Environmental Impact Assessment Report (EIAR) – Volume 2

Chapter 10 - Climate

Proposed ORE Capable Terminal on a 250m Wharf Extension & Ancillary Operational Support Infrastructure

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MALONE O'REGAN ENVIRONMENTAL

CHAPTER 10

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All appendices referenced in this document are presented in EIAR Volume III

APPENDICES CHAPTER 10

10 CLIMATE

10.1 Introduction

The chapter provides a description and assessment of greenhouse gas ('GHG') emissions associated with the Proposed Development and its potential effects on National Carbon Budgets and Sectoral Emissions Ceilings in the context of global climate change. In addition, this chapter assesses the potential risks of climate change to the Proposed Development.

10.2 Methodology

The potential risks of climate change on the Proposed Development have been assessed by completing a Climate Vulnerability Assessment (Section 10.4.3), utilising available policy and guidance.

Identifying climate hazards and quantifying GHG emissions was achieved through a detailed desk-based review of local, regional and continental-scale tools. This assessment has used the following policy and guidance:

- KCCDP 2021-2027 [1];
- Kilkenny County Council Climate Change Risk Assessment [2];
- Kilkenny County Council Climate Action Plan 2024 – 2029 [3];
- Port of Waterford Masterplan 2020-2044 [4];
- Port of Waterford Strategic Flood Risk Assessment [5];
- Port of Waterford Site Specific Flood Risk Assessment ('SSFRA') [6];
- Port of Waterford Energy Masterplan [7];
- Department of Communications, Climate Action and Environment – Climate Action Plan 2025 [8];
- Minister for the Environment, Climate and Communication, Climate Action and Low Carbon Development (Amendment) Act 2021 [9];
- Geological Survey of Ireland ('GSI') [10];
- Transport Infrastructure Ireland ('TII') Carbon Tool [11];
- Department for Energy Security and Net Zero ('DESNZ'), *Greenhouse gas reporting: conversion factors 2025*, 2025 [12];
- Environmental Protection Agency – Climate Ireland [13];
- Department of Communications, Climate Action and Environment – National Adaptation Framework, Planning for a Climate Resilient Ireland, 2018 [14];
- Environmental Protection Agency – Ireland's Provisional Greenhouse Gas Emissions 1990-2021 [15];
- Ireland's Greenhouse Gas Emission Projections 2021–2040 [16];
- Intergovernmental Panel on Climate Change ('IPCC') sixth assessment report [17];
- Environmental Agency, Adapting to Climate Change: Industry sector examples for your risk assessment [18]; and,
- The Planning System and Flood Risk Management – Guidelines for Planning Authorities' DOEHLG 2009 [19].

The potential effects of the Proposed Development on climate were determined by assessing the sources of GHG emissions from the Proposed Development. The assessment of GHG emissions follows IEMA's Guidance on Assessing Greenhouse Gas Emissions and Evaluating their Significance [20].

IEMA guidelines specify the use of emission factors, which were sourced from the TII Carbon tool [11] the UK Department for Energy Security and Net Zero ('DESNZ') conversion factors [12]. The TII Carbon Tool is primarily used for lifecycle assessments of national roads and rail projects, but provides a comprehensive list of emission factors and methods to calculate GHG emissions that are relevant to the Proposed Development.

The potential risks of climate change to the Proposed Development have also been assessed by completing a climate change risk assessment. By utilising available policy and guidance, the vulnerability of assets associated with the Proposed Development to potential climate hazards was determined. The identification of climate hazards was achieved through a detailed desk-based review of local, regional and continental-scale tools.

Due to the location of the Proposed Development within an existing developed industrial area, there were no anticipated significant effects on microclimate in terms of wind tunnelling and shading. Further, as part of the structural design process for the ORE facilities, the building structures will be designed to withstand estimated wind pressures in the area. As such, the potential effects of the Proposed Development on microclimate was screened out of any further assessment as part of this EIAR[1].

10.2.1 Assessment Boundary

Anthropogenic GHG emissions have a global effect when they are released in large quantities into the atmosphere over long periods of time – decades or longer; therefore, assessing the effects of GHG emissions of a Proposed Development at a local level is inconsequential. GHG emissions are not geographically circumscribed. Even at a national scale, the effect of the GHG emissions of an entire country the size of Ireland has no noticeable effect on the global, national or regional climate as stand-alone emissions. It is cumulative, global anthropogenic GHG emissions which cause noticeable changes in global, national and regional climate.

Nonetheless, given the importance of climate change and the fact that any project will contribute to an increase or decrease in GHG emissions, an assessment was required. This assessment was a combination of qualitative and quantitative assessments in the context of National Budgets and Sectoral Emissions Ceilings, as the data required to quantify exact GHG emissions from the Proposed Development is not currently available. Refer to Section 10.12 for further information.

It was not possible in the light of current knowledge and assessment methods to quantify the contribution of every part of the Proposed Development, but every attempt has been made to do so as far as practicable. There are no regulatory assessment and verification tools for quantifying GHGs from all sources. For the purposes of this assessment, the boundary for assessing GHG emissions will only be associated with activities within the Republic of Ireland. In addition, the assessment of GHG emissions considered the direct emissions arising from the Proposed Development.

[1] *Microclimate can be described as the climate within 1-2km of a site. The microclimate of an area is influenced by both the natural (topographic) and the built environment (buildings and structures). The construction of new structures impacts existing microclimates and creates new ones of great complexity depending on the design, density and function of the building. Microclimate impacts are typically associated with dense urban development involving tall structures and refer to shading and wind tunnelling.*

10.2.2 Policy Context

10.2.2.1 Paris Climate Agreement

The Paris Climate Agreement is a legally binding international treaty on climate change that was adopted by 196 parties at COP 21 in Paris 2015 [21]. The goal of the agreement is to limit global warming potential by 2°C, preferably 1.5°C, compared to pre-industrial levels. The agreement aims to reach a global peaking of GHG emissions as soon as possible to achieve climate neutrality by 2050. The agreement includes commitments from all countries to reduce their emissions and work together to adapt to the impacts of climate change, and calls on countries to strengthen their commitments over time [21]. The agreement provides a pathway for developed nations to assist the developing nations in their climate mitigation and adaption efforts, while creating a framework for the transparent monitoring and reporting of countries' climate goals.

10.2.2.2 National Climate Change Adaptation Framework

The National Climate Change Adaptation Framework was developed in 2018, in accordance with the requirements set out in the Climate Action and Low Carbon Development Act of 2015 [14]. The aim of the statutory framework was set out as a national strategy to reduce the vulnerability of the country to the negative effects of climate change and to avail of the positive impacts. The strategy also aims at improving and enabling adaptation through online engagement and civil society, the private sector and the research community [14]. An updated National Adaptation Framework was developed and published in 2024. This new National Adaptation Framework introduces a broader set of guiding principles, emphasising the urgency for more intelligent, rapid, and far-reaching adaptation strategies. It advocates for a pathway planning approach, which considers a variety of potential future warming and impact scenarios, to ensure flexible and effective adaptation measures. The 2024 National Adaptation Framework moves towards an outcomes-based strategy to better monitor and evaluate progress in enhancing the resilience of infrastructure, ecosystems, and society at large against climate change.

The key objective of the National Adaptation Framework is to support climate action by setting out policy with a view to becoming more resource-efficient and contributing to the low-carbon economy.

In relation to the Built Environment, the National Adaptive Framework highlights the need to accommodate future climate change impacts in developments permitted today. This, in turn, would eliminate the need for costly future redesigns and redevelopments. Innovative building design, new materials, and standards will contribute to increased climate resilience in the built environment.

The National Adaptive Framework identifies critical infrastructure as a sectoral opportunity associated with climate change due to Ireland's favourable setting for the generation of renewable energy. The National Adaptation Framework highlights the private sector as having a role to play in climate change adaptation and enhancing climate resilience through investments in renewable energy.

10.2.2.3 Climate Change Action Plan 2025

The Climate Action Plan 2025 is the third statutory annual update to Ireland's Climate Action Plan, prepared in accordance with the Climate Action and Low Carbon Development (Amendment) Act 2021 [8].

The Climate Action Plan sets out the roadmap to deliver on Ireland's climate ambitions and aligns with the legally binding economy-wide carbon budgets and sectoral emission ceilings that were agreed by the Government in 2022.

10.2.2.4 Climate Change Risk Assessment

The minister for the Environment, Climate and Communication has launched a set of guidelines to assist local authorities in preparing climate action plans under the Climate Action and Low Carbon Development (Amendment) Act 2021 [22].

These guidelines have been issued under the provisions of the Act and are, therefore, statutory in nature for the respective local authorities to complete. These are outlined in Technical Annex B – Climate Change Risk Assessment [22]. The annex was prepared for local councils to aid in preparing climate risk assessments for their constituents and includes the following:

- Identifying the range of climate hazards that have previously affected the local authority and its administrative area; and,
- Assessing the exposures and vulnerabilities of the local authorities and its administrative areas to these hazards.

Whilst the Climate Change Risk Assessment has been adapted at a county level and is, therefore, much larger than that of the Proposed Development, the basic premise of identifying and classifying the frequency and level of impact caused by hazards has been followed using this guidance as far as practicable.

10.2.2.5 National Carbon Budget and Sectoral Emission Ceilings

The National Sectoral Emission Ceilings refer to the total amount of permitted GHG emissions that each sector of the economy can produce during a specific period of time.

Under Section 6C of the Climate Action and Low Carbon Development Act (as amended), sectoral emission ceilings outline the maximum GHG emissions that are permitted in different sectors of the Irish economy.

This Act commits Ireland to achieving climate neutrality by 2050. The carbon budget programme, which includes three successive 5-year periods of national emission ceilings, is measured in tonnes of CO_2e (tCO_2e) – see Table 10-1 below.

Table 10-1: Ireland's National Carbon Budget

National Climate Budget	Emission Ceiling for Assessment Periods (tCO_2e)
First Carbon Budget (2021 to 2025)	295,000,000
Second Carbon Budget (2026 to 2030)	200,000,000
Third Carbon Budget (2031 to 2035)	151,000,000

Considerations need to be made regarding how emissions may develop post-2030 to establish a basis for proposals for the provisional third carbon (2031 to 2035).

Within the national carbon budgets, sectoral emission ceilings have been created to reflect the EPA's Emission Inventory. Currently, the sectoral emission ceilings are only presented for the first two carbon budget periods (2021 to 2025 and 2026 to 2030). GHG emissions associated with the entire Proposed Development will be compared to the Second Carbon Budget (2026-2030) and the relevant Sectoral Emission Ceiling presented in Table 10-2 below.

Table 10-2: Sectoral Emission Ceilings Relevant to the Proposed Development

Sectors	Second Sectoral Emission Ceiling (2026 to 2030) (tCO_2e)
Transport	37,000,000
Electricity	20,000,000
Built Environment Commercial	5,000,000

10.2.2.6 Kilkenny City and County Development Plan 2021 - 2027

The KCCDP contains the following policies with respect to climate change [1].

Strategic Aim: *To provide a policy framework with objectives and actions in this City and County Development Plan to facilitate the transition to a low carbon and climate resilient County with an emphasis on reduction in energy demand and greenhouse gas emissions, through a combination of effective mitigation and adaption responses to climate change.*

Strategic Objective (2A): *To support and encourage sustainable compact growth and settlement patterns, integrate land use and transportation, and maximise opportunities through development form, layout and design to secure climate resilience and reduce carbon emissions.*

Strategic Objective (2D): *To integrate appropriate mitigation and adaptation considerations and measures into all forms of development.*

Strategic Objective (5L): *To promote a diverse and sustainable local economy through the designation of sufficient lands for employment related uses, including facilities, to promote SME growth through the local area plans for the District towns.*

Strategic Objective (11A): *To support and facilitate the provision of energy in accordance with Ireland's transition to a low carbon energy future by means of the maintenance and upgrading of electricity and gas network grid infrastructure and by integrating renewable energy sources and ensuring our national and regional energy system remains safe, secure and ready to meet increased demand as the regional economy grows over the period of the plan.*

Achieving Climate change targets is a key strategic issue highlighted in the KCCDP, which the Proposed Development will contribute towards achieving:

"*Contributing towards achieving climate change targets in particular by means of encouraging and facilitating a modal shift towards more sustainable travel modes and patterns and an increase in renewable energy production, including wind, solar and bio energy, both at a macro and micro scale.*"

Chapter 11 of the KCCDP highlights the key objectives of the Climate Action Plan. The Proposed Development provides infrastructure to allow progress towards these objectives. The relevant objectives outlined are as follows:

- Deliver the Renewable Electricity Support Scheme ('RESS'), which will provide support for renewable electricity projects in Ireland through a series of scheduled, competitive auctions; and,

- Streamline the consent system, the connection arrangements and the funding support for the new technologies both onshore and offshore.

10.2.2.7 Kilkenny County Council Climate Action Plan 2024 – 2029

Kilkenny County Council has issued a Climate Action Plan 2024 – 2029 [3]. The plan is a statutory 5-year plan which outlines the measures that Kilkenny County Council will take to reduce energy use and carbon emissions and adapt to the changing climate across its governance, services and operations. In addition, it sets out how Kilkenny County Council will facilitate, support and inspire stakeholder climate action in the County through leadership, collaboration and advocacy.

