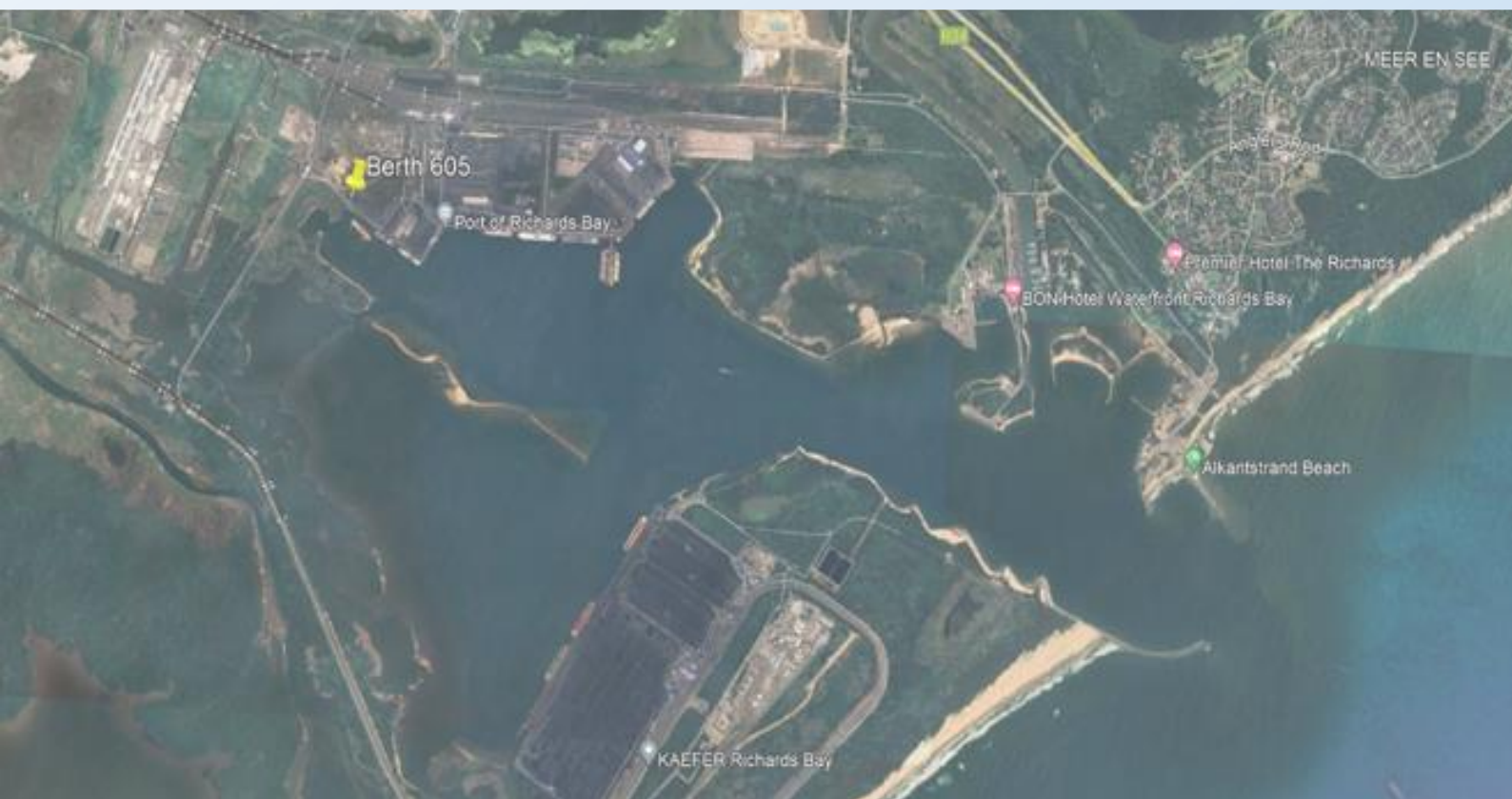


TRANSNET NATIONAL PORTS AUTHORITY

SCOPING AND ENVIRONMENTAL IMPACT REPORTING PROCESS FOR THE DEVELOPMENT OF NEW BERTH 605 AND ASSOCIATED INFRASTRUCTURE TO SUPPORT THE CONTAINER HANDLING FACILITY, PORT OF RICHARDS BAY, KWAZULU-NATAL

CLIMATE CHANGE IMPACT ASSESSEMENT FINAL REPORT



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**CLIMATE CHANGE IMPACT ASSESSEMENT FINAL
REPORT**

REPORT: CONFIDENTIAL

PROJECT NO. 43102877

OUR REF. NO. XRB.E.0030-T001-RPT-0089

DATE: JUNE 2025

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CLIMATE CHANGE IMPACT ASSESSEMENT FINAL
REPORT

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QUALITY CONTROL

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APPENDICES

APPENDIX A



EXECUTIVE SUMMARY

WSP Group Africa (Pty) Ltd (WSP) has been appointed by Transnet National Ports Authority (TNPA) to undertake feasibility and environmental studies for the development of Berth 605 and associated infrastructure (the Project) to support the Container Handling Facility. The Project requires an Environmental Authorisation (EA) and must be subjected to a Scoping and Environmental Impact Reporting (S&EIR) process. As part of the S&EIR process, a Climate Change Impact Assessment (CCIA) has been deemed necessary. This report presents an overview on the CCIA and Decarbonisation Plan for the proposed Berth 605 Project and associated infrastructure at the Port of Richards Bay in KwaZulu-Natal (KZN). The assessment focuses specifically on Berth 605 and its associated infrastructure and considers two components: the potential physical impacts of climate change on the Project, and a screening of Scope 1 and Scope 2 Greenhouse Gas (GHG) emissions that is anticipated for the Project.

The physical climate risk assessment identifies both chronic and acute regional climate projections and site-specific considerations. These include an increase in mean annual temperatures, a rise in the number of hot days, and the potential for more frequent heat extremes. Coastal risks such as sea level rise, storm surges, and wave activity were also assessed, along with changes in wind patterns. Without appropriate design and operational mitigation measures, these hazards are expected to pose a moderate level of risk to the Project. With suitable adaptation measures in place, such as heat stress management plan and flood defence strategies (e.g. sandbags) the overall risk profile is considered low. The GHG emissions screening focuses on Scope 1 and Scope 2 emissions directly attributable to the development and operation of the Project. Scope 1 emissions are expected from capital dredging, diesel-powered construction equipment, and temporary on-site generators. Scope 2 emissions are associated with electricity usage located within the Project boundary. No quantified GHG inventory has been developed due to the absence of activity data; however, a materiality-based screening approach has been applied to ensure that all major emission sources within the defined Project boundary have been identified and assessed.

A set of mitigation recommendations is proposed to support emission reductions, recognising that final implementation will depend on Project-specific feasibility and procurement decisions. These include the use of Tier II/III-compliant dredging vessels, hybrid or solar-assisted power systems during construction, and the adoption of lower-carbon construction materials. Over the longer term, integration with TNPA's planned renewable energy infrastructure, such as the 20 MW solar PV facility, may support the decarbonisation of electricity use during operations. Implementation of these measures may be considered through the Project's Environmental Management Programme (EMPr), technical specifications, and contractor requirements. A high-level roadmap is provided to support integration across design, construction, and operational stages. While alignment with TNPA's internal energy and just transition strategies was intended, these documents were not available at the time of reporting. In their absence, publicly available information on TNPA's ongoing initiatives was used to contextualise recommendations.

This report has been developed using best available data at the time of drafting. It is intended to serve as a practical and adaptable framework that supports climate-informed Project design, risk screening,



and the identification of emissions reduction opportunities for Berth 605 and its associated infrastructure.

ABBREVIATIONS

List of Abbreviations

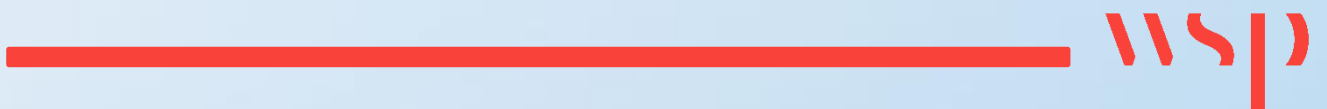
AEL	Atmospheric Emission License
AR4	Fourth Assessment Report
AR5	Fifth Assessment Report
AR6	Sixth Assessment Report
CCIA	Climate Change Impact Assessment
CCKP	Climate Change Knowledge Portal
CH ₄	Methane
CMIP6	6 th Phase of the Coupled Model Intercomparison Project
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ESMP	Environmental and Social Management Plan
GCMs	General Circulation Models
GHG	Greenhouse Gas
GHG Protocol	GHG Protocol Corporate Accounting and Reporting Standard
GPG	Good Practice Guidance
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
KZN	KwaZulu-Natal
N ₂ O	Nitrous Oxide
NCCRP	National Climate Change Response

NDC	Nationally Determined Contribution
NEM: AQA	National Environmental Management: Air Quality Act 39 of 2004
NGER	National Greenhouse Gas Emission Reporting Regulations 2017
PFCs	Perfluorocarbons
PCD	Port Chart Datum
PoRB	Port of Richards Bay
RCP	Representative Concentration Pathways
S&EIR	Scoping and Environmental Impact Reporting
SF ₆	Sulphur Hexafluoride
SRES	Special Report on Emissions Scenarios
SSP	Shared Socioeconomic Pathways
TNPA	Transnet National Ports Authority
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WML	Waste Management License
WMO	World Meteorological Organisation
WSP	WSP Group Africa (Pty) Ltd



1

INTRODUCTION



1 INTRODUCTION

Since the mid-20th century, global climate change has been primarily driven by anthropogenic activities, notably the combustion of fossil fuels, land-use change, and industrial emissions (Lindsey & Dahlman, 2024). The past decade has been the warmest on record, with 2024 projected to be the hottest year based on multi-dataset global temperature analyses extending back to 1850 (NASA, 2025; WMO, 2025). Global mean surface temperatures in 2024 are estimated to have reached 15.10°C, surpassing the previous record set in 2023 by 0.12°C. This represents a 0.72°C increase above the 1991–2020 average and a 1.60°C rise above pre-industrial levels, making 2024 the first full calendar year to exceed the 1.5°C threshold established under the Paris Agreement. This warming has been accompanied by several large-scale climatic changes, including increases in ocean heat content, more frequent and prolonged marine heatwaves, changing precipitation patterns, and more intense extreme weather events (Marvel et al., 2023). Africa, while contributing minimally to global greenhouse gas (GHG) emissions, faces disproportionate impacts from climate change. Key regional climate risks include rising temperatures, changes in rainfall seasonality, increased frequency of extreme heat events, and sea-level rise. These changes pose significant threats to climate-sensitive sectors such as agriculture, water, infrastructure, and coastal systems.

