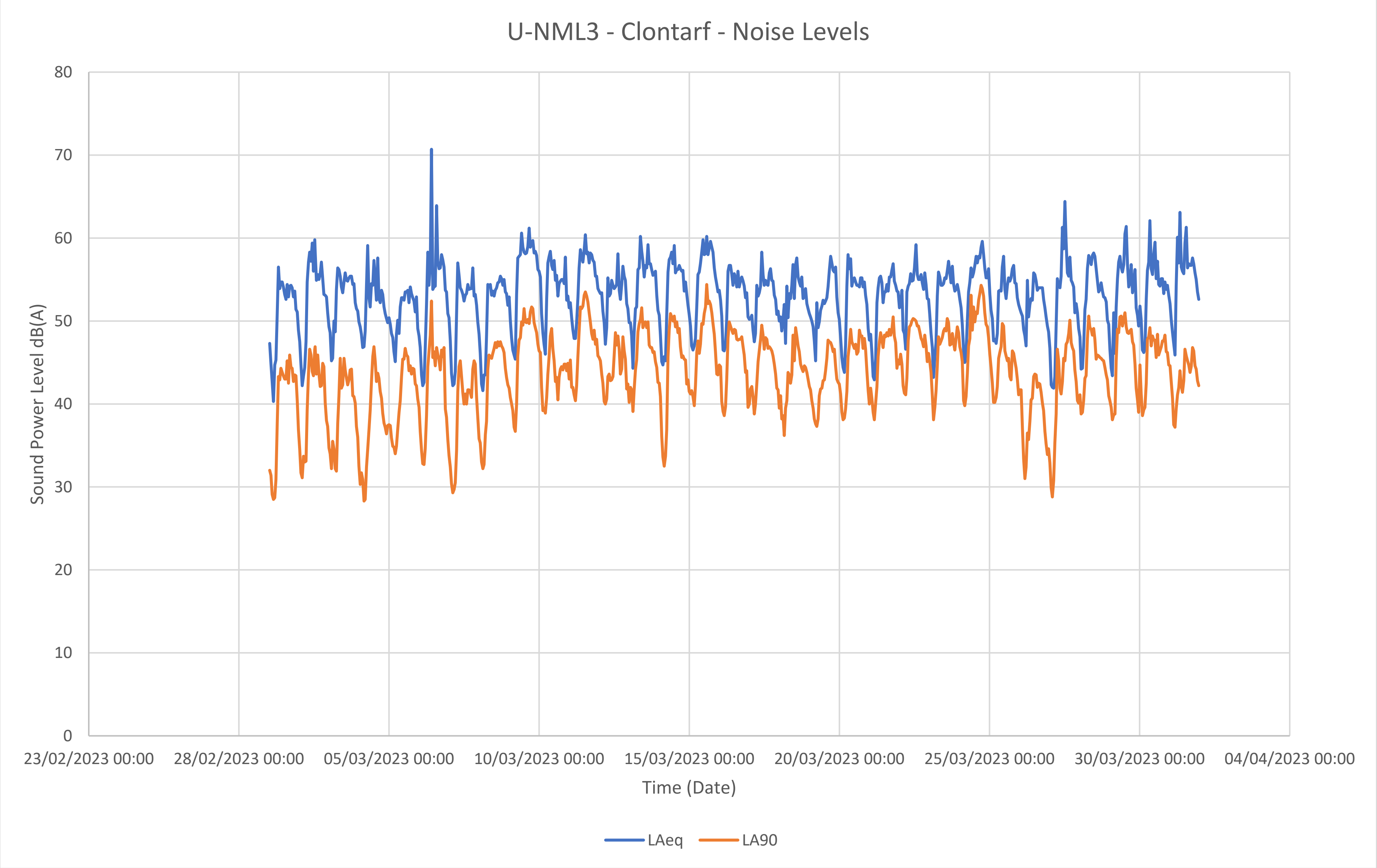
L_{A90} Range – 46.3 – 49.5

Survey Notes:

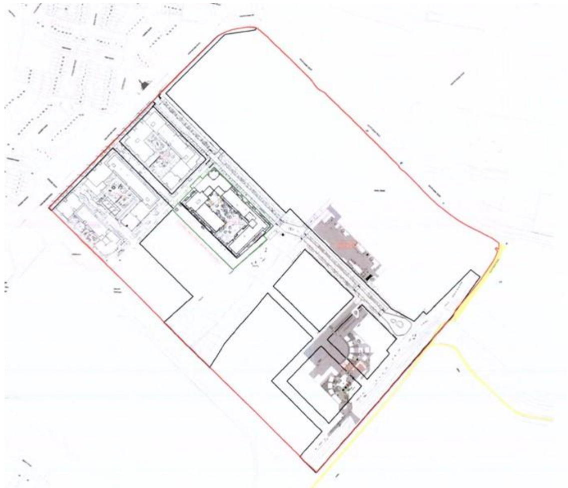
An array of plant/equipment noise sources from surrounding plots. Occasional vehicle / HGV movements into ESB site, sometimes stopped and idling. Small spits of rain for short period.


U-NML1 - Marina - March 2023
Sound Presure Level dB(A)
70
60
50
40
30
20
10
0
23/02/2023 00:00
28/02/2023 00:00
05/03/2023 00:00
10/03/2023 00:00
15/03/2023 00:00
20/03/2023 00:00
25/03/2023 00:00
30/03/2023 00:00
04/04/2023 00:00
Time (Date)
LAeq
LA90

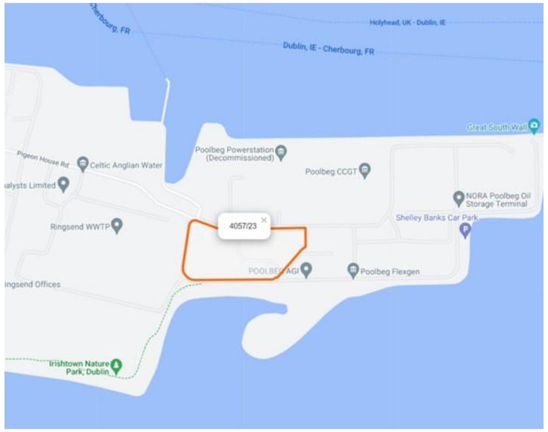
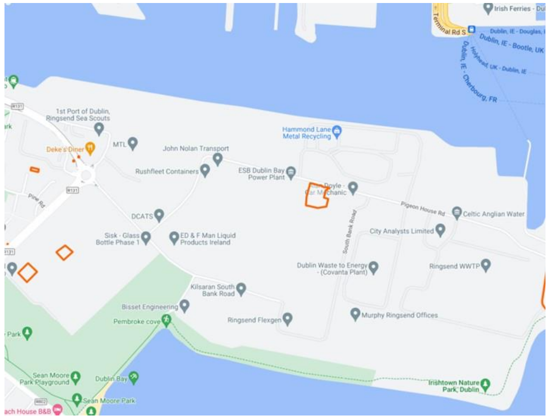

U-NML2 - P&O Noise Levels
Sound Pressure Level dB(A)
80
70
60
50
40
30
20
10
0
23/02/2023 00:00
28/02/2023 00:00
05/03/2023 00:00
10/03/2023 00:00
15/03/2023 00:00
20/03/2023 00:00
25/03/2023 00:00
30/03/2023 00:00
04/04/2023 00:00
Time (Date)
LAeq
LA90

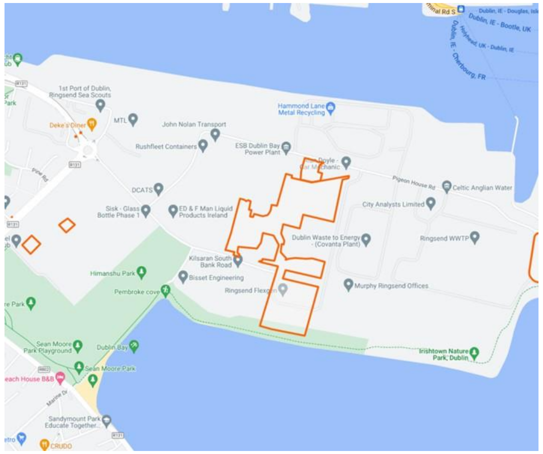

U-NML3 - Clontarf - Noise Levels
Sound Power Level dB(A)
80
70
60
50
40
30
20
10
0
23/02/2023 00:00
28/02/2023 00:00
05/03/2023 00:00
10/03/2023 00:00
15/03/2023 00:00
20/03/2023 00:00
25/03/2023 00:00
30/03/2023 00:00
04/04/2023 00:00
Time (Date)
LAeq
LA90