10.2.2.8 Port of Waterford Masterplan 2020-2044

Port of Waterford produced a Masterplan Document for 25 years to cover the period 2020-2044 [4]. Within the Masterplan, the port reviewed its strategies in the context of a number of headings: current infrastructure, economics and finances, future port projections and projected developments.

Within the Masterplan, an assessment of flood risks was undertaken, for which a strategic flood risk assessment was carried out [5]. The perceived risks and consequences that were highlighted in the risk assessment, as well as the Site-Specific Flood Risk Assessment ('SSFRA') [6] were considered in the assessment of climate risks associated with the Proposed Development (Section 10.3.3 below).

10.2.3 Assessing Greenhouse Gas Emissions

The main sources of GHG emissions associated with the Proposed Development will be from HGVs transporting materials to and from the Site, vessel movements related to the berth extension and ORE terminal, use of onshore cranes and machinery, plant use during the Construction Phase and embodied carbon within the building materials.

This assessment of GHG emissions considered the potential direct emissions that will occur during both the Construction and the Operational Phases of the Proposed Development. This included GHG emissions arising from fuel use, HGV and employee traffic and electricity use. Consequently, this assessment included certain emissions classified as 'indirect' under the ISO 14064 Part 1 Standard [23], such as emissions arising from purchased electricity consumption and embodied carbon emissions associated with construction materials.

Other indirect emissions, including upstream supply chain effects (outside the embodied carbon scope) and downstream or waste disposal associated with the Proposed Development, were considered to be too far upstream or downstream of the Proposed Development; therefore, they were not included as part of this assessment. Moreover, some of these emissions are outside the geographical boundary of this assessment and thus not covered in the National Carbon Budgets and Sectoral Emissions Ceilings.

10.2.3.1 Construction Phase

The construction of any development results in GHG emissions from various sources, processes, and operations. Table 10-3 presents the potential GHG emissions associated with the Construction Phase, as considered within the scope of this assessment.

Table 10-3: Scope of Construction Phase GHG Assessment

Emission Source	Description
Fuel combustion from construction plant and equipment	GHG emissions arising from the on-site combustion of diesel by construction plant and machinery.

Emission Source	Description
Construction traffic	GHG emissions arising from the movement of HGVs transporting materials and construction employee travel.
Embodied carbon in construction materials	Emissions associated with the extraction, manufacture and transport of construction materials.

Currently, it is difficult to quantify construction GHG emissions, which is a common issue encountered on all projects. A report prepared by UCD School of Architecture, Planning and Environmental Policy, "*Whole Life Carbon in Construction and the Built Environment Ireland*", prepared on behalf of the Irish Green Building Council (Building in a Climate Emergency Research Group, UCD School of Architecture, Planning and Environmental Policy, 2022) [24] states "… *The high-level national climate emissions inventories do not relate data directly to the construction sector…. Undefined construction sectors emissions make it difficult to assess the impact of the Irish construction industry on climate emissions….*".

Some of the emissions related to the Construction Phase cannot be assessed in the light of current knowledge and methods of assessment (refer to Section 10.2.1). Additionally, some Construction Phase GHG emissions were considered to be outside the boundary of this assessment, due to the geographical assessment boundary or due to being too far down the supply chain. These included the following:

- As most construction works will be carried out using diesel-fuelled plant, electricity will only be used for limited purposes such as internal fitting of the buildings. Such information cannot be estimated at this time. In addition, it was predicted to be insignificant compared to the overall construction GHG emissions; therefore, it has been screened out of this assessment;
- Embodied carbon for equipment (e.g. quayside cranes);
- Travel and transport occurring outside Ireland; and,
- GHG emissions related to specialised skills workers, including engineers and installers, have been screened out as it was not possible to determine the distance travelled, especially as suppliers and contractors have not been selected at the time of this assessment.

Nonetheless, Construction Phase emissions were identified and quantified as far as practical and possible, mitigation measures identified, and the potential impact will be put into context throughout this chapter.

10.2.3.2 Operational Phase

Table 10-4 presents the potential GHG emissions arising during the Operational Phase, as considered within the scope of this assessment.

Table 10-4: Scope of Operational Phase GHG Assessment

Emission Source	Description
Fuel combustion from vessels, machinery and equipment	GHG emissions arising from the on-site combustion of fuel by vessels, Port-side equipment and machinery.
Operational traffic	GHG emissions arising from the movement of HGVs and operational employee travel.
Operational electricity consumption	GHG emissions arising from purchased electricity during the Operational Phase.

Direct fuel emissions will arise from freight shipping, the operation of pilot vessels, the operation of CTVs and SOVs operated by the ORE operators, tugboats operated by external companies and Port-side equipment (E.g. Cranes, Loaders, etc.) operated and owned by licensed stevedores, and at the ORE terminals

Pilot Vessels have been screened out of this assessment, as these vessels operate exclusively on Hydrotreated Vegetable Oil ('HVO') fuel. This is considered a low-carbon, renewable fuel, compliant with the EU's Renewable Energy Directive. As such, it will have no effect on GHG emissions from the Proposed Development and will not be assessed any further.

Operational electricity consumption as a result of the Proposed Development will arise from the installed instantaneous electrical power for operating facilities related to the wharf extension, ORE Operator facilities and associated buildings.

Following the previous hydrodynamic modelling study prepared to inform the Port of Waterford Master Planning [25], an updated 2024 report titled *Port of Waterford: Belview Extension Numerical Hydrodynamic Modelling* was prepared by ABP Marine Environmental Research ('ABPmer') [26]. Based on the 2024 modelling study findings, the Proposed Development was predicted to result in only minor localised changes to hydrodynamics and sediment transport, with no significant effects beyond the immediate area of the Proposed Development. As such, no increase in maintenance dredging activities was predicted as a result of the Proposed Development; hence, the GHG emissions associated with operational maintenance at the port will not be relevant to the Proposed Development and, as such, were screened out from this assessment.

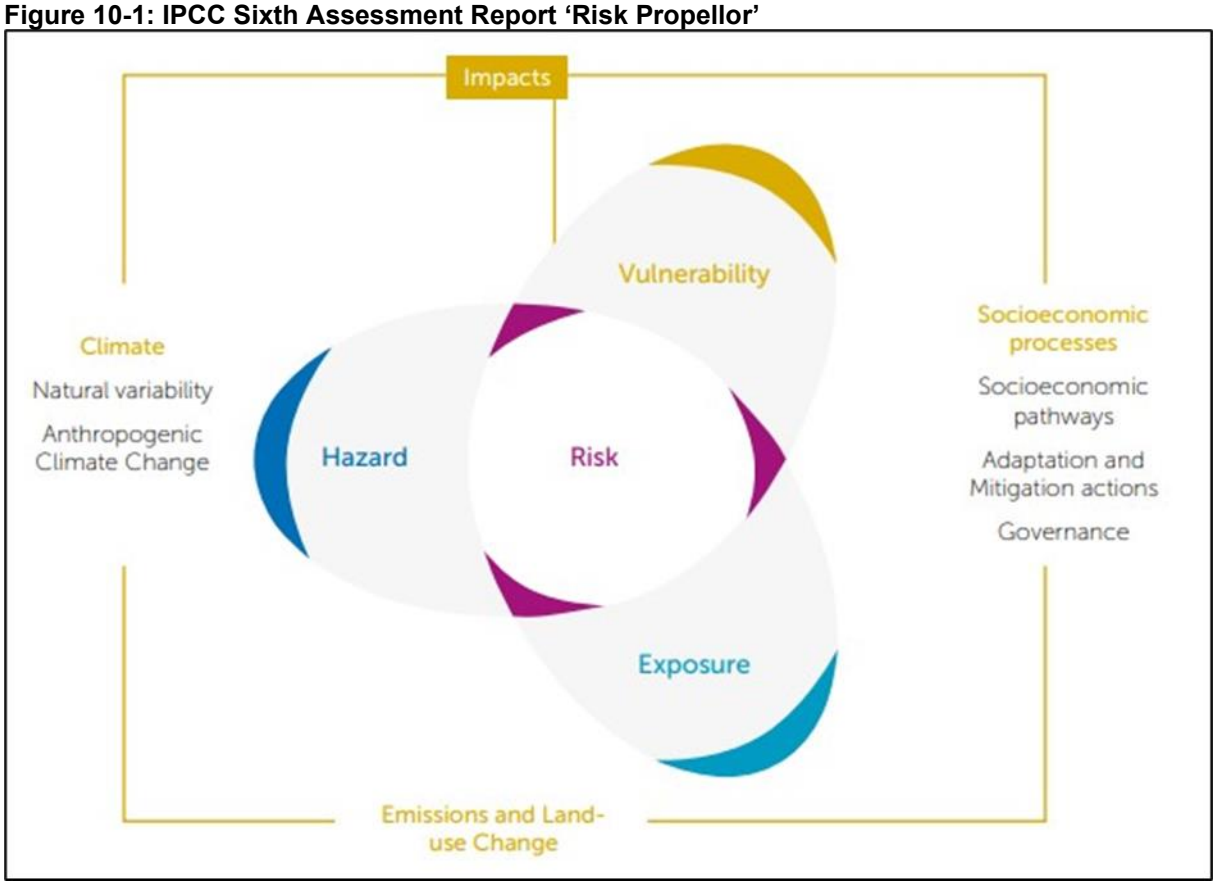
10.2.4 Climate Change Risk Assessment

The IPCC define three key components for identifying climate risk that interact to generate the risk of climate impacts [17]. These include:

- Hazard: The potential occurrence of a natural or a human-induced physical event or trend (such as a heatwave, heavy rainfall event, or sea level rise) that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources;
- Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected (e.g. homes in a flood plain); and,
- Vulnerability: The propensity or predisposition to be adversely affected (e.g. people's underlying health conditions can be worsened by high temperatures or heatwaves).

Figure 10-1 below displays the framework for identifying potential climate risks associated with a development and, in turn, the completion of a climate risk assessment.

Figure 10-1: IPCC Sixth Assessment Report 'Risk Propellor'



In adherence to the Annex B Guidelines provided for local councils, the assessment process entails the identification of the characteristics of climate hazards. This involves both the frequency and magnitude of impacts across the 'Asset Damage' category.

Given the scale and nature of the Proposed Development, the climate risk assessment will focus exclusively on the physical vulnerabilities of the Proposed Development to climate hazards, both present and future. According to Annex B, these physical vulnerabilities are described as:

> *"Properties of an asset related to the structure or facilities can exacerbate/reduce the impacts before, during or after a hazard event e.g. poor design and construction of building provision of active cooling."*

The impacts of climate risks that will potentially cause disruption to the delivery of services and functions for the Proposed Development were considered as the main focus of this assessment. Descriptions of the level of impacts range from Catastrophic (Widespread service failure with services unable to cope with wide-scale impacts) to Negligible (Appearance of threat but no actual impact on service provision); these are further detailed in Appendix 10-1 – Climate Vulnerability Assessment. The Magnitude of impact, in accordance with the Annex B Guidelines, will only relate to asset damage, due to the nature of activities on the site. The magnitude of impact across the asset damage categories ranges between Negligible (impacts can be absorbed) to catastrophic (disaster with the potential to lead to shut down, collapse or loss of assets / network). The frequency of these climate hazards ranges from Rare (<1% occurrence in a year, occurs once in over 100 years) to Very Frequent (>100% occurrence in a year, occurs several times in a single year). Full details on these quantitative/qualitative descriptions are presented in Appendix 10-1.

Future changes in climate hazards were identified as likely to be of significance if the current climate hazards exposed to the Proposed Development were determined to be significant. A detailed desk-based review of available resources (Climate Ireland Platform, Met Éireann data) was used to determine potential climate hazards exposed to the Proposed Development and their projected changes in the future.

10.3 Receiving Environment

10.3.1 Baseline Climate

Ireland's climate is primarily driven by ocean influences, mainly the Atlantic, resulting in maritime climate conditions. This results in relatively warm summers and mild winters. The wettest months of the year typically occur between November and January. The prevailing wind direction is from the southwest, contributing heavily to the wet weather experienced in the spring and warmer temperatures in the summer.

Typically, climate is averaged weather data over a 30-year period to determine long-term trends in important variables such as temperature, precipitation, and wind speed. The 30-year period is considered long enough to smooth out year-to-year variations. Recently, Met Éireann compiled a set of climate averages for the period 1991 to 2020.

The closest station to the Proposed Development with available 30-year averages is in Rosslare, Co. Wexford. However, this station closed in 2007/2008, meaning that over a decade of recent climate variability is unavailable. The closest station with the available 30-year data for the 1991-2020 period is Cork Airport, located ca. 110km southwest. Due to the lack of available information, this station was chosen as the best representation of recent climate data. See Table 10-5 below.