Semi-arid regions in Southern Africa are particularly vulnerable to climate change, with coastal areas and their associated infrastructure, including ports, facing elevated exposure to sea-level rise, storm surges, and erosion. Although the port sector contributes to climate change through emissions from cargo handling, transport, and energy use, it is also highly susceptible to climate-related disruption. Climate hazards relevant to ports include sea-level rise, intensified storms, elevated temperatures, and infrastructure degradation, all of which can impair port operations and damage assets (Cadario, 2024). KwaZulu-Natal (KZN), where the Port of Richards Bay is located, has experienced several recent events highlighting its exposure to climate-related hazards. On 15 March 2025, the eThekweni Municipality experienced extreme rainfall resulting in widespread flooding, mud-covered roads, and infrastructure damage (eNCA, 2025). Similarly, the June 2024 floods (NSRI, 2024) and earlier events in 2022 impacted Durban and surrounding areas, highlighting the vulnerability of coastal municipalities and port infrastructure to compound climate risks (Magubane, 2022).

As South Africa's largest bulk port, Richards Bay plays a central role in the national and regional logistics network. The proposed development of a new berth on the port provides an opportunity to embed climate considerations into infrastructure planning.

In response, WSP has been appointed by TNPA to undertake feasibility and environmental studies for the development of Berth 605 and associated infrastructure to support the Container Handling Facility. The New Berth 605 will ensure that the 606 to 609 berths are utilised for the Multi-Purpose Terminal (MPT) only and not for handling of containers. This will result in the improved operational efficiency of the MPT. Furthermore, the dedicated berths within the Container Handling Facility will ensure high operational efficiencies of the facility. The Project must be subjected to a Scoping and Environmental Impact Reporting (S&EIR) process in order to obtain an Environmental Authorisation (EA).

As part of the S&EIR process, a Climate Change Impact Assessment (CCIA) has been deemed necessary. This CCIA will identify and evaluate the potential climate-related risks associated with the proposed development, focusing on both acute and chronic climate hazards and appropriate

measures to improve climate resilience within the defined Project boundary. Furthermore, the assessment will consider the impact of the Project on Climate change.

This CCIA addresses two aspects of climate change integration in infrastructure planning.

- First, it evaluates the impact of climate change on the Project, identifying key vulnerabilities, exposure pathways, and risks that may affect Berth 605 during construction and operation. This includes acute and chronic climate risks such as sea-level rise, storm surge, and heavy rainfall events.
- Second, it assesses the impact of the Project on climate change through a Greenhouse gas (GHG) emissions assessment. Due to the early stage of Project development and the limited availability of design and procurement data, an estimate GHG assessment was conducted. This report uses a literature-based estimation approach, drawing from comparable infrastructure projects and peer-reviewed emission factors to approximate likely emissions. This is followed by a high-level decarbonisation plan that identifies mitigation levers and outlines potential emission reduction strategies across the project life.

Together, these two components provide a structured basis for incorporating climate considerations into the planning and implementation of the Project.

2

PROJECT DESCRIPTION



2 PROJECT DESCRIPTION

2.1 PROJECT LOCALITY

The Berth 605 Project is located within the Port of Richards Bay, King Cetshwayo District Municipality and uMhlathuze Local Municipality within the KZN Province (**Figure 2-1**). The overarching objective of the Project is to have a dedicated berth for the Container Handling Facility (CHF) at the Port of Richards Bay.

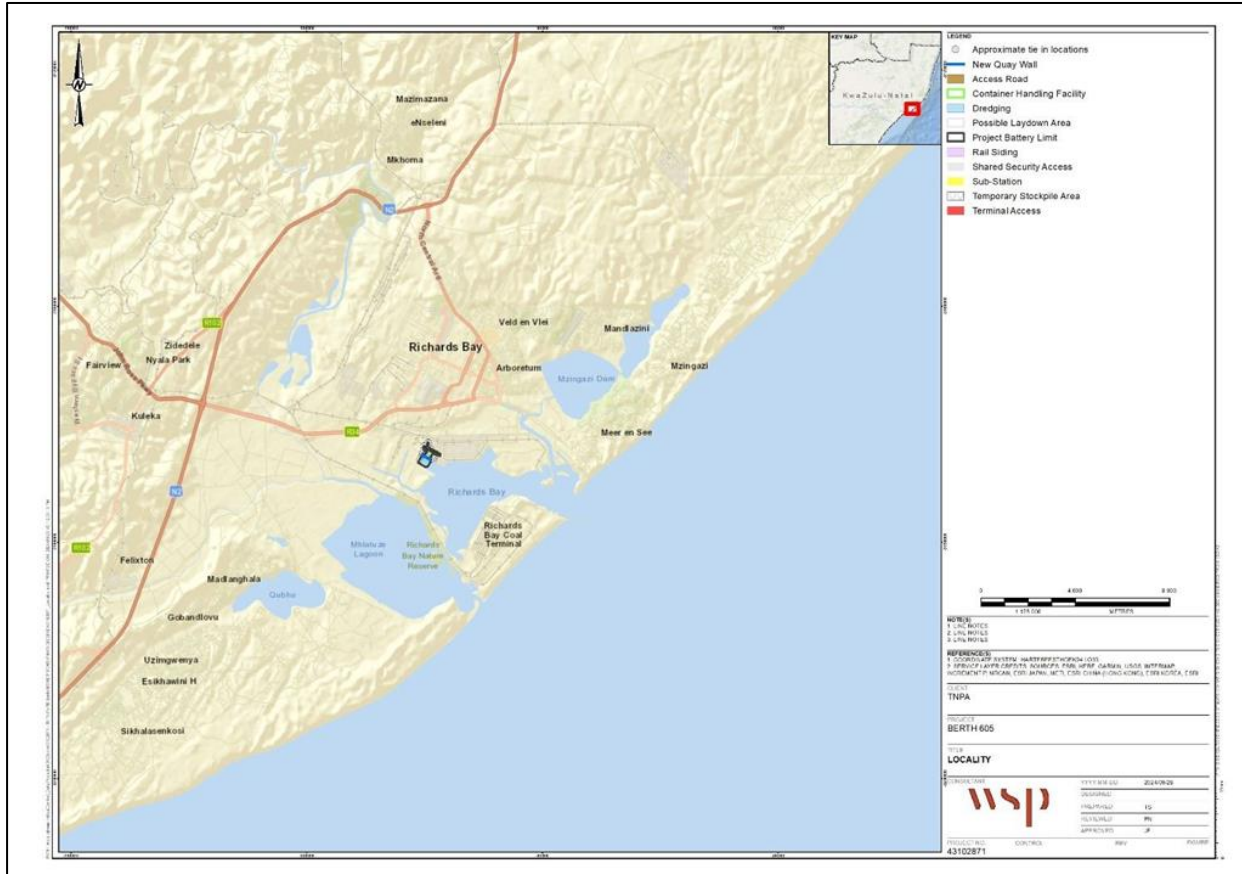


Figure 2-1 - Locality Map of the Berth 605 Project area

Figure 2-2 presents an overview of the site layout. This layout indicates the structures and infrastructure deemed necessary to achieve the overall objective of the Project:

- **New berth pocket and quay wall** – A new berth pocket and quay wall is proposed. The new proposed Berth 605 quay wall will extend from the existing Berth 606 quay wall maintaining the same cope line alignment (cope level is the top of the quay wall). On the other end of Berth 605, the quay wall will stop short of Urania Road. The quay is a mass gravity structure with a concrete foundation and walls with soil backfill internally which provides a wider footprint, but a lower density will result in a stable foundation, this is aligned to the existing Berth 606 quay wall and is considered as an economical design that has been used at the PoRB and Port of Coega. The quay wall is expected to be 366 m in length. The new quay wall is designed for a future depth of -19 m Port

Chart Datum (PCD). This will ensure that the berth can be lengthened and deepened without the need for additional quay wall deepening costs.

- **End of berth basin slopes** – The Berth 605 must fit within the space between the end of the existing Berth 606 and the South Dunes Road. With a slope of 1V:3H from -14.5 PCD to the existing ground level is 60 m long, this provides a total berth length of 338.5 m from the toe of the embankment to the start of Berth 606. This will support a vessel of 315 m Length Overall. A basin width of 305 m is applied to the bottom of the basin where a proclaimed depth of at least -14.5 m PCD is to be maintained.
- **Dredging** – The new Berth 605 quay wall will be constructed to -19 m PCD to allow for further Port expansion at a point in the future. For this project, the berth will be dredged such that a proclaimed depth of -14.5 m PCD is achieved, however the design dredging depth also considers sedimentation and sounding accuracy i.e. 0.6 m below -14.5 m PCD providing a design depth of -15.1 m PCD. This dredge depth is consistent with the PoRB depths and the requirements of the design vessel. This approach limits the volume of dredge material requiring disposal.
- **Dredge disposal** – An estimated 2.8 million cubic metres of dredged material will be disposed of at an existing authorised offshore disposal site. However, it is estimated that a bulked volume of approximately 3.6 million cubic metres will be disposed of at the offshore dump site. The difference between the actual dredged volume and the bulked volume is the 'bulking factor' of 1.3 which indicates that the dredged volume is not the same as the volume that will be disposed of at sea considering that it will be loosened during handling and thereby increase in volume. The loosened material to be disposed of will have the same weight as the dredged material but it will differ in volume as it is no longer compacted material.
- **Scour protection** – The concept design evaluated the necessary scour protection to prevent excessive erosion, which will compromise the structural integrity of nearby infrastructure, such as Urania Road, or cause excessive sediment movement within the berth pocket. The movement of material within the berth is also of significant concern. The depth of the berth pocket is impacted when material erodes from one area and is deposited elsewhere in the berth pocket. Consequently, maintenance dredging will be required to maintain the required berth pocket minimum navigation depth. A revetment (sloped embankment) will be constructed on the seaward side of the Urania Road. This slope must be protected against wave and propeller action to maintain the structural integrity of the Urania Road. A riprap scour protection system has been considered.
- **New rail siding** – Based on the design throughput and the current requirement of a 50-wagon container train and 2 locomotives, it is proposed that the rail siding will consist of two rail lines that are 370 m each in length, each servicing 25 rakes. The existing Mhlatuze Yard will be used for shunting and staging purposes to service the new proposed rail siding.
- **New access road** – a new shared access road and vehicle access control point to the PoRB, the CHF and the adjacent vacant land surrounding the CHF is proposed. The new road will be an estimated 735 m length with a lane width of 3.7 m and a reserve width of 30 m. It will consist of two (2) lanes each direction and three (3) intersections; at Urania Road, at Ventura Road and one to the CHF. The shared access road will also have a security control facility as the road is accessible from outside of the Port's security perimeter. Street lighting will be provided for as part of the new road network extension. It must be noted that the road itself and the berth will not be traffic generating, the traffic that will be generated is associated with the operation of the CHF which will be designed by the future operator.