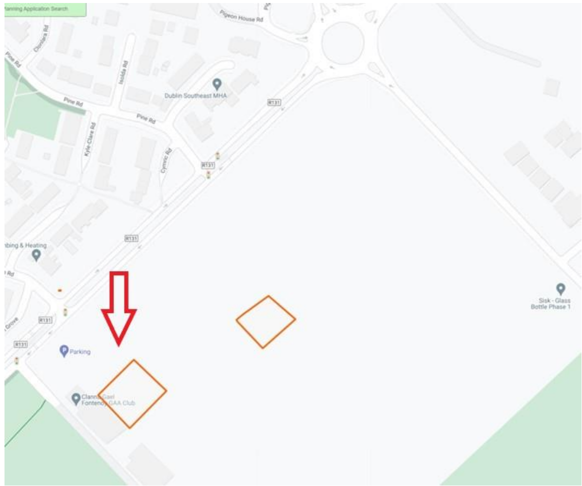
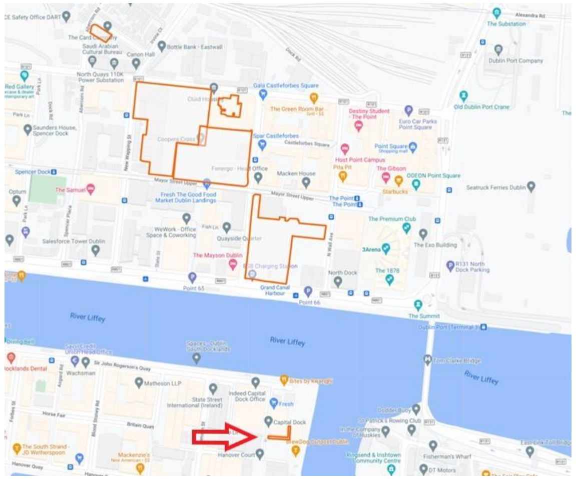
Appendix 12.2

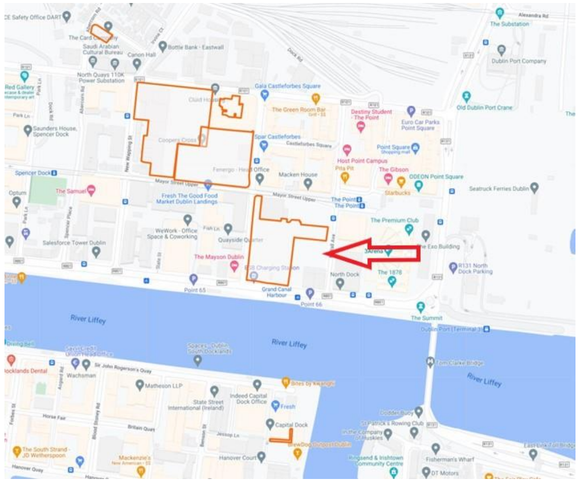
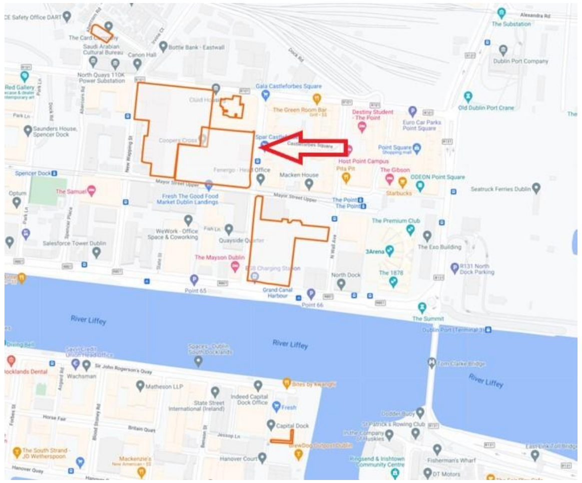
Ref:	Applicant	Location	Map	Description
PWSDZ3207/21 Permission granted 24/03/22	Pembroke Beach	Glass Bottle site		Mixed use development including residential buildings, residential amenity facilities, café restaurant, car parking, landscaping, an ESB substation and various associated works.
PWSDZ3406/22 Permission granted 08/02/23	Pembroke Beach	Glass Bottle site		Mixed use development including residential buildings, residential amenity facilities, retail space, car parking, landscaping, an ESB substation and various associated works.