Table 10-5: Climate Averaged Data from Cork Airport (1991 to 2020)

Variable	1991 to 2020 Averages
Mean Temperature (°C)	10
Precipitation (sum of monthly mean in mm)	1,239
Mean of wind speed (knots)	9.8
Mean number of days with gale force winds	5.1

According to Met Éireann's Climate Average Report, which compares the 1961 to 1990 averages to the 1991 to 2020 averages, the following is noted:

- Annual mean air temperature for Ireland has increased by approximately 0.7°C. Spring showed the highest increase (0.8°C), whilst winter showed the smallest increase (0.6°C);
- Annual average rainfall has increased by approximately 7% between the two periods. The greatest increase was seen in the west and north of the country;
- The 30-year average annual distribution of rainfall shows a typical west-to-east decline in the number of rain days and wet days, with east and southeast regions experiencing the lowest number of wet days; and,
- The average annual number of very wet days observed over the period 1991 to 2020 shows that these events are more frequent in the west of the country than in the eastern and midland regions.

10.3.2 Projected Future Climate Change

Observed changes in Ireland's climate over the last century align with global and regional trends associated with human-induced climate change. Climate projections in Ireland are based on global GHG emission scenarios, predicting the future usage of fossil fuels globally and the corresponding release of GHG gases. The Representative Concentration Pathway ('RCP') is a trajectory adopted by the IPCC [27]. RCP scenario 4.5 (RCP4.5) represents an intermediate scenario with emissions expected to peak in 2040 and then decline [27]. RCP scenario 8.5 (RCP8.5) is the worst-case scenario approach based on an overestimation of projected coal outputs [27]. The range of these scenarios provides an intermediate and worst-case estimation of potential environmental changes in response to climate change. Based on this range, the following projections were made regarding Ireland's climate:

- Projected seasonal changes in temperature range from 0.9°C to 1.9°C (RCP8.5), with an increase in the duration and intensity of heatwaves expected; and,
- Projected changes in the frequency of very wet days (>30mm of precipitation) range between a 21% increase (RCP4.5) and a 31% increase (RCP8.5).

Projections regarding regional-scale sea-level risk and changes in wind speed require more comprehensive research to determine the long-term trends.

10.3.3 Climate Hazards

According to the IPCC's Sixth Assessment Report, climate impacts are becoming more severe and are manifesting at an accelerated pace [17]. These impacts can have cascading effects on both natural and human systems, often interacting with other human activities. The IPCC defines climate risk as the potential for adverse consequences to human and ecological systems, recognising the diverse values and objectives associated with these systems [17].

Section 2 of Appendix 10-1 highlights the scales used to identify the climate hazards that have the potential to impact the Proposed Development from a desk-based review of available resources. Following this review, the following hazards were identified as relevant to the Proposed Development:

- Wildfires;
- Heatwaves / Droughts;
- Cold Snaps;
- Extreme Rainfall;
- Flooding;
- Landslides;
- Sea Level Rise; and,
- Severe Wind.

The KCCDP [1] highlighted flood risk as the most pressing climate hazard in the county and has established mitigation measures against these risks. Further, as discussed in Section 7.3.8 of this EIAR, the Site is at risk of coastal erosion as a result of storm surge, which can occur as a result of severe wind, extreme rainfall, flooding and sea level rise. These climate hazards have been considered fully in the Climate Vulnerability Assessment (see Section 10.4.3 below).

The 2025 SSFRA [6], prepared in accordance with the Planning System and Flood Risk Management Guidelines – DoEHLG 2009, identifies the Proposed Development as being at

risk of both tidal/coastal and fluvial flooding, due to its location within a tidally influenced area and its proximity to the Lower Suir Estuary and the Luffany Stream [6].

10.3.4 Baseline Operational Emissions

Operational fuel and electricity use for 2023 and 2022 were used to establish a baseline for the Port's current contribution to Ireland's National Emissions Ceilings. As presented in Section 17.4.2, 2023 fuel data associated with the operation of ships, tugboats, cranes and ancillary equipment and 2022 electricity consumption data were used to establish the baseline operational GHG emissions at the Site.

The baseline operational GHG emissions associated with the Port of Waterford are presented in Table 10-6 below. Please refer to Appendix 10-2 for detailed calculations.

Table 10-6: Port of Waterford 2023/2022 Baseline Operational Emissions

Port of Waterford Baseline Operational Emission Source	Baseline tCO_2e (2023)
Ships*	1,519
Tugboats*	165
Cranes^**	434
Ancillary Equipment**	33
Pilot Launches (HVO)	0
	Baseline tCO_2e (2022)
Electricity***	475
Total Baseline Operational Emissions (tCO_2e)	**2,627**

^At the expanded wharf
**Marine gas oil emission factor for tCO_2e assessed using DESNZ 2023 conversion factors.*
***TII Diesel – emission factor for tCO_2e assessed using TII Carbon Tool* [11].
****SEAI emission factor for electricity consumption 2022.*

When assessed against one year of the National Second Carbon Budget, the Port of Waterford baseline operational GHG emissions amount to ca. 0.007% of the budget, which is imperceptible in the context of national GHG emissions.

10.4 Characteristics & Potential Effects of the Proposed Development

The potential effects of the Proposed Development were assessed under the following stages:

- Construction Phase; and,
- Operational Phase.

10.4.1 Construction Phase

This section details the quantification of GHG emissions, which will occur during the Construction Phase. These emissions were compared to the National and Sectoral Emission Ceilings.

Please refer to Appendix 10-2 for detailed calculations.

The Construction Phase is anticipated to begin in Q3 2026 and span 18-24 months.

Table 10-7 below presents GHG emissions arising from the carbon embodied in the construction materials.

Table 10-7: Proposed Development's Carbon Embodied in Construction Materials

Area	Material	Unit	Embodied tCO_2e
Buildings	Concrete*	2,335 Tonnes	248.6
	Masonry*	390 Tonnes	30.8
	Steel*	312 Tonnes	436.5
	Glazing**	12 Tonnes	11
	Cladding***	141 Tonnes	7
	Concrete Piles*	145 No.	99
	Wood*	78 Tonnes	53
Buildings Total (tCO_2e)			**887**
Wharf	Dredging*	7,000 Tonnes	84.2
	Site Clearance*	1,080 Tonnes	1
	Imported Engineering fill*	160,000 Tonnes	316
	Imported rock armour*	20,000 Tonnes	3510
	Stone - cl804*	2,635 Tonnes	68
	Concrete (Beam Elements and Deck)*	6,634 Tonnes	1027
	Precast Concrete Slabs*	3,010 Tonnes	367
	Paving*	875 Tonnes	14
	Steel Tubular Piles*	420 No.	1000
	Steel Fender Panels*	112 Tonnes	157
Wharf Total (tCO_2e)			**6,541**
Total Construction Materials Embodied Carbon (tCO_2e)			**7,428**

**Embodied tCO_2e assessed using TII Carbon Tool* [11].
***Glazing Embodied tCO_2e assessed using DESNZ conversion factors* [28].
****Cladding Embodied tCO_2e assessed using conversion factor provided by the manufacturer* [29].

Site clearance and demolition was assessed as part of the Construction Phase as the quantity of the material arising during the Site clearance and demolition was included in the total quantity of material assessed in Table 10-7.

Some other materials have been excluded from this assessment based on the type of material, quantity used and country of production. These are outside of the boundary of this assessment (see Section 10.2.1) and include:

- Roof cladding is outside the scope of the assessment as a roof cladding system was yet to be proposed at the time of this assessment and is likely to be manufactured internationally; and,
- Plant and Equipment outside the scope of the assessment (no data available as suppliers were not chosen at the time of writing this report, and it is likely to be manufactured internationally).

Table 10-8 below presents carbon arising from the fuels used in the plant utilised for the Construction Phase of the Proposed Development.

Construction operations on-site will generally be between the following hours;

- Monday – Friday: 07:00 – 18:00; and,
- Saturday: 07:00 – 14:00.

Table 10-8: GHG Emissions Arising from Plant Use during the Construction Phase

Plant Type	Operating Hours during the Construction Phase	Fuel use (l/h)	Emission Factor (kg of CO_2e per litre)	Fuel Consumption for the Entire Construction Phase	kg/CO_2e	tCO_2e Entire Construction Phase
1582T Non-powered steel construction barge (e.g. Skerchi) 60m x 21.5m x 4m	Not Independently Powered					
Barge mounted boom crawler crane to 250T	252	26	2.667	6,552	17,474	17
Spud-leg Barge (e.g. ACN5)	Not Independently Powered					
Impact hydraulic piling hammer e.g. CX85 / CX110	Not Independently Powered					
Vibratory piling hammer e.g. ICE 1412 / PVE 38M	Not Independently Powered					
Tugboat	252	500	2.667	126,000	336,042	336
Safety boat	4,284	112	2.667	479,808	1,279,648	1,280
Work boats	5,040	150	2.667	756,000	2,016,252	2,016
Lighting Towers	15,876	1	2.667	10,319	27,522	28
90T boom crawler crane	756	26	2.667	19,656	52,423	52
65T boom crawler crane dragline (dredging/silt removal)	1,260	26	2.667	32,760	87,371	87
Mobile cranes 25T - 160T as required	1,260	16	2.667	20,160	53,767	54
Articulated Trucks (30T) e.g. Cat C13	3,276	57	2.667	186,732	498,014	498
Large Dozers (50T) e.g. Cat D9	504	39	2.667	19,656	52,423	52
Medium Dozers (23T) e.g. Cat D6	1,008	18	2.667	18,144	48,390	48

Plant Type	Operating Hours during the Construction Phase	Fuel use (l/h)	Emission Factor (kg of CO_2e per litre)	Fuel Consumption for the Entire Construction Phase	kg/CO_2e	tCO_2e Entire Construction Phase
Graders (10T)	252	13	2.667	3,276	8,737	9
Large 18-20T Vibratory Rollers	252	18	2.667	4,536	12,098	12
Small 3-5T Tandem Vibratory Rollers	1,764	15	2.667	26,460	70,569	71
Large, tracked excavator (65T) e.g. Cat365	504	14	2.667	7,056	18,818	19
Medium, tracked excavator (22T) e.g. Cat320	1,260	12	2.667	15,120	40,325	40
Small, tracked excavator (16T) e.g. Cat316	756	10	2.667	7,560	20,163	20
Mini excavator (1.5-2T).	504	3	2.667	1,512	4,033	4
Wheeled excavator (10T) JCB	1,512	14	2.667	21,168	56,455	56
Shuttering, scaffoldings etc.	12		2.667	-	-	-
(MEWP) Mobile access platforms	1,260	3	2.667	3,780	10,081	10
Dredger	252	46	2.667	11,592	30,916	31
Telehandler	2,268	6	2.667	13,608	36,293	36
Total:						**4,778**

Table 10-9 below presents carbon arising from the transport of building materials to the Proposed Development during the Construction Phase. For the purpose of this assessment, predicted traffic volumes were provided for the entirety of the Construction Phase by the Design Team. It is anticipated that some construction materials will be transported by ships to the Site; however, at the time of writing, it was not possible to calculate the percentage of construction materials that will be transported by sea. For the purposes of this assessment, it has been assumed that all deliveries will be made by HGVs, representing a worst-case scenario in terms of transport-related impacts.

An average one-way distance of ca. 80.4km was estimated between the Proposed Development and major population centres with ports, airports and raw material sources. This distance was used to calculate the estimated journey distance for the delivery of construction materials. Please note that this approach will likely result in an overestimation of HGV-related GHG emissions associated with the Construction Phase. Additionally, an average laden condition was assumed for all HGVs entering and exiting the Site throughout the Construction Phase.

Table 10-9: GHG Emissions Arising from the Transport of Raw Materials to the Proposed Development during the Construction Phase

Construction Phase	Description	No. of Journeys 1 way	Return	Distance (km)	Total km	HGV Tonnes CO_2e
1	Establish site compound, laydown areas, pre-casting yard for beam elements, access routes	30	60	80.4	4,824	5
2	Site clearance, removal of accessible silts to fill formation	74	147	80.4	11,819	13
3	Dredging works	84	168	80.4	13,507	14
4a	Filling works. (160,000T imported)	9,135	18,270	80.4	1,468,908	1,576
4b	Commencement of pre-casting where applicable	504	1,008	80.4	81,043	87
4c	Pilling Works	210	420	80.4	33,768	36
5a	Commencement of land-based structures and infrastructure.	420	840	80.4	67,536	72
4d	Placement of Rock Armour	1,323	2,646	80.4	212,738	228
4e	Place precast beam elements and in situ tie sections	218	437	80.4	35,119	38
4f	Installation of precast deck sections and in situ deck elements	441	882	80.4	70,913	76
4g	Fender piling	126	252	80.4	20,261	22
4h	Fendering Works and wharf fittings	168	336	80.4	27,014	29
5b	Rear surfacing works structures and infrastructure	378	756	80.4	60,782	65
5c	Ancillary buildings and site works	504	1,008	80.4	81,043	87

Construction Phase	Description	No. of Journeys 1 way	Return	Distance (km)	Total km	HGV Tonnes CO_2e
6	Wharf Completion	42	84.0	80.4	6,754	7
Total						**2,356**

Table 10-10 below presents carbon as a result of construction workers travelling to and from the Proposed Development during the Construction Phase. The Design Team provided the expected number of daily personnel and visitor vehicles visiting the Site during the Construction Phase. The Central Statistics Office calculated that an average worker would travel 30km (round-trip) each day they travel to work. Therefore, it was assumed that every vehicle used on-site will travel ca.15km for each movement. It was assumed that no construction workers will arrive by walking, cycling or using public transport.