- **Footprint of the CHF and apron area** – The CHF will be built and operated by the operator therefore this S&EIR process only considers the disturbance footprint of the CHF and not the associated permits that it will require when operational. The total area considered is 6.75 Ha for the CHF with estimated dimensions of 270 m x 250 m. The apron area is an operational area located behind the quay wall and is used for the movement of trucks. The apron area is an estimated 33 m wide and 400 m in length.
- **Provision of electrical supply to feed the facility operations and equipment** – The preferred alternative is applicable where the required electrical demand is within the available capacity of the current existing 11 kV network. A new feed will be taken from the existing 11 kV network to provide electrical power to the new CHF and quay wall. However, while there is existing capacity on the current 11 kV network, this is limited and may not be able to provide for the full electrical demands in the future. To protect against restricting future electrical supply constraints, a new 11 kV Switching Station fed from the existing Primary Substation is proposed.
- **Water** – The concept design allows for water to be sourced from the municipal supply. There are three municipal feeds into the port, supplied by two separate municipal reservoirs. This provides adequate supply contingency, and therefore, no additional storage has been included in the system. The existing 225 mm diameter water main will be extended along with the new quay wall to supply ship water along the new quay. At the end of the new quay wall extension the water main will follow Urania Road to tie into the existing 150 mm diameter pipe in the vicinity of the existing gate house. Connections to new buildings will be off takes from either the existing network directly, or via extensions to the existing network brought to the boundary of the proposed CHF. A tie in point will be provided. Connections to new buildings will be off takes from either the existing network directly, or via extensions to the existing network brought to the boundary of the proposed CHF. A tie in point will be provided which will consist of approximately 500 m of pipework with a diameter of 150 mm. Inside the quay wall, water will be provided to landing valves for ships and firefighting.
 - Building water - A new 75 mm diameter pipe will branch off from the 150 mm diameter water pipe to supply a metered connection for the handling facility. Any connections to new buildings will be made from the metered supply point, located on the western side of the site, just south of the Seafarers club. The CHF operator will be responsible for the water network within the facility.
 - Ship water - The proposed new water main line will tie into the existing 225 mm diameter asbestos cement water pipe, that is in the existing quay of Berth 606, located on the eastern side of the new Berth 605. The new pipe will be 200 mm diameter, within the new quay wall, with 75 mm off takes to the landing valves. The 200mm diameter pipe reduces in size to a 160 mm diameter, where the pipe exits the new quay wall and is parallel to Urania Road and will tie into the existing 150 mm diameter asbestos cement pipe north of the existing security access to complete the ring.
 - Fire water - The fire water in the PoRB is off the water reticulation network. Allowance for fire-hydrants will be made where there isn't a dedicated firefighting system. This allowance is for normal hydrants outside the CHF boundary along the lengths of pipelines that will be installed to service the new quay wall extension.
- **Sewerage** – The existing sewer network has been evaluated to identify areas that require upgrades to accommodate the extension of the sewer network for the new proposed CHF. The sewerage system will allow for wastewater from new toilets, basins, baths and showers. The proposed sewer

will be designed to tie into the closest existing pipe network or an existing pump station closest to the proposed CHF. Sewerage inside the CHF will be designed to accommodate for approximately 160 people. The new sewerage pipeline will have a connection point at the northwestern boundary of the CHF. It will be approximately 100 m in length and 160 mm pipe diameter. The preferred alternative involves designing a sump to accommodate the facility's sewer through gravity flow, with pumping from the sump to the existing pumpstation PS20, located north of the facility. The final sewer pipe route will be determined during the design phase.

- **Stormwater** – With the hydrological analysis complete and design flows computed, the stormwater pipes were sized. The minimum size of stormwater pipelines is 600 mm diameter, which considers effective maintenance of the stormwater network. The stormwater pipe system has been designed to accommodate a 1 in 5-year storm. The proposed CHF, as well as any future development adjacent to Berth 605 will require major floods to flow overland into the bay. The area will therefore have to be designed and shaped to accommodate overland flow during a major storm, to prevent water ponding and to control flood damage to any infrastructure. Conventional catchpits, at 50 m to 80 m spacing, have been shown along the proposed access road. The access road stormwater is then routed in a pipe system to the bay at a slope of 0.5%. The pipeline will be approximately 360 m along the quay line and 400 m on the other side with a 900 mm pipe diameter. It will have a velocity of 0.6 m/s for self-cleaning, to prevent sand settling inside the pipe and blocking. There will also be cross drainage at the new rail siding which will be 400 m in length and 600 mm diameter. The existing network discharges into the bay through the existing quay wall.
- **Provision for temporary laydown and stockpile areas** – Areas for temporary stockpiles and laydown areas have been designated and will be further assessed as part of the project. An approximate area of 4.2 Ha, 220 m in length and 170 m wide to be used as a potential lay down area for the project (alongside the proposed CHF). In addition, two temporary stockpile areas are proposed which are split into two areas across the Harbour Arterial Road. These areas cover an area of approximately 6 Ha. The infilling of approximately 6 Ha of the basin is also being considered for stockpiling (this infilled area also forms part of the basin to be dredged).

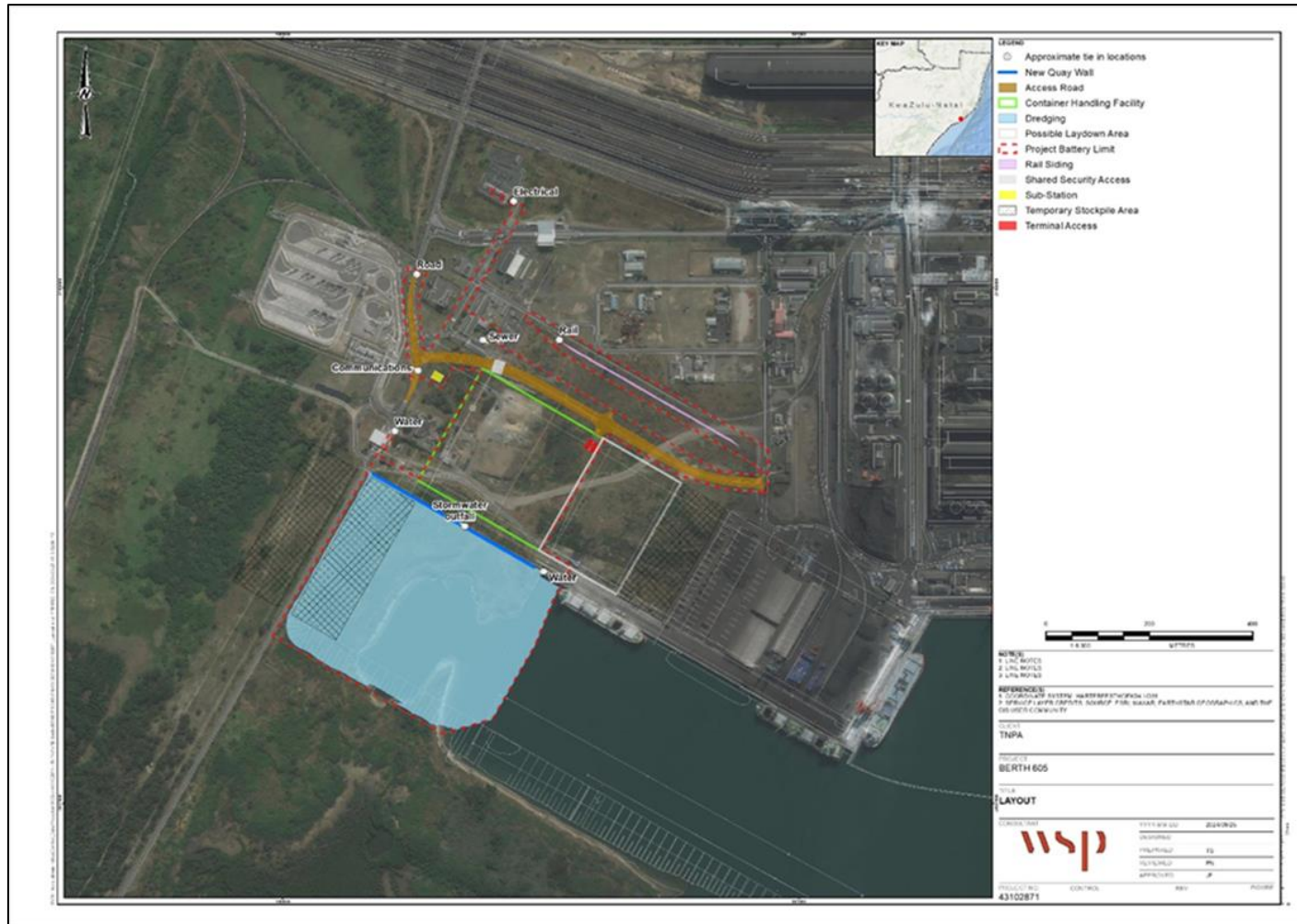
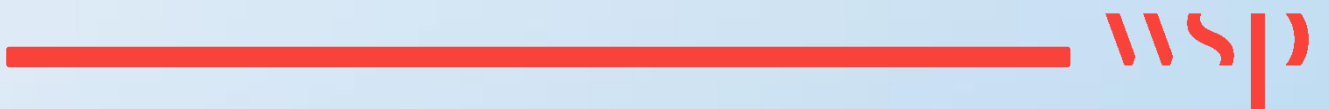


Figure 2-2 - Berth 605 Site layout

3

METHODOLOGY



3 METHODOLOGY

This section outlines the methodology that will be used, detailing the scope, objectives, and key tasks involved in evaluating both the impacts of climate change on the Project and the impact of the Project on climate change (i.e., GHG assessment). The evaluation of these key tasks will include the use of baseline and projected climatic data obtained from the World Bank Group Climate Change Knowledge Portal (CCKP). The assessment also employs other sources including the Greenbook and literature to assess climate related hazards and lastly the report provides a high level GHG assessment and decarbonisation plan.

3.1 IMPACT OF CLIMATE CHANGE ON THE PROJECT

This component examines the potential impacts of climate change on the Project and includes the following tasks:

- Description of the current climate baseline of the region.
- Description of the projected changes in climate for the region under two shared socio-economic; pathways (medium-high mitigation and low mitigation).
- Desktop review of potential physical climate change impacts that significant Project components are most vulnerable to.
- High-level review of adaptation measures, as required.

3.2 IMPACT OF THE PROJECT ON CLIMATE CHANGE

This component evaluates the impact of the Project on climate change in terms of GHG assessment and comprises the following tasks:

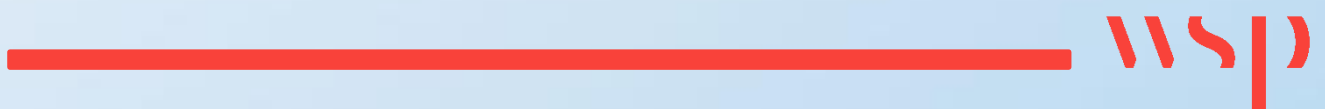
- Desktop review of the relevant legislation for the Project.
- Review of the organisational and operational boundaries associated with the Project.
- Compile GHG inventory for the Berth 605 Project based on data provided by TNPA and supplemented where necessary with publicly available literature data. The inventory will include emissions from Scope 1 and Scope 2; and
- Evaluate and tabulate annual GHG emissions for the Project as carbon dioxide equivalent (CO₂e) and compare with the South Africa's National Determined Contribution (NDC) targets.

3.3 DECARBONISATION PLAN

A separate Decarbonisation Plan will be developed in alignment with TNPA's Energy Policy, Just Transition Strategy, and Disaster Management Plan. This plan will specifically address the Berth 605 Project and will not encompass the entire Port of Richards Bay. The focus will be limited to Scope 1 and Scope 2 emissions associated with the proposed Project. Notably, Scope 3 emissions are excluded from the scope of this plan.