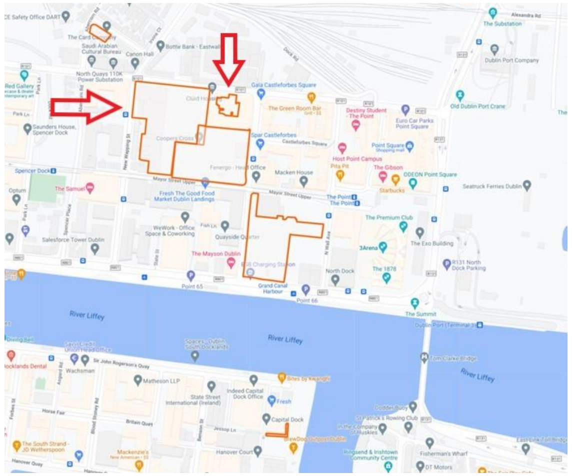
Ref:	Applicant	Location	Map	Description
PWSDZ4058/22 Permission refused 26/05/23	Pembroke Beach	Glass Bottle site		Mixed use development including residential buildings, residential amenity facilities, retail space, café/restaurant space, car parking, landscaping and various associated works.
PWSDZ4380/22 Permission refused 08/06/23	Pembroke Beach	Glass Bottle site		Mixed use development including residential buildings, residential amenity facilities, retail space, café/restaurant space, car parking, landscaping and various associated works.

Ref:	Applicant	Location	Map	Description
4057/23 Decided 24 Aug 2023 (Additional Information)	EirGrid plc	Pigeon House Road		Construction of a new 220kV gas insulated switchgear (GIS) Switchboard building, new shunter reactor units x2, new series reactor unit, associated connections, removal of existing shunt reactors x2 & associated works.
3417/23	Everyday Waste and Skip Hire Ltd	84 Pigeon House Road		Single sorting building and canopy to the rear of the site of construction and demolition recycling facility.

Ref:	Applicant	Location	Map	Description
PWSDZ3074/23 Decided 13 Sep 2023 (Extension to Dec 2023)	ESB Engineering & Major Projects	Pigeon House Road		Demolition of existing buildings x2 & storage tanks x4. Construction/ installation of OCGT generating unit & associated plant. Construction of bund wall, connection to existing AGI & various associated works.
PWSDZ4341/23 Decision Pending	Pembroke Beach DAC	Former Glass Bottle Site		Modification to permitted mixed-use scheme, altering number of residential units and some structural changes.

Ref:	**Applicant**	**Location**	**Map**	**Description**
PWSDZ4276/23 Decision Pending	Pembroke Beach DAC	Former Glass Bottle Site		Modifications to permitted mixed-use development, including changes to materials, plans & entrances.
DSDZ4100/23 Permission Granted on 31/08/23	Capital Dock Residential Fund c/o KW Real Estate ICAV	Capital Dock, Sir John Rogerson's Quay		Changes to ground floor level elevations of the public house with ancillary restaurant.

Ref:	**Applicant**	**Location**	**Map**	**Description**
DSDZ4208/23 Decision Pending	Waterside Block 9 Developments Ltd	City Block 9, North Wall Quay & Mayor St Upper		Various structural amendments to permitted commercial scheme.
DSDZ4304/23 Decision Pending	KWCI GP Ltd	Coopers Cross, City Block 3 at Sheriff St Upper, Castleforbes Rd & Mayor St Upper		Various structural amendments to permitted commercial scheme.

Ref:	Applicant	Location	Map	Description
DSDZ4085/23 Decision Pending	KW PRS ICAV	Coopers Cross, City Block 3 and Northbank House at Sheriff St Upper, New Wapping St & Mayor St Upper		Revisions to residential scheme subject to extant permission DSDZ21186/20.