Table 10-10: Transport of Construction Employees related to the Proposed Development during the Construction Phase.

Construction Phase	Description	No. of Journeys 1 way	Return	Distance (km)	Total (km)	Car Tonnes CO_2e
1	Establish site compound, laydown areas, pre-casting yard for beam elements, access routes	168	336	30	10,080	2
2	Site clearance, removal of accessible silts to fill formation	168	336	30	10,080	2
3	Dredging works	420	840	30	25,200	6
4a	Filling works. (160,000T imported)	756	1,512.	30	45,360	10
4b	Commencement of pre-casting where applicable	2,520	5,040	30	151,200	33
4c	Pilling Works	1,575	3,150	30	94,500	21
5a	Commencement of land-based structures and infrastructure.	1,890	3,780	30	113,400	25
4d	Placement of Rock Armour	2,100	4,200	30	126,000	27
4e	Place precast beam elements and in situ tie sections	1,680	3,360	30	100,800	22
4f	Installation of precast deck sections and in situ deck elements	1,260	2,520	30	75,600	16
4g	Fender piling	1,386	2,772	30	83,160	18
4h	Fendering Works and wharf fittings	1,848	3,696	30	110,880	24
5b	Rear surfacing works structures and infrastructure	2,100	4,200	30	126,000	27

Construction Phase	Description	No. of Journeys 1 way	Return	Distance (km)	Total (km)	Car Tonnes CO_2e
5c	Ancillary buildings and site works	6,300	12,600	30	378,000	82
6	Wharf Completion	252	504	30	15,120	3
Total						**317**

The total GHG Emissions for the Construction Phase of the Proposed Development were predicted to be ca. **14,880 tonnes of CO_2e**, comprising the carbon embedded in construction materials, construction plant use, the transport of raw materials via HGVs and construction staff journeys.

Table 10-11 below presents the predicted GHG emissions arising from the Construction Phase of the Proposed Development as a percentage of two years of the National Second Carbon Budget 2026-2030, Transport and Built Environment – Commercial Sectoral Emissions Ceilings.

Table 10-11: Construction Phase GHG Emissions as % of National Carbon Budget and Relevant Sectoral Emissions Ceilings

National Carbon Budget / Emissions Ceilings	Tonnes of CO_2e for two years	Construction Phase as %tage of Emissions Ceiling for 2026 - 2028*
National Second Carbon Budget 2026 – 2030	80,000,000	0.02%
Transport Emissions Ceiling 2026 - 2030	14,800,000	0.02%
Built Environment – Commercial Emissions Ceiling 2026 - 2030	2,000,000	0.37%

**Percentages represent total Construction Phase GHG emissions / two years of the National Second Carbon Budget and relevant Sectoral Emissions Ceilings (2026-2030).*

Given that the GHG emissions arising from the Construction Phase of the Proposed Development will amount to ca. 0.02%, ca. 0.02% and ca. 0.37% of two years of the National, Transport and Built Environment – Commercial Sectoral Emissions Ceilings, respectively, it can be concluded that the Proposed Development will have 'not likely' and 'not significant' effect on the relevant emission ceilings.

10.4.2 Operational Phase

The Operational Phase of the Proposed Development will span over an indefinite number of years beginning in ca. 2028. Operational Phase emissions were calculated for a 365-day operating year.

Table 10-12 below presents annual fuel emissions arising from freight shipping, the operation of CTVs, SOVs operated by the ORE operators and Tugboats operated by external companies to facilitate the additional ships as a result of the wharf extension.

The Proposed Development's 250m wharf extension will increase berthing capacity at the port. According to the Port of Waterford Vessel Log, 239 ships visited the Bulk Berth in 2023, which equates to ca. 60 ships per each of the four berths. Therefore, given the 250m extension to the wharf, the most conservative scenario is that potential ship numbers would increase by

ca. 120 per annum. Calculations assume a maximum travel distance to the Irish Exclusive Economic Zone of ca. 370km.

According to the POW Master Plan 2020 – 2044 [4], one tugboat is required for vessels above 130m in length, while two tugboats are required for vessels above 145m in length. Based on the 2023 vessel log, 46 vessels exceeded 130 meters in length and required tugboat assistance. The Port of Waterford provided information indicating that the travel distance from the tugboat terminal near Waterford City to the Great Island Power Station, where tugboat support is needed (approximately 8 km). Using this data, the GHG emissions associated with tugboat operations resulting from the Proposed Development were calculated.

Table 10-12: Annual GHG Emissions arising from Freight Ships, CTV and SOVs associated with the Proposed Development during the Operational Phase

	No. of Journeys 1 way	Return	Distance (km)	Total (km)	Tonnes CO_2e
CTV (Four Return Trips Daily)*	1,460	2,920	30	87,600	346
SOV Return Trip Every Week*	52	104	30	3,120	12.3
Estimated Freight Ships as a result of the berth extension**	120	240	370	88,800	3,732
Tugboat	46	92	8	736	31
Total					**4,122**

**Marine vessel's tCO_2e emission factors assessed using DESNZ conversion factors* [28].
***TII Boat - Freight Emission Factor for tCO_2e assessed using TII Carbon Tool* [11].

The Port of Waterford provided anticipated fuel consumption for port-owned vehicles involved in port operations as a result of the 250m wharf extension presented in Table 10-13 below.

Table 10-13: Annual GHG Emissions arising from Port-Owned Operational Vehicles associated with the Proposed Development during the Operational Phase

Plant	Fuel Type	Consumption per year (L)	Total tCO_2e/year
Secondary Handling Machinery*	Diesel (L)	10,000	33.4
Total:			**33.4**

**TII Diesel – emission factor for tCO_2e assessed using TII Carbon Tool* [11].

Annual anticipated fuel consumption arising from port-side equipment operated and owned by licensed stevedores is presented in Table 10-14 below.

Table 10-14: Annual GHG Emissions arising from Port-side equipment Operated and Owned by Licensed Stevedores

Plant	Fuel Type	Consumption per year (L)	Total tCO_2e/year
Mobile Harbour Crane*	Diesel (L)	60,000	200.5
Total			**200.5**

**TII Diesel – emission factor for tCO_2e assessed using TII Carbon Tool* [11].

Table 10-15 below presents the anticipated annual GHG emissions arising from electricity consumption associated with the Proposed Development.

Table 10-15: Annual GHG Emissions arising from the consumption of electricity associated with the Proposed Development during the Operational Phase

Plant	Consumption per year (kWh)	Total tCO_2e/year
Two Quayside Fixed Cranes	440,618	113.4
Lighting	66,640	17.2
Ancillary	16,660	4.3
New Buildings	73,000	18.8
PV system	273,000 generated	-56.0
Total		**97.6**

Rooftop-mounted solar PV panels will be installed on the ORE operator facilities, covering a combined maximum area of ca. 2,100m^2 across the two buildings. The estimated annual electricity generation was calculated using the Sustainable Energy Authority of Ireland ('SEAI') baseline for a well-sited domestic solar PV system, which produces approximately 2,600kWh/year from a 20m^2 array [30]. Based on this data, the 2,100m^2 array has a potential maximum generation of approximately 273,000kWh of electricity per annum. This estimated generation has a potential GHG emissions offset of ca. **56 tonnes of CO_2** per annum[2], contributing to the reduction in GHG emissions arising from the Operational Phase of the Proposed Development.

Table 10-16 below presents the annual carbon arising from the yearly HGV movements as a result of the 250m Quay Extension with ORE Capability. It was estimated that ca. 52,925 HGV inbound truck movements will be required in a typical year. To ensure consistency in the approach using the TII Carbon Tool emission factors, an average-laden condition was assumed for HGVs entering and leaving the Site. An average distance between the Proposed Development and major population centres has been used to estimate the likely travel distances for products arriving at and leaving the Proposed Development. This will result in the calculated GHG emissions from the Operational Phase transport being an overestimation of actual traffic numbers and distance travelled.

Table 10-16: Annual GHG Emissions arising from the Transport of Materials to the Proposed Development during the Operational Phase

	No. of Journeys 1 way	Return	Distance (km)	Total km	HGV Tonnes CO_2e
Projected Yearly HGV Movements as a result of 250m Quay Extension with ORE Capability	52,925	105,850	93.2	9,865,220	10,585
Total					**10,585**

Table 10-17 below presents annual carbon as a result of employees travelling to and from the Proposed Development during the Operational Phase. It is proposed that the ORE Capable berth will operate under two scenarios:

[2] *Calculated using the 2025 Gross Electricity Supply Emission Factor in gCO_2/kwh* [34].

- Operator 1, a Crew Transfer Vessel, 35 personnel working at the facility, including landside personnel and personnel going to/from sea daily; and,
- Operator 2, a Crew Transfer Vessel, 35 personnel working at the facility, including landside personnel and personnel going to/from sea daily.

There will be an additional 30 personnel for port-related activities at the Port of Waterford. Therefore, a worst-case scenario has been used, assuming that if all personnel arrived on a specific day, the total number of personnel arriving would be ca. 100 personnel. According to the Central Statistics Office, the average Irish person travels a distance of 15km to work each day. This results in a round trip of 30km per day, which was applied in this assessment (Central Statistics Office, 2016). Using these methods to estimate the number of employees attending the Site daily and the distance travelled will result in an overestimation of GHG emissions.

Table 10-17: Annual GHG Emissions arising from the Transport of Employees related to the Proposed Development during the Operational Phase

	Employee Numbers per year	No. of Return Journeys	Annual Distance Travelled km/Operational phase (includes return trip)	kg/CO_2e	Total Annual Tonnes CO_2e/Operational Phase
Operational Phase	36,500	73,000	1,095,000	237,133	237
Total					**237**

Total annual GHG Emissions for the Operational Phase of the Proposed Development were predicted to be ca. **15,275 tonnes of CO_2e**, comprising:

- Annual operational vehicle movements: HGV's and Employee Vehicles;
- Annual ship vessel movements: CTV, SOV, Freight Ships and Tugboats;
- Annual electricity consumption: Quayside Fixed Cranes, Lighting, Ancillary and New Buildings;
- Predicted annual solar generation resulting in electricity consumption offset; and,
- Annual fuel consumption: Harbour crane and handling machinery.

The predicted annual GHG emissions occurring for the Operational Phase of the Proposed Development were compared to one year of the National Second Carbon Budget (2026-2030), Electricity, Transport and Built Environment – Commercial Sectoral Emissions Ceilings, as presented in Table 10-18 below.

Table 10-18: Annual Operational GHG Emissions as % of National Carbon Budget and Relevant Sectoral Emissions Ceilings

National Carbon Budget / Emission Ceilings	Tonnes of CO_2e per year	Annual Operational Phase as %tage of Emissions Ceiling for 2026 – 2030*
National Emissions Ceiling 2026 - 2030	40,000,000	0.04%
Electricity Emissions Ceiling 2026 - 2030	4,000,000	0.002%

National Carbon Budget / Emission Ceilings	Tonnes of CO_2e per year	Annual Operational Phase as %tage of Emissions Ceiling for 2026 – 2030*
Transport Emissions Ceiling 2026 - 2030	7,400,000	0.2%
Built Environment – Commercial Emissions Ceiling 2026 - 2030	1,000,000	0.03%

**Percentages represent total Operational Phase GHG emissions / one-year National Second Carbon Budget and relevant Sectoral Emissions Ceilings (2026-2030).*

Given that the GHG emissions arising from the Operational Phase of the Proposed Development will amount to ca. 0.04%, ca. 0.002%, ca. 0.2% and ca. 0.03% of the National, Electricity, Transport and Built Environment – Commercial Emissions Ceilings, respectively, it can be concluded that the Proposed Development will have 'not likely' and 'not significant' effect on the relevant emission ceilings.

10.4.3 Climate Vulnerability Assessment

The Climate Change Vulnerability Assessment assessed the potential impacts to the Proposed Development from climate hazards and the frequency of these events. To determine the level of risk associated with the Proposed Development, receptors have been divided into the following:

- On-site Assets (e.g. plant, equipment and building);
- Inputs (Electricity and Water);
- Outputs (Operating Capacity); and,
- Transport Links.

Table 10-19 below identifies the potential impacts to the identified receptors using UK Guidance on Adapting to Climate Change: Industry sector examples for your risk assessment [18].