4

APPLICABLE POLICIES, LEGISLATION, GUIDELINE AND STANDARDS



4 APPLICABLE POLICIES, LEGISLATION, GUIDELINE AND STANDARDS

This section provides an overview of the applicable policies, legislation, guidelines, and standards that form the framework for addressing GHG and climate change issues relevant to the Project. It includes international and national policies, highlighting their relevance to the Project. **Table 4-1** and **Table 4-2** summarise the key policies and their alignment with the Project.

Table 4-1 - Applicable policies, legislation, guidelines and standards - International

Policy, legislation, guideline or standard	Relevance to the Project
International Policy	
<p><i>The Intergovernmental Panel on Climate Change (IPCC) is a panel established in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) to provide independent scientific advice on climate change.</i></p> <p><i>This first Assessment Report (AR1) of the IPCC served as the basis for negotiating the United Nations Framework Convention on Climate Change (UNFCCC).</i></p>	<p>The IPCC Policy is relevant to the Project. The main role of the policy is to provide policymakers with regular assessments of the scientific basis of climate change, its impacts, and possible adaptation and mitigation strategies. The Project should align with the IPCC assessments to mitigate climate risks and ensure compliance with environmental regulations. Additionally, the IPCC data aids in risk assessment and long-term planning, informing decisions on infrastructure design and Project sustainability. Therefore, the Project's integration of IPCC policies supports climate resilience and aligns with global climate goals.</p>
<p><i>The Paris Agreement, which was adopted in December 2015, is an international accord within the UNFCCC. Its main objective is to limit global warming to well below 2 degrees Celsius above pre-industrial levels, with efforts to limit it to 1.5 degrees Celsius. To achieve this, the agreement aims to enhance the global response to climate change by strengthening countries' abilities to deal with the impacts of climate change and reducing GHG emissions (2015).</i></p>	<p>The Paris Agreement does not single out specific industries, rather it sets a framework for parties to develop and submit their own Nationally Determined Contributions (NDCs). These NDCs are country-specific climate action plans that outline the measures and targets each country will undertake to contribute to the global effort in combating climate change.</p> <p>The Paris Agreement also emphasises transparency and accountability and requires parties to regularly report on their GHG emissions and progress towards their NDCs.</p> <p>In support of the objective of the Paris Agreement the current CCIA provided an overview of potential material emission sources in addition to the mitigation measures.</p>
<p><i>Sustainable Development Goals (SDGs)</i></p>	<p>Sustainable Development Goals (SDGs) are global actions to achieve a better and more sustainable future. They recognise that ending poverty and other deprivations must go together with strategies that improve health and education, reduce inequality, and spur economic growth, all while tackling climate change and working to preserve our oceans and forests. SDG 9 (Industry and Infrastructure) and SDG 13 (Climate Action) are applicable to this assessment. SDG 9 supports Target 9.1 by promoting the development of reliable, sustainable, and climate-aligned port infrastructure. The integration of climate risk screening and a high-level decarbonisation plan contributes</p>

Policy, legislation, guideline or standard	Relevance to the Project
	to SDG 13 by supporting adaptation measures (13.1) and the inclusion of climate considerations in infrastructure planning (13.2).
<i>Greenhouse Gas Protocol (GHGP)</i>	<p>The Greenhouse Gas Protocol (GHGP), a joint initiative of World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD), arose out of the need to help countries and companies account for, report, and mitigate emissions, based on a report that identified an action agenda to address climate change that included the need for standardized measurement of GHG emissions. The GHGP provides accounting and reporting standards, sector guidance, calculation tools and trainings for businesses and local and national governments. It has created a comprehensive, global, standardised framework for measuring and managing emissions from private and public sector operations, value chains, products, cities and policies to enable GHG reductions across the board.</p> <p>The GHGP will be used in quantifying the GHG emissions for the proposed Project.</p>
<i>International Maritime Organization (IMO) Regulations; Greenhouse Gas Emissions Reduction (2023)</i>	<p>The International Maritime Organization's (IMO) revised GHG emissions strategy aims to reduce 20% (striving for 30%) of emissions by 2030 and 70% (striving for 80%) of emissions which would require the average ship to reduce its GHG intensity by ~90% by 2040. Moreover, the strategy aims for 5-10% of the energy used in shipping in 2030 to have zero/near-zero GHG emissions. The goals of this strategy's energy transition are aligned with those of the Paris Agreement, by introducing a fuel standard and a market-based measure through a GHG pricing mechanism to incentivize shipowners and fuel suppliers to reduce emissions.</p>
<i>International Convention for the Prevention of Pollution from Ships (MARPOL)</i>	<p>The Convention focuses on regulations aimed at preventing and minimizing pollution from ships, both from accidental pollution and pollution from routine operations. The MARPOL Protocol of 1978 has been updated by amendments through the years. Some regulations included in the Protocol include:</p> <ul style="list-style-type: none"> ■ Tankers are required to have double hulls ■ No discharge or residues containing noxious substances is permitted in 19km of the nearest land ■ Requirements for the packing, marking, labelling, documentation, stowage and quantity limitations of harmful substances ■ Regulation of sewage pollution ■ Disposal of garbage and plastics in the sea <p>Limits on Sulphur Dioxide, Nitrogen Oxide and Particulate matter emissions</p>
<i>The World Association for Waterborne Transport Infrastructure (PIANC) Working Group 178</i>	<p>The PIANC Permanent Task Group on Climate Change (PTGCC) Technical Note aims to protect owners, designers and financiers address climate change by detailing how future climatic scenarios will affect waterborne transport infrastructure. It includes a four-stage methodological framework for improved resilience:</p> <ul style="list-style-type: none"> ■ Stage 1: Details how assets, operations and systems could be impacted ■ Stage 2: Climate-related information needed to develop an adaptation strategy ■ Stage 3: How the vulnerability of waterborne transport infrastructure, operations and systems can be assessed ■ Stage 4: Potential measures to be considered when developing an adaptation pathway
<i>International Association of Ports and Harbors (IAPH) and World Ports Sustainability Program (WPSP; 2018)</i>	<p>The International Association of Ports and Harbors (IAPH) is a non-governmental organization (NGO) that is the global trade association for seaports worldwide which focuses on issues such as port development, sustainability, digitalisation, policy advocacy and port efficiency. In 2018, the WPSP was launched to demonstrate global leadership of ports in contributing to the SDGs. The program builds on the World Ports</p>

Policy, legislation, guideline or standard	Relevance to the Project
	<p>Climate Initiative that was developed in 2008 by IAPH and focuses on climate and energy as a main theme.</p> <p>The program aims to facilitate the decarbonisation of ports around the world by providing climate adaption planning and emission reduction initiatives which include the use of the Environmental Ship Index (ESI). Furthermore, the development of its Clean Marine Fuels toolkit, Port Readiness Level tool involvement in the Clean Energy marine Hubs platform is used by IAPH to help build a Net Zero future.</p>

Table 4-2 - Applicable policies, legislation, guidelines and standards – National

Policy, legislation, guideline or standard	Description
National Policy and Strategy	
<i>South Africa's National Climate Change Response Policy White Paper (NCCRP) (2011)</i>	<p>The National Climate Change Response Policy is a comprehensive strategy to address both mitigation and adaptation in the short, medium and long term (up to 2050).</p> <p>Strategies are specified for the following areas:</p> <ul style="list-style-type: none"> ■ Carbon Pricing. ■ Water Agriculture and commercial forestry. ■ Health. ■ Biodiversity and ecosystems. ■ Human settlements. ■ Disaster risk reduction and management. <p>The policy has two main objectives: first, to manage inevitable climate change impacts through interventions that build and sustain social, economic and environmental resilience and emergency response capacity. Secondly, to make a fair contribution to the global effort to stabilise GHG concentrations in the atmosphere.</p> <p>The current assessment aligns with the NCCRP white paper because the proposed mitigation measures for the GHG emission sources will be outlined to indicate how the Project can minimise its impact or contribution to climate change.</p>
<i>National Climate Change Adaptation Strategy (NCCAS) (2020)</i>	<p>The NCCAS provides a common vision of climate change adaptation and climate resilience for South Africa, and outlines priority areas for achieving this vision. It draws on South Africa's NCCRP (DEA 2011), the National Development Plan (NDP) (NPC 2011), the adaptation commitments included in its NDC, sector adaptation plans, provincial adaptation plans and local government adaptation plans.</p> <p>The main objective of the strategy is to provide guidance across all levels of government, sectors, and stakeholders affected by climate variability and change. It should also serve as the country's National Adaptation Plan and fulfils the commitment to its international obligations under the Paris Agreement.</p>
<i>South Africa's Nationally Determined Contribution (NDC, 2021)</i>	<p>South Africa updates and enhances its NDC under the Paris Agreement, meeting its obligation under Article 4.9 to communicate NDCs every five years, and responding to the requests in paragraphs 23 to 25 of decision 1/CP.21. The NDC was updated in 2021 to account for developments and increased ambitions since the first submission.</p> <p>The updated NDC further outlines mitigation targets with two periods of implementation (2021-2025 and 2026-2030). For 2025 target year the lower boundary is set at 398 MtCO₂e with an upper boundary set at 510 MtCO₂e, while 2030 target year has a range of 350-420 MtCO₂e.</p>

Policy, legislation, guideline or standard	Description
	<p>South Africa's updated NDC targets are aligned with planned policies and measures to provide opportunities for accessing large-scale international climate finance to fund low-carbon infrastructure, and to fund the just transition. The climate change impact assessment is carried out in the context that South Africa has GHG emission targets, and these projects need to understand what their GHG contribution will be.</p> <p>The updated 2021 NDC will be used to determine the contribution of the Project to the overall lower NDC target for 2030.</p>
National Legislation and Regulations	
<i>South Africa's National Environmental Management: Air Quality Act (NEM: AQA 2004)</i>	<p>The South African National Environmental Management: Air Quality Act aims to promote the protection of the environment and human health by regulating air quality and preventing air pollution in South Africa.</p> <p>The Act states that the contents of a provisional atmospheric emission licence and an atmospheric emission licence must specify GHG emission measurement and reporting requirements. The current assessment will align with this, in that the method used for GHG measurement or calculations will be outlined in the final CCIA report under the section that focuses on the impact of the Project on climate change.</p>
<i>South African National Greenhouse Gas Emission Reporting (NGER) Regulations (2017)</i>	<p>The Reporting Regulations adheres to the National Environmental Management Air Quality Act. The purpose of the National Greenhouse Gas Emissions Reporting Regulations (NGER) is to introduce a single national reporting system for the transparent reporting of GHG emissions, which will be used to maintain a National Greenhouse Gas Inventory, allow South Africa to meet its UNFCCC reporting obligations and to inform the formulation and implementation of legislation and policy.</p> <p>The emission sources and data providers who are covered by the Regulations are set out in Annexure 1 and Regulation 4. The Regulations also set out the reporting requirements, calculation methodology, verification procedure (to be carried out by the National Inventory Unit) and penalties (which include fines and imprisonment).</p> <p>The NGER Regulations will be considered in calculating the GHG emissions associated with the proposed Project.</p>
<i>Declaration of Priority and Pollution Prevention Plans (2018)</i>	<p>Under Section 29 of the South African National Environmental Management: Air Quality Act (NEM: AQA 39 of 2004), Government Notice 710 of 2017 (Government Gazette 40996), the following GHGs have been declared as priority pollutants.</p> <ul style="list-style-type: none"> ■ Carbon Dioxide (CO₂). ■ Methane (CH₄). ■ Nitrous oxide (N₂O). ■ Hydrofluorocarbons (HFCs). ■ Perfluorocarbons (PFCs). ■ Sulphur hexafluoride (SF₆). <p>Further, persons falling within the list of production processes, specified in Annexure A, which involves emission of GHGs above 0.1 Mt annually are required to prepare and submit to the Minister pollution prevention plans for approval in line with NEM: AQA, Government Notice 712 of 2017 (Government gazette 40996). Secondly, any person conducting a production process set out in Annexure A as a primary activity is required to submit a pollution prevention plan.</p> <p>The first pollution prevention plan must cover a period from the date of promulgation of these Regulations up to 31 December 2020 and the subsequent pollution prevention plans must cover periods of five calendar years each.</p>
<i>South African Carbon Tax Act (2019)</i>	<p>The Act imposes a tax on carbon dioxide equivalent (CO₂e) GHG emissions. The tax follows the polluter pays principle to ensure that high-emitting companies are accountable for their contribution to climate change.</p>

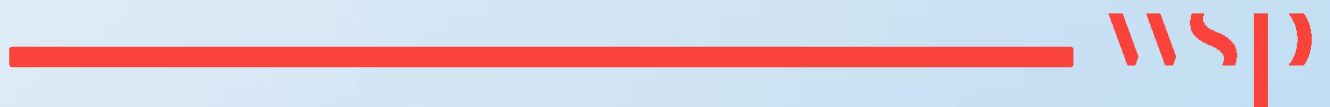
Policy, legislation, guideline or standard	Description
	<p>The legislation outlines that the carbon tax rate starts at R120 per tonne of CO₂e emitted within the 2019 reporting year and will increase by consumer price inflation (CPI) +2% until the end of 2022, after which it will only increase by consumer price inflation.</p> <p>According to the act person is (a) a taxpayer for the purposes of this Act; and (b) liable to pay an amount of carbon tax calculated as contemplated in section 6 in respect of a tax period as specified in section 16 if that person conducts an activity in the Republic resulting in GHG emissions above the threshold determined by matching the activity listed in the column “Activity/ Sector” in Schedule 2 with the number in the corresponding line of the column “Threshold” of that table.</p> <p>By accounting for the GHG emissions, the organisation can determine its emissions level and whether the polluter pays principle is applicable to it considering that high emitting companies are held accountable for their contribution to climate change.</p>
<p><i>Draft National Guideline for the Consideration of Climate Change Implications in Applications for Environmental Authorisation, Atmospheric Emission Licence (AEL) and Waste Management Licence (WML) (2021)</i></p>	<p>On 25 June 2021, the Minister of Forestry, Fisheries, and the Environment published a notice under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) seeking public comment on a draft National Guideline for the consideration of climate change implications in applications for environmental authorisation, Atmospheric Emission Licenses (AELs), and Waste Management Licenses (WMLs).</p> <p>The draft National Guideline aims to create a consistent approach for the incorporation of climate change considerations in Environmental Impact Assessments (EIAs), WMLs and AELs.</p> <p>It outlines a methodological approach for minimum requirements for consideration when conducting climate change assessments and has been considered in compiling this report.</p>
<p><i>Climate Change Act 22 of 2024</i></p>	<p>On March 17, 2025, the South African Climate Change Act, Act No. 22 of 2024, officially came into operation via Proclamation Notice 251 of 2025. This marked the commencement of the Act, which aims to establish a legal framework for addressing climate change in South Africa. The Act provides a comprehensive South African legal framework for regulating the climate change impacts with the goal of achieving net-zero by 2050. The Act aims to enable effective development of climate change responses through a long-term transition to a climate-resilient and low-carbon society and economy while considering sustainable development. The Act aims to contribute fairly to global GHG stabilisation and conforms to South African international climate change obligations and commitments to protect and preserve our planet for current and future generations.</p> <p>It must be noted that although the Act has come into operation, the commencement in terms of section 38 of the Climate change Act, sections 12(6), 13(1), 13(2), 13(3)(b), 14(3)(a), 15(5), 15(6), 17, 18, 19, 20, 21, 22, 25(4)(c), 26(2) to (6), 27, 28 and 30(2)(a) and (b), has been deferred to a later date. The reason for deferring these specific provisions is that the Department of Forestry, Fisheries and the Environment (DFFE) is developing a set of regulations that will enable implementation of these provisions. Some of the draft regulations are at an advanced stage of development and will be gazetted for public input and comment soon.</p> <p>The Act provides two main mechanisms to reduce the country's GHG emissions:</p> <ul style="list-style-type: none"> ■ Section 24 (under Chapter 5) of the Act obliges the Minister to determine a national GHG emissions trajectory. This trajectory must be set in consultation with the Cabinet. The trajectory must specify a national GHG emission reduction objective. This objective must be informed by South Africa's current and projected greenhouse gas emissions and be consistent with South Africa's international obligations. ■ Section 25 (under Chapter 5) of the Act deals with sectoral emissions targets. According to section 25, the Minister must identify GHG-emitting sectors and sub-

Policy, legislation, guideline or standard	Description
	sectors that should be subject to sectoral emissions targets. The Minister must then set sectoral emissions targets for each sector, in consultation with the relevant Minister responsible for that sector. These targets must align with the national GHG emissions trajectory. The Minister responsible for each sector must then implement each sectoral target through a range of planning instruments, policies, measures, and programmes. As previously noted , Section 25(4) (c) which focuses on the quantitative and qualitative of GHG emission reduction goals will come into operation at a later date.
<i>Durban Climate Change Strategy (DCCS) (2022)</i>	The Durban Climate Change Strategy (DCCS) was the first multi-sector climate change strategy developed for Durban and adopted by the eThekweni Municipal Council in 2015. The strategy focuses GHG reduction and mitigation strategies to build resilience for the increase in EWEs in Durban. Furthermore, Durban aims to achieve net-zero GHG emissions by 2050 while building governance, social, environmental and economic adaptive capacity. The total GHG emissions recorded for Durban in 2017 was 29,025,638 tonnes of carbon dioxide equivalent (tCO ₂ e) which have increased from 2010 emissions (27,066,285 tCO ₂ e). It has also been identified that the Transportation (40.8%) and Industry (33.5%) sectors largely account for the province's emissions.
<i>KwaZulu Natal (KZN) Strategic Plan (2023/2025)</i>	The KwaZulu Natal (KZN) Strategic Plan aims to address socio-economic issues such as youth unemployment, GDP growth as well as environmental issues. The plan acknowledges the impacts of climate change and recent extreme weather events (EWEs) that have occurred, such as the 2022 floods and 2023 heatwave. Moreover, the Department of Economic Development, Tourism and Environmental Affairs (EDTEA) of KZN has sponsored the Ugu, KwaDukuza and Endumeni municipalities for ecosystem-based adaptation to ensure community resilience. Furthermore, climate change and weather education form part of the department's climate change adaptation strategy. A R500,000 per annum commitment has been made by EDTEA for Air Quality and Climate Change management.
<i>eThekweni Municipal Spatial Development Framework 2024-2025</i>	<p>This eThekweni Municipal Spatial Development Framework aims to position the eThekweni municipality as social equitable, environmentally sustainable, resilient and functionally efficient. The DCCS and Durban Climate Action Plan (CAP), which were approved in June 2022, underpin the climate change response of Durban. The CAP builds upon the 2015 DCCS, it aims to limit warming to no more than 1.5°C and sets a goal for Durban to be net-zero by 2050. It also seeks an 80% reduction in GHG emissions by 2050 compared to 2015 baseline levels.</p> <p>The municipality launched a project titled the Central KwaZulu Natal Climate Change Compact (CKZNCCC) to facilitate the sharing of knowledge and experiences amongst local municipalities. The aim of the partnership is to reduce the vulnerability and increase the resilience of the participating communities. The CKZNCCC convene on a quarterly basis.</p>
Organisational Policies	
Transnet (SOC) Ltd Energy Strategy, January 2021	<p>The objective of the energy strategy is to address three main components which are identified as the drivers of the strategy this includes the reduction of energy costs, improvement of energy security and curbing carbon emissions.</p> <p>The three drivers of the strategy mentioned above has resulted in four programmatic focus areas which are Energy Management, Alternative Energy Supplies, Business Diversification Opportunities and Corporate Social Responsibility. Furthermore, the strategy will provide a contextual basis for identifying and evaluating greenhouse gas mitigation measures.</p>
Transnet ESG Strategy, October 2023	The ESG strategy was developed to identify all the strategic ESG risks, impacts as well as opportunities that need to be managed or pursued to fulfil the stakeholder's

Policy, legislation, guideline or standard	Description
	<p>needs and expectations. This strategy will be considered under the Operational Division (TNPA) context, as it provides a strategic framework and offers relevant guidance on climate goals informing mitigation and adaptation measures.</p> <p>There are five key focus areas identified:</p> <ul style="list-style-type: none"> ■ Climate Response with a goal to reduce Transnet's carbon footprint and enhance our climate change adaptation mechanisms across all operations ■ Sustainable and Ethical Procurement with a goal to ensure sustainable and ethical procurement of goods and services. ■ Stakeholder expectations and grievances with a goal to secure Transnet's social license to operate and to build organisation resilience and productivity by promoting a positive employees morale and workplace culture ■ Safe & Secured Operations with a goal to achieve zero employee harm (injuries and fatalities across operations and promote conscious health and wellness, minimise incidents or railway and pipelines encroachment, theft and vandalism, and improved housekeeping and clean working environment across all operational divisions. ■ Transparency, Accountability, Ethics and Compliance with a goal of ensuring ethical business practices, ethical management of data, and improved compliance to environmental legislations <p>Additionally, the strategy further identified the following four ESG Pillars:</p> <ul style="list-style-type: none"> ■ Natural Environment Stewardship ■ Strengthening Our Stakeholder Orientation ■ Investing in Sustainable Business, and ■ Advocating for Just & Effective Governance

5

IMPACT OF CLIMATE CHANGE ON THE PROJECT



5 IMPACT OF CLIMATE CHANGE ON THE PROJECT

Climate data is essential for understanding the potential impacts of climate change on the Project. This includes presenting data in the form of climate normals (i.e., a climate baseline) and future climate projections. Climate normals, typically based on the most recent 30-year period, serve as a long-term benchmark that characterises a region's average climate conditions. Future climate projections, on the other hand, represent the predicted changes based on climate models and are defined as the difference between these projections and the baseline. The purpose of this section is to establish a clear understanding of the current and projected climate conditions for the region where the Project is located. By presenting both climate normals (baseline data) and future projections, this section provides the foundation for assessing potential climate change impacts on critical Project components, enabling informed decision-making for risk mitigation and adaptation planning.