Table 10-19: Potential Impacts to the Identified Receptors from Climate Hazards

Climate Hazard	Potential Impacts on Proposed Development Receptors
Temperature-related (cold snaps, heatwaves, droughts)	• Impacts on infrastructure such as ice on surfaces and melting road surfacing; • Increased heat or sun exposure can cause the expansion of metallic infrastructure in building elements or tracks, or rapid degradation of materials such as rubbers or plastics; • Freezing temperatures result in an increased risk of pipework freezing; and, • Severe cold can lead to contraction of metals and embrittlement of materials such as plastic, rubber and metals.
Wildfires	• Wildfires can cause extensive damage to infrastructure; • Working activities may have to be suspended during a wildfire to ensure safety of their employees and equipment; and, • Wildfires can cause damage to access roads and transportation routes.
Flooding	• Impacts on the wider supply chain infrastructure for critical emissions control plant by docks and road access flooding; • Increase in flow may cause damage caused from flooding;

Climate Hazard	Potential Impacts on Proposed Development Receptors
	• Potential for increased site surface water and flooding; • Increased rainfall can result in the washing of suspended solids from all areas, including stockpiles and roadways causing blocked drainage infrastructure and offsite pollution; and, • Increases in groundwater levels may affect infrastructure at the facility.
Landslides	• Landslides and erosion can damage infrastructure, particularly during construction phases when embankments are unconsolidated; • Landslides can endanger the safety of workers and equipment; and, • Landslides and soil erosion can disrupt operations by blocking access roads and damaging equipment. *Note: This assessment focuses on the specific location of the Proposed Development, while Chapter 7 Land, Soils and Geology, provides information on a wider area.*
Sea Level Rise	• Sites located near the coast have a potential increased risk of flooding; • Sea Level Rise can impact access to raw materials, damage to docks or ports; • Sea Level Rise can damage transport infrastructure in Coastal / Estuary areas; • Sea Level Rise will result in port areas being increasingly vulnerable to storm surges and coastal flooding; and, • Sea Level Rise increases the likelihood of damage to onsite infrastructure, equipment and raw materials as a result of coastal flooding.
Severe Wind	• Severe wind has the potential to damage infrastructure, such as cranes, containers and loaders; • Disruptions to vessel berthing can result due to high winds, impacting operations; • Debris and loose material have the potential to be blown into the water, causing pollution; and, • Severe wind can result in disruption to power supply, impacting operations.

10.4.3.1 Frequency of Climate Hazards

Based on the Annex B Guidance on current climate hazards [22], the frequency of the climate hazards was quantified through an analysis of available information. The frequency scores assigned, rated between 1-5 for each hazard, are justified in Table 10-20 below.

Table 10-20: Frequency of Climate Hazards

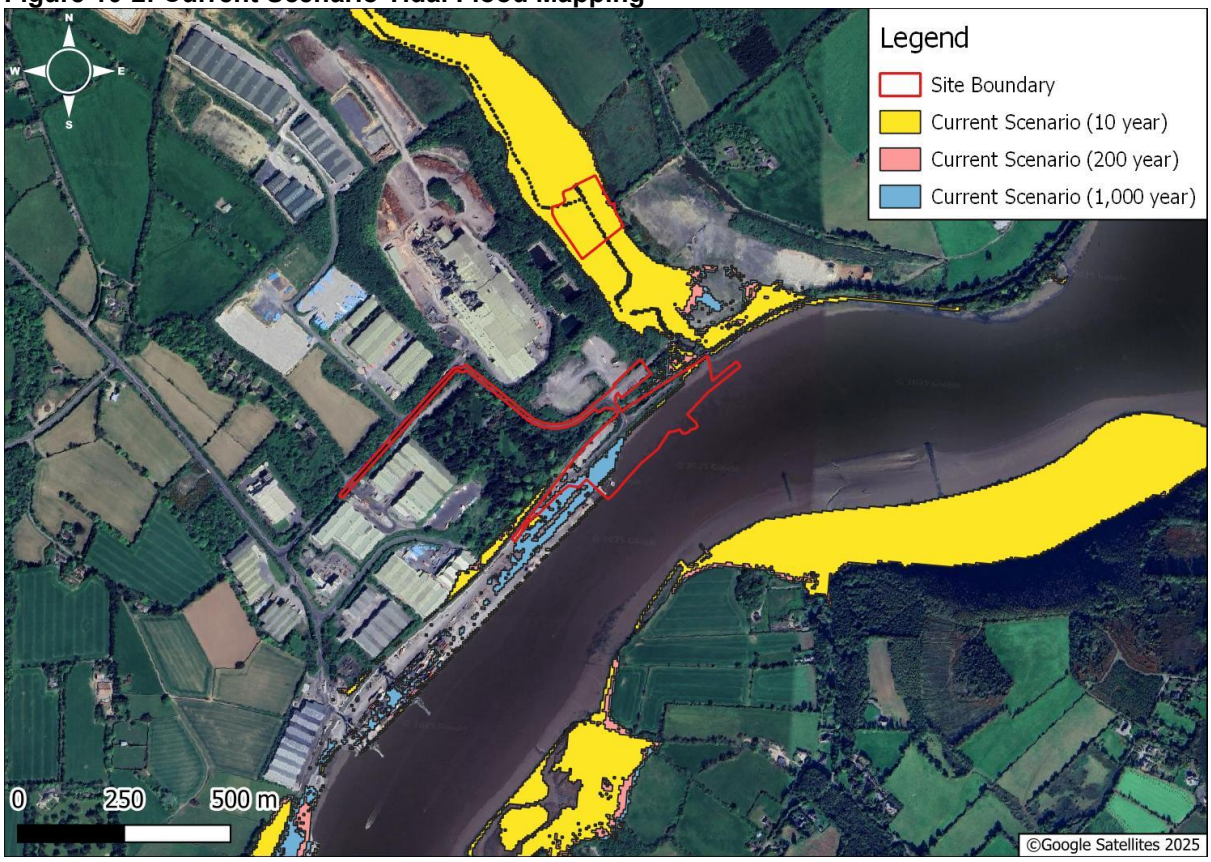
Climate Hazard	Frequency Score	Frequency Description	Justification
Wildfires	1	Rare	There are no records of wildfires within 5km of the Site. Further, according to the European Forest Fire Information System ('EFFIS') Wildfire Risk Viewer [125], the Proposed Development is at "Low" risk of wildfire.
Heatwaves / Droughts	2	Occasional	Met Éireann defines heatwaves as five consecutive days with temperatures over 24°C. According to Met Éireann temperature data from a local weather station (Johnstown Castle – ca.37km to the east), between 2008 and mid-2025, there were no occurrences that met the criteria for a heatwave.

Climate Hazard	Frequency Score	Frequency Description	Justification
Cold Snaps	5	Very Frequent	According to Met Éireann a yellow weather warning occurs when low temperatures are expected to be below -3°C. The minimum temperature values from the local Johnstown Castle weather station indicated that between 2008 and mid-2025, the number of times minimum temperatures fell below -3°C was 26 times. According to Met Éireann, an orange weather warning occurs when low temperatures are expected to be below -5°C at which point the weather event is *"dangerous weather conditions which may pose a threat to life and property."* Between 2008 and mid-2025, there were two occurrences that met the criteria for orange weather warning events.
Extreme Rainfall	4	Frequent	According to Met Éireann, a yellow weather warning for rainfall occurs when daily precipitation exceeds 30mm in a single day. The daily precipitation values from a local weather station (Duncannon – 10km southeast of the Proposed Development) indicate the following: • Since 1995, the number of times daily precipitation exceeded 30mm was 45 times; and, • The occurrence of an orange rain weather warning (>50mm) has only occurred three times since 1995 (August 1997, October 2002 & March 2013).
Flooding	2	Occasional	According to the Port of Waterford SSFRA [6], the Proposed Development is not located within any predictive, indicative, historic or anecdotal river flood zones, and overall indicates a low risk of river flooding. There is one record of a recurring flood event within 2.5km of the Proposed Development. OPW Flood mapping meeting minutes in relation to this recurring flood state: "*One pub is regularly flooded due to a combination of high tides and strong winds*" See Appendix 10-3 for further details.
Sea Level Rise	2	Occasional	The Port of Waterford SSFRA [6] has identified the Port to be tidally influenced by the Lower Suir Estuary. Current scenario tidal flood mapping (Figure 10-2) identified areas of the Port itself to be vulnerable to tidal flooding and areas next to the River Luffany. The Port of Waterford SSFRA [6] concludes that the potential tidal/coastal flood risk to the Proposed Development is considered to be imperceptible.
Landslides[3]	1	Rare	According to the Geological Survey of Ireland (Landslide Susceptibility Map), there are no recorded landslides within 5km of the Proposed Development. The susceptibility of the Proposed Development to landslides has been classified as "Low (inferred").
Severe Wind	2	Occasional	According to Met Éireann, an orange weather warning for wind occurs when 10-minute mean wind speeds are between 65 and

[3] This assessment focuses on the specific location of the Proposed Development, while Chapter 7 Soils and Geology, provides information on a wider area.

Climate Hazard	Frequency Score	Frequency Description	Justification
			80km/h or wind gusts are between 110 and 130km/h. Met Éireann defines an orange wind warning as *"Infrequent and dangerous weather conditions which may pose a threat to life and property".* Between 2008 and mid-2025, there have been five orange warning criteria events for 10-minute mean wind speeds and two orange warning criteria events for wind gusts observed at the Johnstown Castle station.

Figure 10-2: Current Scenario Tidal Flood Mapping



It is important to recognise that there can be co-occurrences of multiple hazards (such as prolonged dry temperatures followed by extreme rainfall, increasing the risk of flooding). However, given the spatial nature of the Proposed Development and the limited likelihood of combined effects, given the current rarity of heatwaves (see Table 10-20), these effects are not considered further.

10.4.3.2 Potential Impacts of the Current Climate Risks

The impacts of current climate risks will result in the disruption to the delivery of service and function expected to be performed by the Proposed Development. For each of the climate hazards identified, the potential impacts, categorised as "Asset Damage", were determined in accordance with the Annex B Guidelines (Appendix 10-1). This quantification of potential impacts was determined for each of the receptors identified, as presented in Table 10-21.

The Port of Waterford commissioned an SSFRA, which was prepared in accordance with *The Planning System and Flood Risk Management – Guidelines for Planning Authorities' DOEHLG 2009* [6]. The design of the Proposed Development was undertaken in consideration of the

predictive flood extent, flood depth, and flood levels as outlined in the Port of Waterford Site Specific Flood Risk Assessment [6]. Therefore, the effects of flooding and sea level change on the Proposed Development have been predicted to be imperceptible.

Table 10-21: Potential Impacts of Receptors to "Asset Damage" as a result of climate change

Receptors	Climate Hazard	Impact Score	Classified Asset Impact	Justification
On-site Assets	Wildfires	2	Minor	The highest impacts associated with onsite assets at the port are likely to result from extreme rainfall and flooding. While modern port machinery, such as cranes and container handling systems, is designed to withstand adverse weather conditions, many assets remain vulnerable. Equipment that is fixed or difficult to relocate may be especially at risk during sudden flood events. Additionally, flooding can damage electrical systems, corrode components, and disrupt operations. The asset damage category of moderate is defined as *"a serious event that requires additional emergency business continuity* [9]*".*
	Heatwaves/ Droughts	1	Negligible	
	Cold Snaps	2	Minor	
	Extreme Rainfall	3	Moderate	
	Flooding	1	Negligible	
	Landslides	2	Minor	
	Sea Level Rise	1	Negligible	
	Severe Wind	2	Minor	
Inputs (Electricity and Water)	Wildfires	2	Minor	According to the KCC Climate Change Risk Assessment, cold snaps and extreme rainfall have the highest consequence to impact areas within the Critical Infrastructure & the Built Environment and Water Resources. Additionally, severe wind has the potential to disrupt energy supply. The asset damage category of moderate is defined as *"a serious event that requires additional emergency business continuity* [9]*".*
	Heatwaves/ Droughts	2	Minor	
	Cold Snaps	3	Moderate	
	Extreme Rainfall	3	Moderate	
	Flooding	3	Moderate	
	Landslides	2	Minor	
	Sea Level Rise	2	Minor	
	Severe Wind	3	Moderate	