5.1 METHODOLOGY

This methodology section provides a detailed approach to understanding both historical climate conditions and future climate projections for the project area. The methodology integrates multiple data sources and modelling techniques to ensure a comprehensive analysis. The two primary components are baseline and projected climate methodologies as detailed below.

5.1.1. BASELINE CLIMATE METHODOLOGY

To understand the historical climate conditions of the Project area, a provincial climate baseline was established using data from the World Bank Group's Climate Change Knowledge Portal (CCKP) and the Copernicus Climate Change Service (C3S) Climate Data Store. This baseline reflects the temperature and precipitation trends observed over the past 30 years in KZN, where the Project is located. The same datasets will also be used to generate projections for future climate conditions up to the year 2100, ensuring consistency between the baseline and projections. These historical trends provide a strong foundation for understanding how the climate has changed over time, which is critical for assessing future risks and planning adaptation strategies.

5.1.2. PROJECTED CLIMATE METHODOLOGY

Future climate conditions for the Project area are estimated using Global Climate Models (GCMs) from the Coupled Model Intercomparison Project Phase 6 (CMIP6), the most advanced climate modelling framework. These models simulate the Earth's climate system and its response to greenhouse gas emissions, providing improved accuracy and insights compared to previous version like CMIP5 (Raju & Kumar, 2020). CMIP6 integrates updated physical and socioeconomic data to offer refined predictions of future climate scenarios, accounting for potential temperature and precipitation changes as well as extreme weather events.

CMIP6 uses Shared Socioeconomic Pathways (SSPs), which represent a range of future emission and socioeconomic scenarios. Two key SSPs are used to develop detailed climate projections. The first, SSP2-4.5 ("Middle of the Road"), assumes moderate mitigation efforts, where some countries fulfil their climate commitments while others fall short. This scenario projects global warming of approximately 2.1°C to 3.5°C by 2100 compared to pre-industrial levels, with radiative forcing stabilizing at 4.5 W/m² around 2070 (Siabi et al., 2023). The second, SSP5-8.5 ("High Emissions"), represents a future characterised by minimal mitigation efforts, continued fossil fuel reliance, and rapid

economic growth. Under this scenario, global temperatures are expected to increase by 3.5°C to 5.7°C by 2100, with radiative forcing rising to 8.5 W/m², resulting in severe climate impacts such as extreme heatwaves, coastal flooding, and widespread uninhabitability in some regions (Othman & Tukiut, 2023).

The selection of SSPs for this analysis was based on their relevance to the Project's goals and the range of potential climate futures they represent. SSP2-4.5 was chosen as it provides a balanced, intermediate pathway that aligns with moderate global mitigation efforts and reflects current trends in international climate policy. In contrast, SSP5-8.5 represents a high-emission scenario, useful for stress-testing the Project against worst-case outcomes where mitigation efforts fail. This selection ensures that the methodology captures both realistic and extreme climate risks, allowing for planning and decision-making. These SSPs are aligned with Representative Concentration Pathways (RCPs), which quantify the radiative forcing associated with varying greenhouse gas concentrations. For example, SSP2-4.5 is analogous to RCP4.5, while SSP5-8.5 aligns with RCP8.5. This combination ensures a dynamic framework for projecting future climate conditions, integrating both physical processes and socioeconomic variables.

Projections are regionally downscaled to the KZN provincial area, ensuring relevance to the specific Project location and allowing for a finer analysis of local impacts. Notably, CMIP6 models exhibit higher climate sensitivity than CMIP5, reflecting updated feedback mechanisms and processes in the Earth's climate system (Raju & Kumar, 2020). These projections form the basis for assessing climate risks and designing effective adaptation and mitigation strategies tailored to the unique vulnerabilities of the Project area.

The climate projections presented in this report were based on two GHG mitigation scenarios from the IPCC 6th Assessment Report: SSP2-4.5 and SSP 2-4.5. These projections cover four time periods: 2020-2039, 2040-2059, 2060-2079, and 2080-2099. Variables analysed include historical annual temperature, historical and projected monthly mean temperature, historical annual mean precipitation, historical and projected monthly mean precipitation, historical and projected monthly number of hot days (>35 °C), as well as historical and projected monthly extreme precipitation days.

Table 5-1 presents the various SSP scenarios outlined in AR6 and where possible, the analogous pathway of the Special Report on Emissions Scenarios (SRES) from the IPCC Fourth Assessment Report (AR4) are highlighted for each SSP.

Table 5-1 - Characterisation of Shared Socioeconomic Pathways in IPCC Sixth Assessment Report. Source: O'Neil et al. 2014

SSP	RCP(s) analogous to SSP(s)	Radiative Forcing in 2100	Challenges	Global Temperature Change	Characterisation
SSP1	RCP 1.9 RCP 2.6	1.9 W/m ² 2.6 W/m ²	Sustainability – Low for mitigation and adaptation	1.0 °C – 2.4 °C	Sustainable development proceeds at a reasonably high pace. Analogous to SRES B1 and A1T scenarios.
SSP2	RCP 4.5	4.5 W/m ²	Middle of the road – Medium for mitigation and adaptation	2.1 °C – 3.5 °C	An intermediate case between SSP and SSP 3. Analogous to RCP 4.5 scenario.
SSP3	RCP 7.0	7.0 W/m ²	Regional Rivalry – High for mitigation and adaptation	2.8 °C – 4.6 °C	Unmitigated emissions are high due to moderate economic growth. Analogous to SRES A2 scenario.
SSP4	RCP 3.4	3.4 W/m ² 6.0 W/m ²	Inequality – High for adaptation, low for mitigation	-	A mixed world, with relatively rapid technological development in low carbon energy sources in key emitting regions, leading to relatively large mitigative capacity in places where it mattered most to global emissions.
SSP5	RCP 8.5	8.5 W/m ²	Fossil-fuelled Development – Low for mitigation, high for adaptation	3.3 °C – 5.7 °C	In the absence of climate policies, energy demand is high and most of this demand is met with carbon-based fuels. Analogous to SRES A1T scenario. Analogous to RCP8.5 scenario.

5.2 BASELINE AND PROJECTED CLIMATIC CONDITIONS

This section focuses on key climate variables, including temperature, precipitation, wind patterns, sea surface temperatures, and sea level rise, to provide an understanding of the region’s historical climate from 1991 to 2020. The baseline offers insights into long-term trends and variability, forming the foundation for assessing current climate risks and preparing for future impacts. The analysis captures observed patterns and trends for each variable, highlighting notable changes and seasonal characteristics. This evaluation ensures a reference point for understanding how historical climatic conditions compare to projected changes under various scenarios, enabling informed decision-making for adaptation and mitigation planning.

Table 5-2 presents the KZN baseline climate data for the 1991 to 2020 period. The mean annual temperature for the province is 18.6°C, with average monthly temperatures ranging between 22.4°C (in January and February) and 13.7°C in July. A clear seasonal trend is observed, with the highest temperatures occurring during the summer months (December, January, and February) and lower temperatures during the winter months (June, July, and August). Mean annual precipitation is estimated to be 866.8 mm, with most rainfall occurring between November to February, and generally conditions persisting during the months of May to August (i.e. lowest rainfall).

Table 5-2 – Baseline climate data for the KwaZulu Natal Province. Source: World Bank CCKP

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg Min Temp (°C)	17.0	17.1	15.7	12.9	9.4	6.4	6.3	8.3	11.1	13.0	14.4	16.0
Avg Mean Temp (°C)	22.4	22.4	21.4	19.0	16.4	13.9	13.7	15.5	17.8	19.1	20.1	21.6
Avg Max Temp (°C)	27.8	27.8	27.1	25.2	23.4	21.4	21.3	22.9	24.6	25.1	25.9	27.2
Precip (mm)	135.7	124.2	95.4	50.6	25.5	16.4	16.7	22.8	51.3	88.1	110.0	130.0

5.2.1. TEMPERATURE

5.2.1.1 Baseline Mean Annual Temperature

Figure 5-1 provides the observed annual average surface air temperature in KZN from 1991 to 2022, alongside a 5-year smoothed curve to illustrate long-term trends. Key observations are summarised below:

- The baseline temperature data for KZN, South Africa, from 1991 to 2022, presents the region's temperature trends over the past 30 years. There is a noticeable increase in the annual mean temperature from 1991 (18.4°C) to 2022 (18.9°C), with the highest annual mean temperature recorded in 2019 (19.6°C).
- The 5-year smoothed curve provides a clearer trend which appears to be a gradual increase over the years indicating a clear warming pattern. The 5-year smooth temperature also peaks around 2016 - 2018, indicating a period of higher average temperatures.
- Summary:
 - Overall Increase: Both the annual mean and the 5-year smooth temperatures indicate an overall warming trend from 1991 to 2022.
 - Fluctuations and Variability: There are periods of higher temperatures (e.g., 2015-2019) and lower temperatures (e.g., 1994-1997), but the general trend shows an upward trajectory which is indicative of a warming trend.

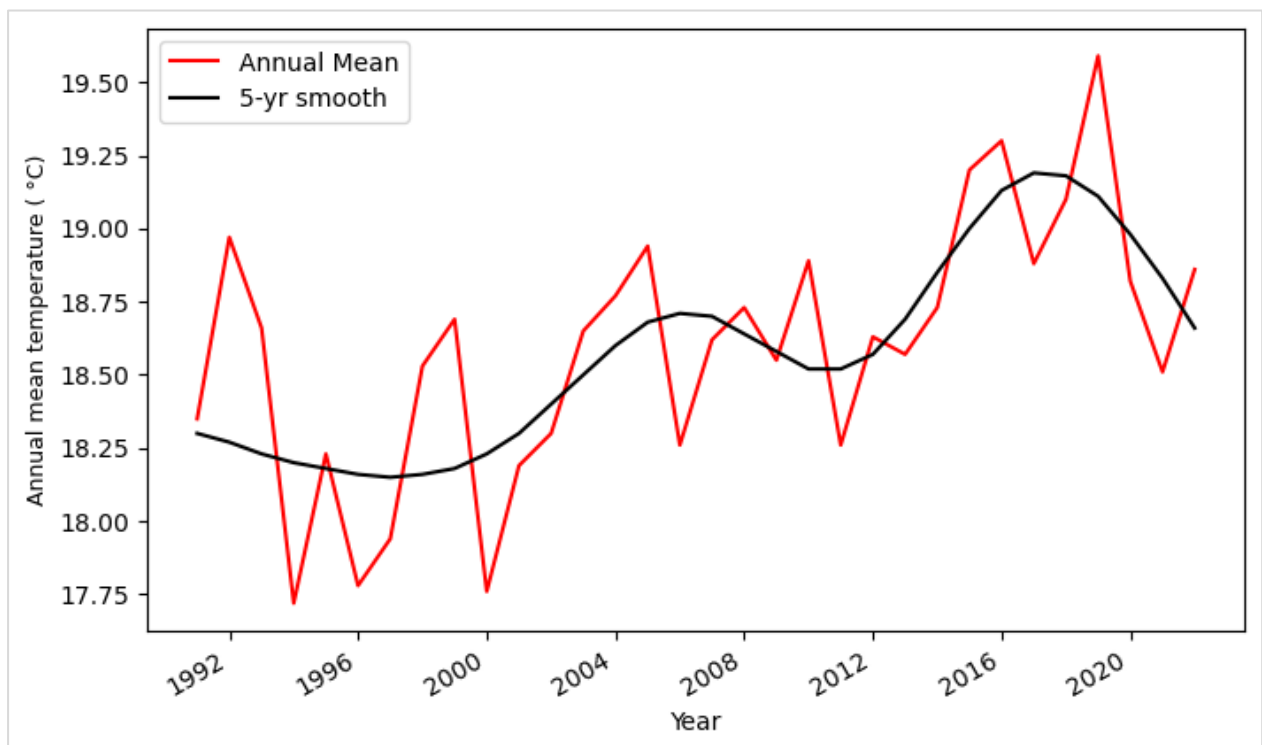


Figure 5-1 - Observed Average Annual Mean Temperature of KwaZulu Natal for 1991 - 2022.
Source: World Bank CCKP

5.2.1.2 Historical and Projected Mean Monthly Temperature

Table 5-3 Indicates the projected changes in monthly mean temperatures and averages for four time periods for the KZN province. Key findings are as follows:

- Historically (1995 to 2014), the monthly average mean surface air temperature in the region was 18.69°C. The data indicates a clear seasonal pattern, with the highest temperatures occurring in January (22.41 °C), February (22.31 °C) and December (21.48 °C) and the lowest in June (14.09 °C) and Jul (14.05 °C).
- 2020-2039:
 - SSP2-4.5: Projects a moderate increase in temperature, with an annual average increase of +0.66°C and a monthly increase ranging from +0.53°C (September) to +0.9°C in (October)
 - SSP5-8.5: Projects an annual average increase of +0.78°C and monthly temperatures projected to range from +0.69°C (December) to +0.89 °C (October).
- 2040-2059
 - SSP2-4.5: More warming is expected, with annual average increase of +1.23°C and monthly increases projected to range from +1.14°C (December) to +1.35°C (October).
 - SSP5-8.5: Projects an annual average increase of 1.73°C and monthly increases ranging from +1.64°C (March) to +1.97°C (October).
- 2060-2079:
 - SSP2-4.5: The data indicates that warming is anticipated to continue, with annual average increase of +1.72°C and with monthly increases ranging from +1.59°C (December) to +2.01°C (October).
 - SSP5-8.5: Projects more significant warming, with an annual average increase of +2.85°C. and monthly increases predicted to range from +2.58 °C (January) to +3.15°C (May). The data further shows a shift in the warm seasons as higher temperatures are also projected for winter (May-June) and October continues to experience high increases of +3.12°C.
 -
- 2080-2099 projections:
 - SSP2-4.5: Projects an increase of +2.09°C in annual average increase of +2.42°C and higher monthly temperatures of +2.16°C (May), +2.2°C (June and July) and +2.27°C (October).
 - SSP5-8.5: The data indicates a significant warming, with an annual average increase of +4.13°C and higher temperatures in May (+4.58°C), June (+4.48°C) and October (+4.46°C).
- Summary:
 - Variability across scenarios: Under both scenarios the temperatures will continue to rise over the next 80 years, with the high emissions scenario (SSP5-8.5) resulting in higher temperature changes relative to the middle of the road scenario (SSP2-4.5). Additionally, the trend of greater temperatures is observed under both scenarios in the later century.
 - Variability across months: The degree of warming varies across different months, with the month of October consistently showing the highest increases in temperatures across all future periods and scenarios.

- Impacts: With temperatures rising to 4.13°C by the end of the century worst case scenario extreme weather events and significant impacts on water resources and human health are likely to occur. These projected changes in mean monthly temperature indicate the need for climate action and adaptation strategies for the project and the KZN considering the profound impact that they may have on human health, water resources and infrastructure.

Table 5-3 – Historical and Projected Monthly Temperature Trends for KwaZulu Natal. Source: World Bank CCKP

Month	Historical Ref. Period, 1995-2014	2020-2039		2040-2059		2060-2079		2080-2099	
		SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5
Jan	22.41	+0.64	+0.78	+1.18	+1.64	+1.7	+2.58	+1.94	+3.86
Feb	22.31	+0.7	+0.81	+1.19	+1.67	+1.72	+2.69	+2.09	+3.91
Mar	21.48	+0.61	+0.83	+1.24	+1.64	+1.65	+2.65	+1.94	+3.9
Apr	19.24	+0.63	+0.7	+1.15	+1.78	+1.61	+2.82	+2.13	+4.02
May	16.52	+0.64	+0.8	+1.23	+1.78	+1.78	+3.15	+2.16	+4.58
Jun	14.09	+0.65	+0.71	+1.32	+1.7	+1.85	+3.05	+2.2	+4.48
Jul	14.05	+0.71	+0.79	+1.28	+1.72	+1.73	+2.87	+2.22	+4.22
Aug	15.78	+0.66	+0.76	+1.18	+1.71	+1.67	+2.88	+1.99	+4.15
Sep	18.07	+0.53	+0.79	+1.21	+1.69	+1.67	+2.87	+2.09	+4.09
Oct	18.95	+0.9	+0.89	+1.35	+1.97	+2.01	+3.12	+2.27	+4.46
Nov	19.95	+0.7	+0.77	+1.32	+1.78	+1.7	+2.83	+2.1	+4.07
Dec	21.48	+0.54	+0.69	+1.14	+1.68	+1.59	+2.69	+1.9	+3.82
Total	18.69	+0.66	+0.78	+1.23	+1.73	+1.72	+2.85	+2.09	+4.13

5.2.1.3 Historical and Projected Mean Monthly Number of Hot days (>35 °C)

Table 5-4 presents the projected changes in the number of hot days (days with temperatures exceeding 35°C). Key observations are provided below:

- Historically (1995 to 2014), the annual total number of hot days were 0.11 days for the region, with monthly increase expected to range from +0.00 days (May-August) to +0.33 days (January). The data shows that the number of hot days varies significantly throughout the year with slight increases expected in summer months (January, February and December), while the winter months (June, July, and August) none.
- 2020-2039 Projections.
 - SSP2-4.5: The total annual number of hot days are projected to increase by +0.11 days, with monthly increasing expected to range between +0.00 days (May-August) and +0.33 days (January).
 - SSP5-8.5: Projects total annual increase of +0.14 in the number of hot days, with monthly increase expected to range from +0.00 days (May-August) to January (+0.37 days).
- 2040-2059 Projections
 - SSP2-4.5: Projects a total annual increase of +0.29 days, with monthly increases projected to range between +0.00 days (May, June and July) to +0.74 days (January).
 - SSP5-8.5: Anticipates an annual total of +0.52 days, with monthly increases projected to range from +0.00 days (June and July) to +1.19 days (January).
- 2060-2079 Projections:
 - SSP2-4.5: Predicts a total annual increase of +0.51 days, with monthly increased projected to range between +0.00 days (June-July) to 1.25 days (January).
 - SSP5-8.5: Indicates a total annual increase of +1.23 days, with monthly increase projected to range between +0.00 days (June-July) to +2.67 days (January). The month of October and December also show a moderate increase of +2.41 days and +2.11 days respectively.
- 2080-2099 Projections:
 - SSP2-4.5: Predicts a further increase of +0.68 days annually, with months of January (+1.69 days), October (+1.27 days), and December (+1.26 days) showing the highest increase.
 - SSP5-8.5: Indicates a total annual increase of +2.69 days in the number of hot days, with the highest increase projected for the months of January (+5.16 days), February (+4.32 days), October (+4.89 days), December (+4.41 days).
- Summary:
 - Trend of Increasing Hot Days: Both SSP scenarios show clear increasing trend in the number of hot days, with SSP5-8.5 showing more pronounced increases relative to SSP2-4.5 especially for the latter half of the century.
 - Significant Monthly Variability: The data shows that the number of hot days varies significantly throughout the year. The summer months (January and February) have the highest number of hot days, while the winter months (June, July, and August) none, indicating cooler temperatures.

- Impacts: An increase in the number of hot days is associated with heatwaves. The data therefore suggests that heatwaves will become more frequent by the end of the century. These changes may have significant impact on the work force and labour productivity and may further affect infrastructure.
- These projections indicate the urgency of adaptation measures (e.g., healthcare responses to heatwave, heat management plan etc.) to help minimise and address the impacts of these projected changes on the region and Project area.

Table 5-4 - Historical and Projected Monthly Number of Hot Days for KwaZulu Natal. Source: World Bank CCKP

Month	Historical Ref. Period, 1995-2014	2020-2039		2040-2059		2060-2079		2080-2099	
		SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5
Jan	0.39	0.33	0.37	0.74	1.19	1.25	2.67	1.69	5.16
Feb	0.21	0.21	0.27	0.52	0.9	0.89	1.99	1.18	4.32
Mar	0.08	0.09	0.14	0.33	0.58	0.63	1.62	0.74	3.68
Apr	0.01	0.01	0.02	0.06	0.16	0.11	0.51	0.2	1.38
May	0	0	0	0	0.01	0.01	0.09	0.02	0.49
Jun	0	0	0	0	0	0	0	0	0.07
Jul	0	0	0	0	0	0	0	0	0.04
Aug	0	0	0	0.01	0.03	0.03	0.16	0.05	0.61
Sep	0.08	0.12	0.15	0.34	0.59	0.57	1.58	0.9	3.32
Oct	0.16	0.24	0.27	0.56	1.08	0.97	2.41	1.27	4.89
Nov	0.12	0.14	0.19	0.44	0.69	0.7	1.59	0.87	3.94
Dec	0.25	0.23	0.26	0.53	1.01	1	2.11	1.26	4.41
Total	0.11	0.11	0.14	0.29	0.52	0.51	1.23	0.68	2.69

5.2.2. PRECIPITATION

5.2.2.1 Baseline Mean Annual Precipitation

Figure 5-2 offers a comprehensive view of historical annual mean precipitation in the KZN region from 1991 to 2022, with a 5-year smoothed curve to indicate long-term trends. Precipitation data like this plays a crucial role in understanding the local climate and its projected changes and impacts. Key observations are summarised below:

- The historical precipitation for KZN, South Africa, from 1991 to 2022, presents the region's precipitation trends over the past 30 years. The annual mean precipitation shows significant fluctuations over the years with some periods of high precipitation (e.g., 2000 with 1218.4 mm) and periods of low precipitation (e.g., 1992 with 560.8 mm).
- The highest annual mean precipitation recorded was in 2000 (1218.4 mm), and the lowest was in 1992 (560.8 mm).
- The 5-year smooth data provide a clear trend, which shows less fluctuation compared to the annual mean. Furthermore, the 5-year smooth precipitation peaks around 1997-1999, indicating periods of higher average precipitation.
- Summary:
 - Fluctuations and Variability: The dataset indicates fluctuations over the years, typical for precipitation data. These fluctuations indicate the importance of analysing long-term trends to understand climatic behaviours.