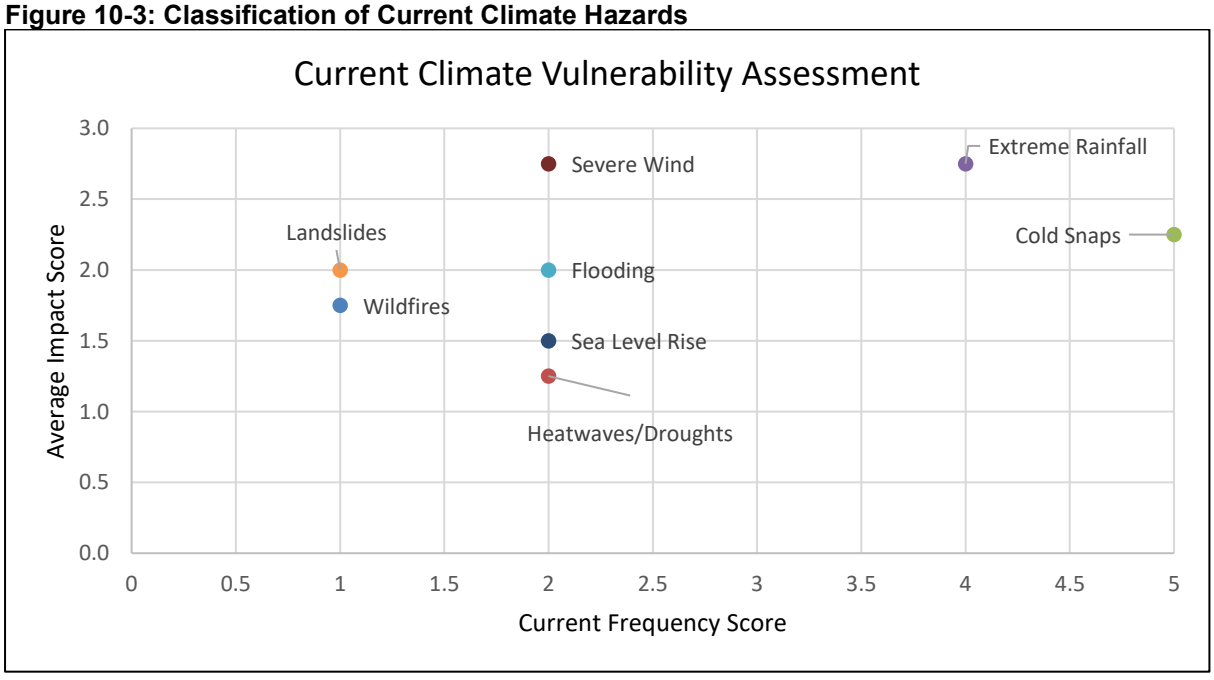
Receptors	Climate Hazard	Impact Score	Classified Asset Impact	Justification
Outputs	Wildfires	2	Minor	Due to the nature of activities associated with the Proposed Development the highest level of impact for a hazard was for an extreme rainfall event as it has the most potential to impact operating capacity. Severe wind can compound the impacts of extreme rainfall by potentially damaging exposed infrastructure long-term, resulting in operational disruptions. The asset damage category of moderate is defined as *"a serious event that requires additional emergency business continuity* [9]*".*
	Heatwaves/ Droughts	1	Negligible	
	Cold Snaps	2	Minor	
	Extreme Rainfall	3	Moderate	
	Flooding	1	Negligible	
	Landslides	2	Minor	
	Sea Level Rise	1	Negligible	
	Severe Wind	3	Moderate	
Transport Links	Wildfires	1	Negligible	The highest level of impact that could affect the transport links associated with the Proposed Development would be a flood event, classified as moderate. This would be due to the nature of infrastructure and transport routes, which have the potential to be impacted if authorities do not have adequate capacity to respond to a flood event compared to more complex road networks. Further, larger vehicles are more at risk of accidents in heavy winds due to their size. Wind-related road closures caused by fallen trees or debris will also disrupt transport routes. The asset damage category of moderate is defined as *"a serious event that requires additional emergency business continuity"* [9]*.*
	Heatwaves/ Droughts	1	Negligible	
	Cold Snaps	2	Minor	
	Extreme Rainfall	2	Minor	
	Flooding	3	Moderate	
	Landslides	2	Minor	
	Sea Level Rise	2	Minor	
	Severe Wind	3	Moderate	

Based on a qualitative judgement of impacts on assets across all the receptors identified, the frequency and impact score for each hazard were identified and classified for the Proposed Development (Table 10-22 below), with an illustrated graph presented in Figure 10-3.

Table 10-22: Summary of Current Climate Impacts for the Hazards Identified

Hazard Type	Current Frequency	Current Frequency Score	Average Impact Score (Across all Receptors)
Wildfires	Rare	1	1.8
Heatwaves/Droughts	Occasional	2	1.3
Cold Snaps	Very Frequent	5	2.3
Extreme Rainfall	Frequent	4	2.8
Flooding	Occasional	2	2.0
Landslides	Rare	1	2.0
Sea Level Rise	Occasional	2	1.5
Severe Wind	Occasional	2	2.8

Figure 10-3: Classification of Current Climate Hazards



**Frequency is measured from 1 (Rare) to 5 (Very Frequent). Impact is measured from 1 (Negligible) to 5 (Catastrophic). Further details are presented in Appendix 10-1.*

10.4.3.3 Potential Future Climate Risks

Understanding how climate change risks may evolve in the future is fundamental to identifying how existing risks may change as a result of climate change.

Table 10-23 below presents the future changes in climate hazards expected due to climate change, based on a desk-based review of the Climate Ireland platform. As assets are expected to remain similar throughout the operational phase of the Proposed Development, the level of impacts from these hazards will remain the same. For a complete understanding

of future climate risks, the CMIP climate scenarios outlined by Climate Ireland (RCP4.5 and RCP8.5) for the future period 2021-2050 is discussed.

The Climate Ireland platform was used to determine the potential changes in the frequency of these hazards. All climate hazards were assessed relative to the Proposed Development area as far as practicable.

Table 10-23: Future Changes in Climate Hazards Expected Due to Climate Change

Climate Hazard	Current Frequency Description	Future Frequency Description	Justification
Flooding	Occasional	Occasional	The Port of Waterford Strategic Flood Risk Assessment [5] completed a screening and scoping assessment for current scenario and future scenario flood events. Mid-Range 1 in 200-year and High Range 1 in 1000-year flood events were identified for each scenario, none of which intersect the Proposed Development. According to flood maps available, the Proposed Development is located within the bounds of the Catchment-based Flood Risk Assessment and Management (CFRAM) Programme for Low, Medium and High Probability flood events. Given there is no potential future change in frequency of flood events associated with the Proposed Development, the projected frequency of future flooding will remain "*Occasiona*l". Predicted flood extent, flood depth, and flood levels, as discussed in the SSFRA, were considered during the design of the Proposed Development [6]. The assessment outlines that the Proposed Development infrastructure has been explicitly designed to accommodate future climate change scenarios. Both the wharf extension and the proposed building structures shall be constructed above the predictive mid-range future climate change scenarios, 0.5% AEP+CC (1 in 200 year + climate change) flood level of 5.93mOD for the proposed wharf extension and 0.1% AEP+CC (1 in 1000 year + climate change) flood level of 6.08mOD for the proposed buildings. The effects of flooding on the Proposed Development will be imperceptible.
Sea Level Rise	Occasional	Common	The Port of Waterford has identified the Port to be tidally influenced by the Lower Suir Estuary. Future scenario tidal flood mapping identified an area 1,545m east of the Masterplan area where the River Suir and Barrow converge as being sensitive to extreme coastal flooding levels. According to flood maps available, the Proposed Development is located within the bounds of the Catchment-based Flood Risk Assessment and Management ('CFRAM') Programme for Current range, Medium range (0.5m sea level rise) and High range (1.0m sea level rise) coastal flood events (Figure 10-4 and Figure 10-5). Predicted flood extent, flood depth, and flood levels as outlined in the SSFRA were taken into account during the design of the Proposed Development [6]. As discussed in the above section, the Proposed Development infrastructure has been explicitly designed to accommodate future climate change scenarios, including sea level rise and increased tidal flooding, which incorporates mid-range future climate change scenarios based on +0.5m sea level rise, which is a standard proxy for climate resilience in coastal infrastructure. The findings of the SSFRA [6] state; *"the potential tidal/coastal flood risk to the proposed new wharf extension is therefore considered to be negligible".*

Climate Hazard	Current Frequency Description	Future Frequency Description	Justification
			The effects of flooding and sea level change on the Proposed Development will be imperceptible.
Heatwaves/Droughts	Occasional	Common	According to the Climate Ireland platform under RCP4.5 and RCP8.5, the number of heatwaves impacting the area associated with the Proposed Development are expected to increase by 0.2 and 0.27 heatwaves. Given that the area associated with the proposed development shows higher levels of projected drought occurrences (Figure 10-6) compared to the rest of the country, the frequency of the hazard has been upgraded to "*Common*".
Cold Snap	Very Frequent	Very Frequent	According to the Climate Ireland platform, under RCP4.5 the number of ice days (where the number of days when maximum temperature is <0°C) are expected to increase by 0.2 days between 2021-2050 associated with the Proposed Development. Under RCP8.5, the number of ice days are expected to increase by 0.17 days over the same period. Due to the low change in frequency expected for ice days, the frequency of cold snaps hazards will remain as "*Very Frequent*" (Figure 10-7 below).
Extreme Rainfall	Frequent	Very Frequent	According to the Climate Ireland platform, under RCP4.5 the number of days where precipitation will exceed 20mm (classified as a "Wet Day") is expected to be ca. 2.5 days. The number of wet days is modelled as 2.5 days under RCP8.5 also (Figure 10-8). Given the existing frequency of current rainfall events, under future climate change, the frequency of extreme rainfall will increase to "*Very frequent*".
Severe Wind	Occasional	Occasional	According to the EPA research paper updated High-resolution Climate Projections for Ireland published in 2025*, "Averaged over the country, the mean projected decrease in annual 10 m wind speed ranges from 1.2% (2021–2050 under SSP1-2.6) to 3.2% (2071–2100 under SSP5-8.5)* [31]*."* Although a reduction in wind frequency is projected, the change is considered not significant and therefore, the projected frequency of severe wind will remain the same.

Figure 10-4: Mid-range future scenario to tidal flood mapping,

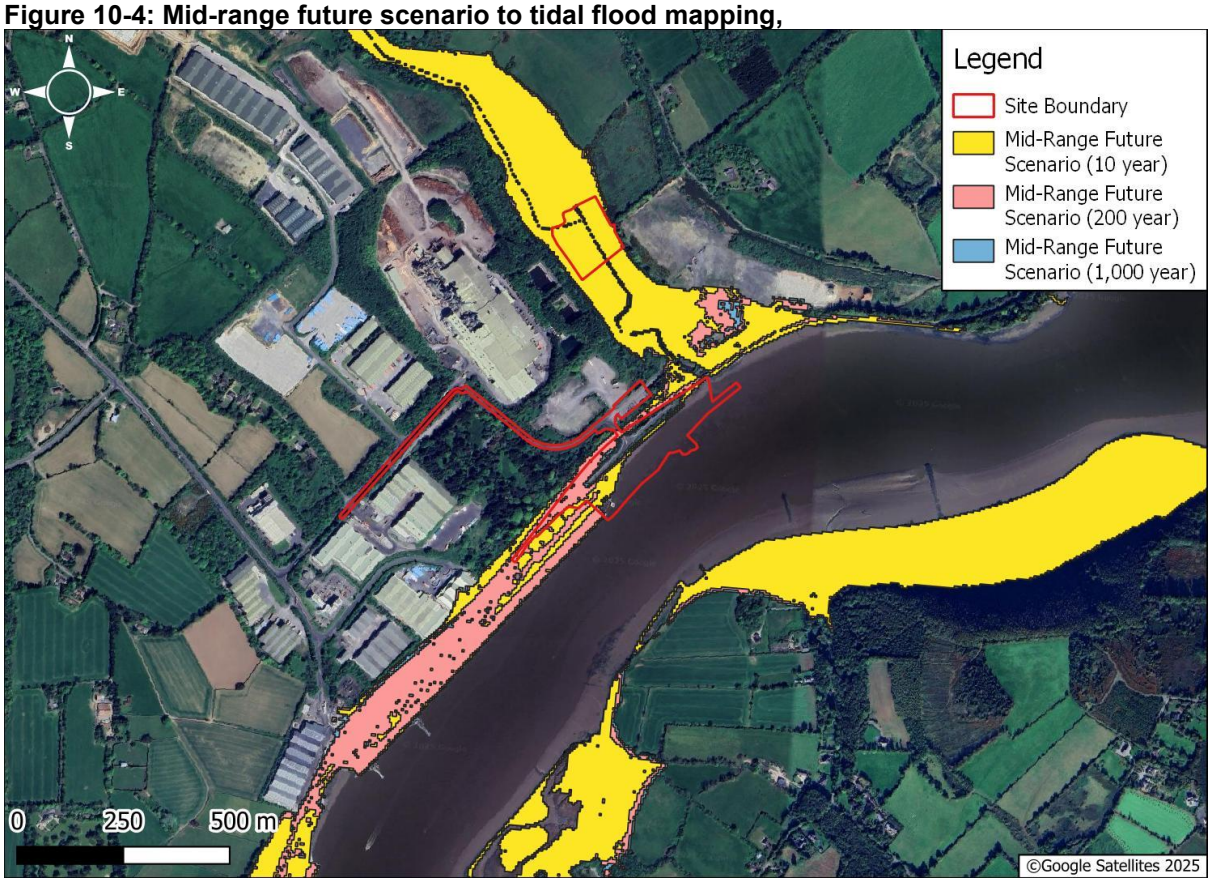


Figure 10-5: High-range future scenario tidal flood mapping,

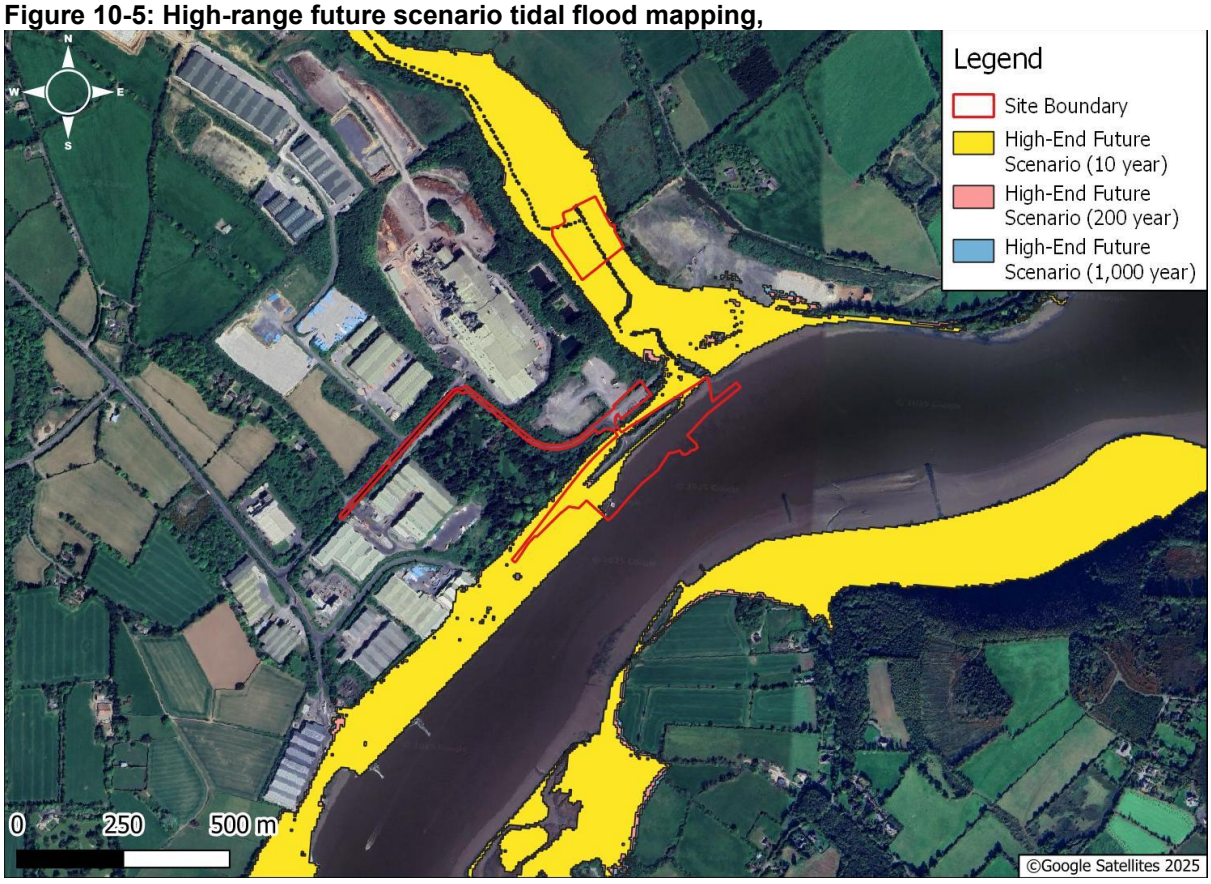


Figure 10-6: RCP4.5 and RCP8.5 Projected changes in number of heatwaves (2021-2050)

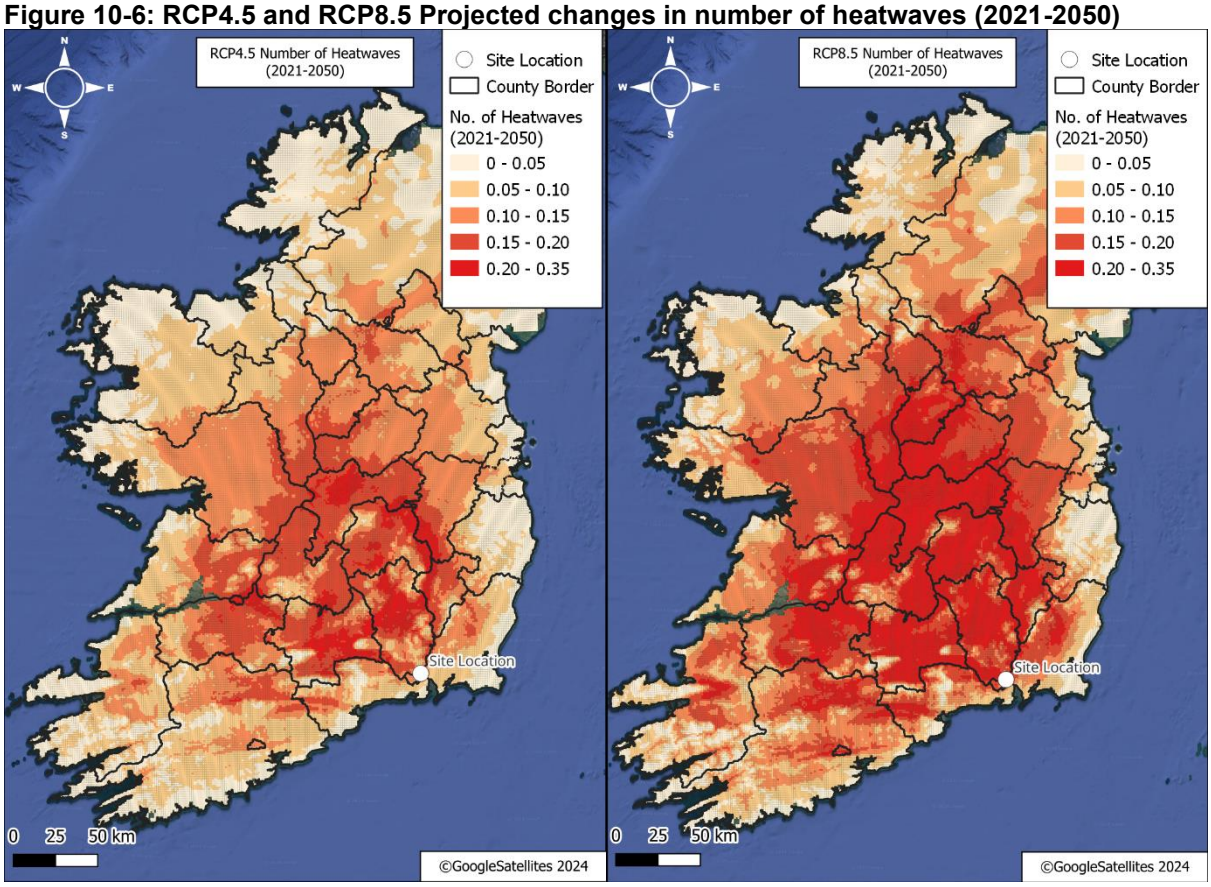


Figure 10-7: RCP4.5 and RCP8.5 Projected Changes in number of ice days (2021-2050)

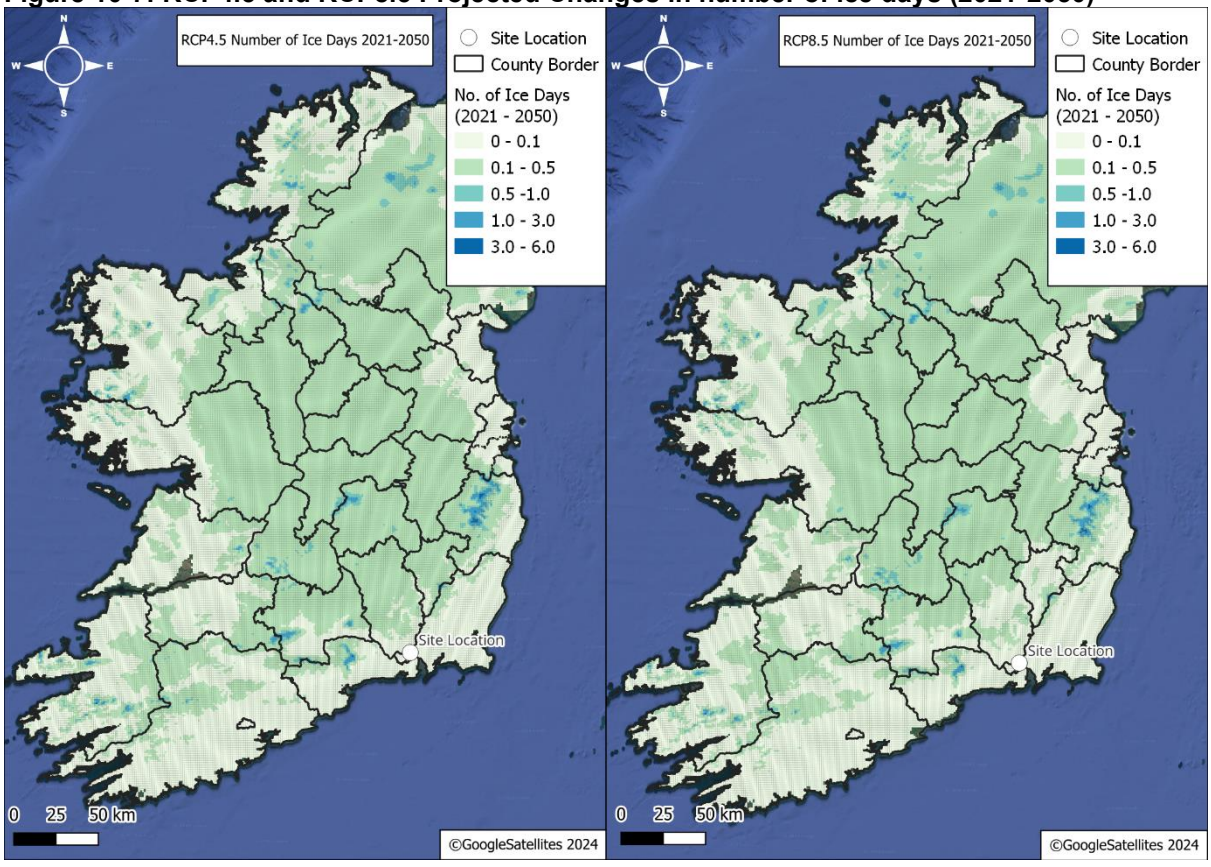
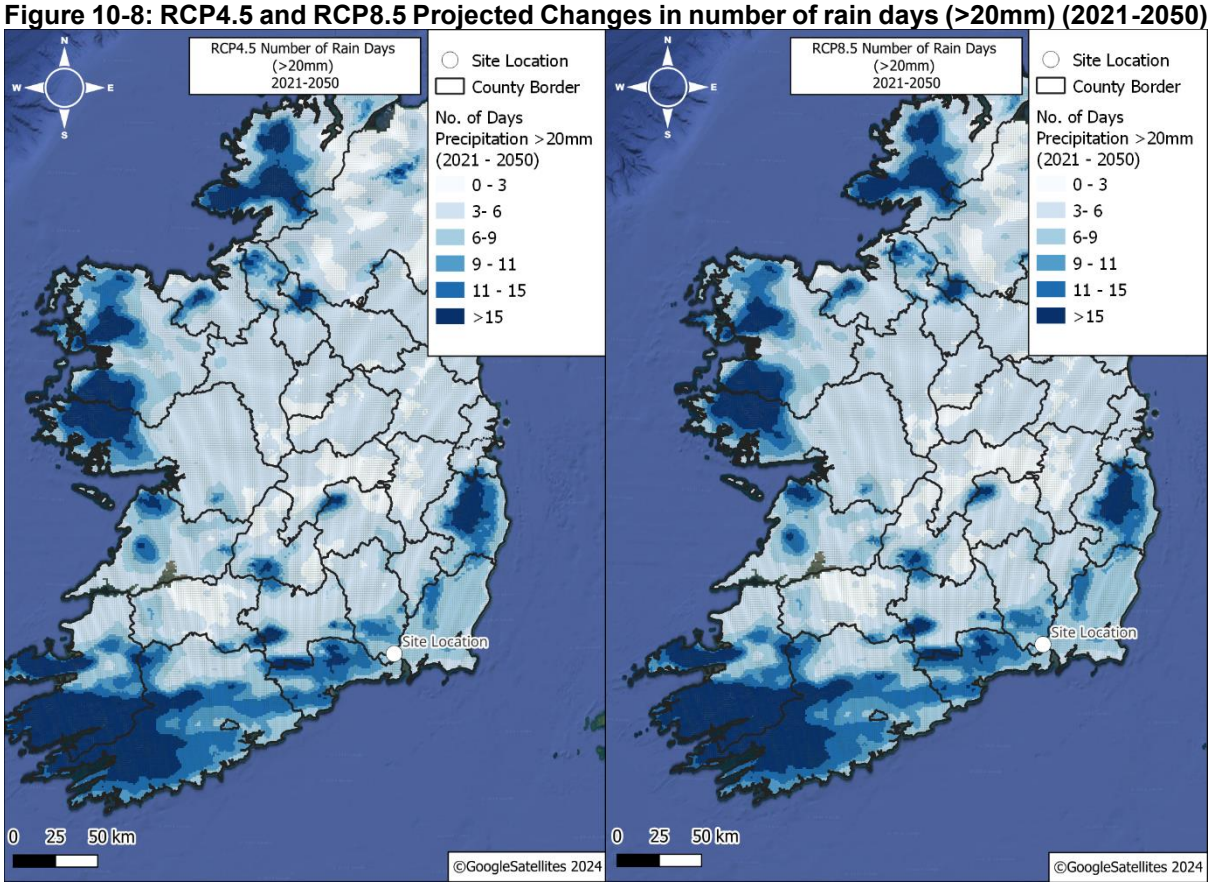


Figure 10-8: RCP4.5 and RCP8.5 Projected Changes in number of rain days (>20mm) (2021-2050)



Based on the availability of information, it was not possible to quantify the potential for future climate risks associated with wildfires and landslide susceptibility. Based on their current frequency, type and location of the Proposed Development and surrounding lands, the potential effects of these hazards on the Proposed Development were considered not likely and not significant.

The impact of future climate risks relating to flooding and sea level rises will be mitigated through consideration of predictive flood extent, flood depth and flood levels during the design stage of the Proposed Development. According to the Port of Waterford SSFRA [6], the Proposed Development infrastructure has been explicitly designed to accommodate future climate change scenarios. Both the wharf extension and the proposed building structures will be constructed above the predictive mid-range future climate change scenarios, 0.5% AEP+CC (1 in 200 year+climate change) flood level of 5.93mOD for the proposed wharf extension and 0.1% AEP+CC (1 in 1000 year+climate change) flood level of 6.08mOD for the proposed buildings. Therefore, the impacts as a result of these climate risks have been deemed not significant.

The impact of heat waves / droughts and cold snaps on the Proposed Development has been deemed imperceptible and minor. Therefore, although an increase in frequency is expected for heatwaves/droughts, the overall impact was assessed to be not significant.

Extreme rainfall frequency is expected to increase; however, due to the considerations given to the risk of flooding during the design stage of the Proposed Development and the impact score of “Moderate” across other receptors, the overall effect of this climate risk was deemed not significant.

As such, based on these results of the Climate Vulnerability Assessment, the potential effects of climate change on the Proposed Development were considered to be 'not likely' and 'not significant'.

10.4.4 Unplanned Events

Unplanned events relating to the Proposed Development include accidental fuel or chemical spills from vessels or machinery, fires or explosions in storage or operational areas, and vessel incidents such as collisions, groundings, or structural damage to infrastructure. The proximity of the Site to the Lower Suir Estuary also presents a risk of fluvial flooding, particularly under extreme weather conditions. While the Port of Waterford SSFRA [6] concluded that the risk of pluvial flooding will be imperceptible, the potential for unplanned discharges, such as from wastewater systems or ballast water, remains. These events, though unlikely, could have significant environmental consequences, particularly given the Site's proximity to sensitive aquatic habitats. As such, the Proposed Development will incorporate robust emergency response procedures, spill containment systems, and environmental monitoring to mitigate potential impacts already in place at the Site.

10.5 Proposed Mitigation Measures and/or Factors

10.5.1 Construction Phase

The selection process for a construction contractor will include a questionnaire on GHG emissions and mitigation measures. The response will be assessed as part of the Construction Tender Response evaluation process.

The selected construction contractor will have to prepare a GHG Emissions Reduction Plan.

In order to minimise GHG emissions during the Construction Phase, the following mitigation measures will be put in place:

- Where possible, materials for construction will be sourced locally, minimising transport requirements;
- Possibilities for re-use of clean, non-hazardous demolition material in construction works on-site will be considered following appropriate testing to ensure the material will be suitable for its proposed end use;
- Transport service, where practicable, will be provided for construction workers arriving at the Site during the Construction Phase;
- Where possible, idling plant will be switched off to reduce fuel use;
- Where possible surplus materials generated during the Construction Phase will be reused or recycled; and,
- Where continuous Site lighting will be required, it will be low energy.

10.5.2 Operational Phase

Once operational, the primary GHG emissions directly arising from the Proposed Development will be transport-related. Although these emissions will not be significant, a number of mitigation measures will be in place to further reduce GHG emissions related to the Proposed Development. These measures are detailed below.

- The use of alternative low-carbon fuel sources in freight vehicles where practicable;
- As part of the wharf extension, the pontoons will be designed to provide electricity for future electrification of the CTVs;

- The Port of Waterford already utilises a fleet of electric vehicles for staff use and will continue to do so; and,
- Transport service or carpooling, where practicable, will be provided for employees arriving to the Site to avoid the use of single-occupancy vehicles.

The Port of Waterford Energy Masterplan, 2021 [32] outlines the following potential GHG-reducing actions to be carried out at the port:

- Shore-to-ship power or alternative maritime power, providing shoreside electrical power to a ship at berth while its main and auxiliary engines are turned off. Emissions from heavy fuel combustion will be avoided;
- Increase the use of solar and wind energy at the port;
- Introduce Pilot boats with the following fuel systems: hybrid with diesel-electric / hydrogen or full electric powered;
- Introduction of fully electric container handlers; and,
- Utilisation of electric forklifts.

In addition, the Port of Waterford Energy Reduction & Decarbonisation Summary (2023) [33] outlines energy-saving measures for the Port of Waterford, some of which include the following:

- Improve energy management, including identification of abnormal energy use and savings opportunities;
- Automate energy and carbon performance reporting;
- Develop efficient infrastructure to reduce losses, manage harmonics and optimise voltage;
- Increase the use of clean energy on-site and reduce associated GHG emissions;
- Use of consumption data to optimise PV solar panel installations; and,
- Consider participation in a Carbon Disclosure Project Scheme.

10.6 Cumulative and In-Combinations Effects

A cumulative GHG emissions assessment of the Operational Phases of the Proposed Development, with the existing baseline carbon emissions from operations at the Port of Waterford, was carried out. In addition, emissions from maintenance dredging carried out under the Port's Dumping at Sea Permit issued by the EPA, Reg. No. S0012, were taken into account in the cumulative assessment. These emissions arise from the fuel used for the dredging vessels, and vary from year to year, depending on the extent of dredging carried out, arising from various factors, e.g. frequency and severity of storms. The only available data on GHG emissions arising from dredging is for 2019, provided by the Port of Waterford. This data was considered representative as the marine diesel emission factor would vary minimally, and these emissions represent a relatively small proportion of the overall cumulative emissions for the Port, and therefore, the impact of variance on the assessment was not material.

Regarding other GHG sources of GHG emissions, the nature of this entire assessment was cumulative as the GHG emissions were assessed against national and sectoral targets, which include all GHG emission sources - refer to the methodology in section 10.2.

Given the established baseline GHG emissions (see Section 10.3.4), the potential cumulative effects of the Operational Phase of the Proposed Development were assessed. Table 10-25

below presents the estimated cumulative GHG emissions associated with the Operational Phase, based on the established baseline Port of Waterford operational emissions.

Table 10-24: Cumulative GHG Assessment of the Operational Phase of the Proposed Development and the Port of Waterford Baseline Operational Emissions

Port of Waterford Baseline Emission Source	**Baseline (2023) tCO_2e**	**Proposed Development Operational Phase Emission Source**	**Proposed Development Operational Phase tCO_2e**	**Cumulative tCO_2e by Emission Source**
Ships	1,519	Freight Ships, CTV, SOV, Tugboat	4,121	5,805
Tugboats	165			
Cranes	434	Secondary Handling Machinery and Mobile Harbour Crane	233.9	700.9
Ancillary Equipment	33			
Pilot Launches	0	N/A	~	0
N/A	~	Operational traffic (HGVs and operational staff)	10,822	10,822
Port of Waterford Dredging Operations	**Baseline (2019) tCO_2e**	**Proposed Development Operational Phase Emission Source**	**Proposed Development Operational Phase tCO_2e**	**Cumulative tCO_2e by Emission Source**
Dredging	1,035	N/A	~	1,035
Ploughing/bed levelling	285	N/A	~	285
Port of Waterford Baseline Emission Source	**Baseline (2022) tCO_2e**	**Proposed Development Operational Phase Emission Source**	**Proposed Development Operational Phase tCO_2e**	**Cumulative tCO_2e by Emission Source**
Electricity	475	Electricity	97.6	572.6
Total Cumulative Emissions Operational Phase tCO_2e				**19,221**

N/A – Not applicable.

In the context of the baseline operations at the Port of Waterford, the cumulative GHG emissions associated with the Operational Phase of the Proposed Development were predicted to be ca. **19,221 tonnes of CO_2e** per operational year.

These cumulative GHG emissions arising from the Operational Phase will amount to ca. 0.05% of one year of the National Second Carbon Budget. Therefore, it can be concluded that the Operational Phase will have a 'not significant' cumulative effect with the existing Port of Waterford operations, including maintenance dredging, in the context of national GHG emissions.

While the direct cumulative effects were determined to be not significant in the context of national GHG emissions, the overall cumulative effect of the Proposed Development was considered to be positive when assessed within the broader context of national ORE.

10.7 Interactions with Other Environmental Attributes

- Chapter 5 (Population and Human Health) Climate change and GHG emissions are significant factors affecting human health and the overall quality of the living environment. However, the Proposed Development will not result in negative effects on human health';
- Chapter 6 (Biodiversity). Climate Change has the potential to impact ecosystems. However, the effects of GHG emissions associated with the Proposed Development was determined as not significant;
- Chapter 7 (Soil and Geology). Climate Change has the potential to directly impact soils and geology. The frequency of extreme rainfall events, extreme wind and tidal flooding has the potential to increase the risk of coastal erosion. Chapter 10 has concluded that the effects of these climate hazards on the Proposed Development will be 'not significant';
- Chapter 8 (Water). Climate Change can have a direct impact on water and has been shown to influence the Proposed Development. The frequency of extreme rainfall events is expected to increase under changing climate conditions. The effect of Climate Change on the Proposed Development, with respect to flooding, has been determined to be not significant;
- Chapter 9 (Air Quality). GHG emissions can directly impact air quality. However, it has been demonstrated in Chapters 9 and 10 that both of these effects will be 'not likely' and 'not significant'; and,
- Chapter 16 (Material Assets – Traffic and Transport). Climate Change is directly linked to GHG emissions, with road traffic considered one of the highest contributors to national emissions. The assessment on GHG emissions from vehicle movements associated with the Proposed Development has shown effects to be not significant in the context of National GHG emissions.

10.8 Indirect Effects

The Proposed Development will generate a range of indirect positive effects. Most notably, the Proposed Development will support the deployment and servicing of ORE projects, thereby contributing to the decarbonisation of Ireland's national energy system. While the Proposed Developments ORE capabilities were estimated to contribute approximately **657 tCO_2e** per year (consisting of SOV, CTV journeys, quayside fixed cranes, electricity demand for new buildings and employee transport), this will be more than offset by the indirect benefits of enabling large-scale offshore wind energy generation The closest ORE to the Proposed Development in operation is the Arklow Bank Wind Park Phase 1 off the coast of Wicklow, this ORE consists of seven turbines with an installed capacity of 25.2 MW and an estimated annual output of approximately 87,600,000kWh[4]. The ORE electricity generation has an annual offset potential of ca. **22,547 tonnes of CO_2e** associated with its operation. The Port of Waterford's enhanced infrastructure will support similar and larger-scale projects, reinforcing Ireland's renewable energy targets.

Additionally, the Proposed Development may reduce reliance on road-based freight transport by enhancing the port's capacity for bulk and container handling, indirectly lowering transport-related emissions in Ireland. Collectively, these indirect effects reinforce the strategic importance of the Proposed Development in supporting sustainable infrastructure and climate action objectives.

[4] *Annual energy production has been calculated considering Arklow Bank Wind Park Phase 1 capacity of 25.2 MW and typical offshore wind capacity factors in Ireland (ca.35–45%).*

The Proposed Development will facilitate the delivery of ORE infrastructure, directly supporting the construction and operation of offshore wind farms that are essential for Ireland to meet national and EU climate targets. Although it is not possible to quantify the precise reduction in national GHG emissions attributable to the Proposed Development, the project is anticipated to make a meaningful indirect contribution to the decarbonisation of the Irish economy. This will be achieved through the provision of critical ORE infrastructure, which supports the transition to a low-carbon energy system in line with national climate and energy objectives. As such, the Proposed Development will have an overall significant positive indirect effect in the context of the National Carbon Budget and relevant Sectoral Emissions Ceilings.

10.9 Residual Effects

Given the low levels of GHG emissions predicted during both the Construction and Operational Phases of the Proposed Development (refer to Section 10.4), the impact in the context of Ireland's National Carbon Budget and relevant sectoral emission ceilings will be imperceptible and not significant. Moreover, these emissions will be more than offset by the indirect positive contribution that the Proposed Development will make in supporting the national decarbonisation efforts, particularly through its support for offshore wind energy infrastructure and the reduction of land-based transport emissions. Taking into account the low calculated emissions and the substantial indirect benefits outlined in Section 10.8, the Proposed Development was considered to have an overall significant positive effect in the context of the National Carbon Budgets and relevant Sectoral Emissions Ceilings.

10.10 Monitoring

No monitoring of GHG emissions will be required; however, as the Port already has ISO14001 in place, the consumption of fuels and electricity will be monitored to ensure energy efficiency. In addition, the Port has outlined objectives related to GHG emissions within its Environmental and Sustainability Policies, provided in Appendix 17-1 and Appendix 10-4, respectively.

10.11 Reinstatement

Not applicable.

10.12 Difficulties Encountered in Compiling This Information

The level of information required to quantify Construction Phase GHG emissions thoroughly was not available at this time, and suppliers and contractors have not been selected at this point; therefore, specific information listed below was estimated:

- Carbon embedded into process equipment. For this, for each piece of equipment, the supplier would have to provide a CO_2e footprint of such equipment. However, specific suppliers have not been selected yet, and most suppliers of industrial equipment do not have such information; therefore, assumptions on materials were made and averaged emission factors were used;
- Based on the preliminary design that was available at the time of writing the report, materials cleared and dredged were estimated through an averaged emission factor; and,
- Specific run times for boats and vehicles used during the Construction Phase was not provided and therefore given a constant run time while taking average loads on common engine types for those pieces of machinery. Therefore, an overestimation was highly likely.

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