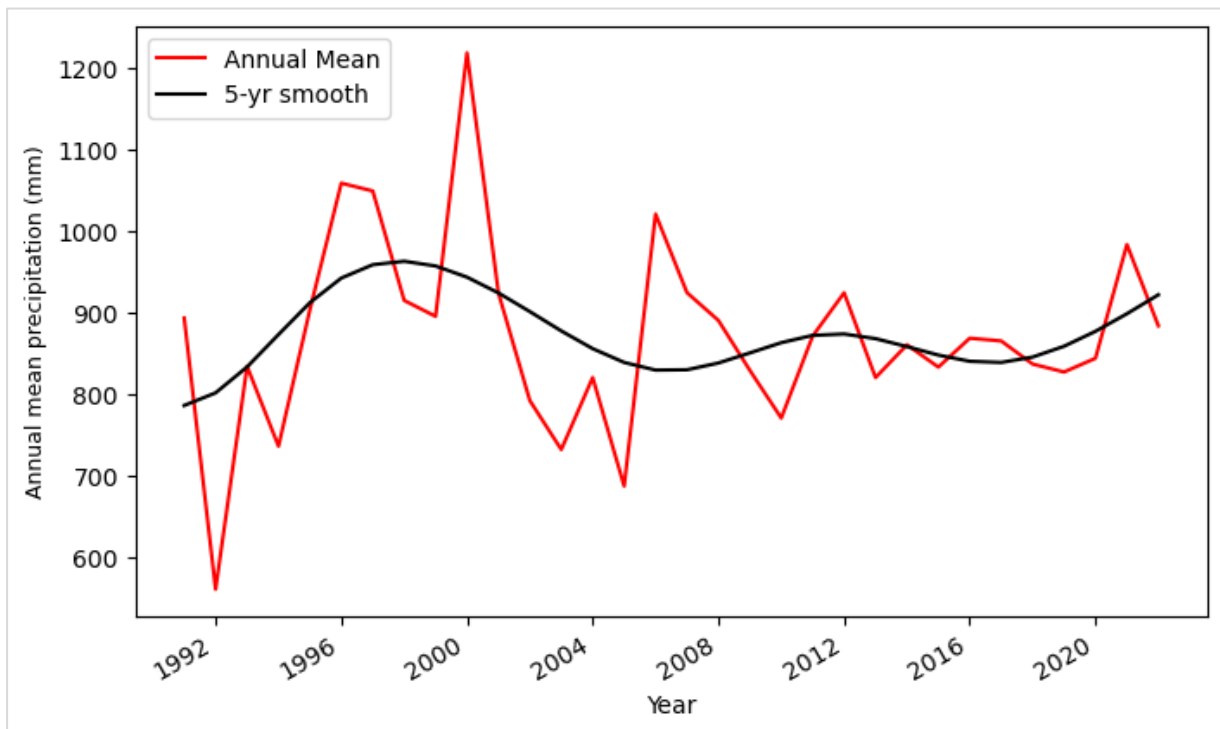


Figure 5-2 - Observed Average Annual Mean Precipitation of KwaZulu Natal for 1991 - 2022.

Source: World Bank CCKP

5.2.2.2 Historical and Projected Mean Monthly Precipitation

Table 5-3 provides the historical and projected changes in monthly precipitation (in mm) for the KZN region. Key findings are summarised as follows:

- **Historical Period (1995-2014):** The total annual precipitation was estimated to be 984.19 mm, with January (148.31 mm) and December (144.05 mm), experiencing high precipitation being the wettest months, while the lowest precipitation occurs in June (20.8 mm) and July (22.33 mm), suggesting these months are drier.
- **2020-2039 Projections**
 - **SSP2-4.5:** Projects a total annual decrease of -1.55 mm with a notable increase in January (4.88 mm). The months of April to October generally project decreases, with September having the largest decrease of -3.15 mm.
 - **SSP5-8.5:** Projects an overall annual increase of 12.36 mm, with the largest increase in January (8.34 mm). The Months of April to October generally show a decrease, with September experiencing the largest decrease of - 3.15 mm.
- **2040-2059 Projections:**
 - **SSP2-4.5:** Projects an overall increase of 10.5 mm in annual mean precipitation, with January (8.17 mm) and December (7.48 mm) showing notable increases. The months of July to October show a decrease in precipitation with significant decrease observed in September (-4.25 mm) and October (-5.24 mm).
 - **SSP5-8.5:** Shows an overall increase of 4.65 mm in annual precipitation, with the months the September (-6.29 mm) and October (-6.26 mm) anticipated to experience notable decreases.
- **2060-2079 Projections:**
 - **SSP2-4.5:** Project an increase of +14.8 mm in annual precipitation, with the months of January (10.5 mm) and December (5.36 mm) anticipated to show increases while September (-4.07 mm) and October (- 4.99 mm) are anticipated to show decrease in precipitation.
 - **SSP5-8.5:** Projects an increase of 19.66 mm in annual mean precipitation, with January (+13.44mm) and December (9.74 mm) seeing an increase while significant decreases in are predicted for September. (-11.75mm) ad October (-9.63 mm).
- **2080-2099 Projections**
 - **SSP2-4.5:** Projects an increase of 20.47 mm in annual precipitation, with a largest increase observed January (+11.82 mm) while in September (-5.99 mm) and October (-6 .82 mm) project a decrease.
 - **SSP5-8.5:** Predicts an increase of 16.68 mm in annual precipitation, with January (+20.5mm) showing a significant increase but significant decreases September (-16.91 mm) and October (-14.96 mm).
- **Summary:**
 - **Trends across scenarios:** The future climate scenarios project an increase in precipitation particularly in the summer months (January, February and December) under the worst-case scenario (SSP5-8.5). The months of July to October project a decrease in precipitation

particularly under SSP2-4.5. While both SSP scenarios show variability in projected precipitation, more extreme changes are observed under SSP5-8.5 towards the 2080-2099 period.

- **Monthly Variability:** The projected changes are not uniform across the months; however, the summer months consistently show increases across all periods and scenarios. Significant reductions are observed late winter and spring (July to October) suggesting dry conditions in these months.
- **Impacts:** The projected increases in precipitation during the summer months could result in flooding risks, while the reduction in precipitation could lead to potential drought conditions thus exacerbating water shortages for the Project and the region. Effective adaptation measures will be required for the project to cope with the risk of flooding and drought.

Table 5-5 - Historical and Projected Monthly Precipitation Trends for KwaZulu Natal. Source: World Bank CCKP

Month	Historical Ref. Period, 1995-2014	2020-2039		2040-2059		2060-2079		2080-2099	
		SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5
Jan	148.31	+4.88	+8.34	+8.17	+8.63	+10.5	+13.44	+11.82	+20.5
Feb	132.42	+2.32	+1.39	+3.42	+2.46	+4.47	+5.64	+6.24	+6.82
Mar	106.49	+0.91	+3.26	+1.66	+1.31	+1.31	+5.66	+2.17	+5.78
Apr	66.15	-2.43	-0.79	+0.4	-0.22	+0.96	+2.46	+4.16	+2.42
May	32.41	+0.8	+1.19	-0.32	+1.22	+2.57	+2.25	+1.85	+3.19
Jun	20.8	-0.24	+1.29	+1.16	+2.15	+1.79	+2.82	+1.67	+2.51
Jul	22.33	-2.71	-2.84	-1.89	-1.34	-1.62	-1.37	-1.66	-0.05
Aug	31.67	-1.91	-2.24	-1.31	-3.85	-2.89	-3.66	-1.9	-5.28
Sep	52.98	-3.15	-3.56	-4.25	-6.69	-4.07	-11.75	-5.99	-16.91
Oct	97.86	-2.28	-1.12	-5.24	-6.26	-4.99	-9.63	-6.82	-14.96
Nov	128.72	+1.39	+3.78	+1.22	+2.92	+1.41	+4.06	+3.23	+3.61
Dec	144.05	+0.87	+3.66	+7.48	+4.32	+5.36	+9.74	+5.7	+9.05
Total	984.19	-1.55	+12.36	+10.5	+4.65	+14.8	+19.66	+20.47	+16.68

5.2.2.3 Historical and Projected Mean Standardised Precipitation-Evapotranspiration Index (SPEI)

Table 5-6 provides the historical and projected changes in monthly Standardised Precipitation-Evapotranspiration Index (SPEI) for the KZN region. Key findings are summarised as follows:

- **Historical Period (1995-2014):** The SPEI remain relatively consistent throughout the year with slight increases in dryness throughout the year. The data shows total annual average of -0.09 indicative of moderate drought conditions.
- **2020-2039 Projections**
 - SSP2-4.5: Projects an annual average increase of +0.06 with monthly increase ranging from +0.04 (January-February) to +0.08 (September).
 - SSP5-8.5: Projects an annual average increase of +0.12 with monthly increase ranging from +0.11 (January-February) to +0.13 (April, August and December).
- **2040-2059 Projections:**
 - SSP2-4.5: Shows an annual average increase of +0.18 with monthly increase ranging from +0.17 (April-May) to +0.2 (December).
 - SSP5-8.5: Shows an annual average increase of +0.03 with monthly increase ranging from +0.01 (March) to +0.04 (September-October).
- **2060-2079 Projections:**
 - SSP2-4.5: Shows an annual average increase of +0.08 with monthly increase ranging from +0.07 (January-March) to +0.1 (August-September).
 - SSP5-8.5: Shows an annual average increase of +0.11 with monthly increase ranging from +0.07 (January) to +0.14 (December).
- **2080-2099 Projections**
 - SSP2-4.5: Shows an annual average increase of +0.16 with monthly increase ranging from +0.15 (November-March) to +0.16 (April-October).
 - SSP5-8.5: Shows an annual average increase of +0.18 with monthly increase ranging from +0.17(January, March and September) to +0.19 (April and May).
- **Summary:**
 - Trends across scenarios: The worst-case scenario (SSP5-8.5) generally projects a slightly higher positive SPEI compared to the moderate emissions scenario (SSP2-4.5), suggesting a somewhat wetter conditions in the higher emissions scenario.
 - Monthly Variability: Although the projected changes are not uniform across the months; however, the changes show minor increase in SPEI values.
 - The SPEI values across the months and years show a slight positive trend, indicating that, on average, future conditions are anticipated to be slightly wetter compared to historical period (1995-2014) which may decrease the risk and intensity of drought conditions. However, the values are generally close to zero, indicating that there isn't a drastic shift towards wetter or drier conditions, but rather a small increase in moisture availability in the future.

Table 5-6 - Historical and Projected Monthly Standardised Precipitation-Evapotranspiration Index (SPEI) Trends for KwaZulu Natal. Source: World Bank CCKP

Month	Historical Ref. Period, 1995-2014	2020-2039		2040-2059		2060-2079		2080-2099	
		SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5	SSP2-4-5	SSP5-8-5
Jan	-0.07	0.04	0.11	0.2	0.02	0.07	0.07	0.15	0.17
Feb	-0.08	0.04	0.11	0.19	0.02	0.07	0.1	0.15	0.18
Mar	-0.08	0.05	0.12	0.18	0.01	0.07	0.1	0.15	0.17
Apr	-0.09	0.06	0.13	0.17	0.03	0.09	0.1	0.16	0.19
May	-0.09	0.07	0.12	0.17	0.03	0.09	0.1	0.16	0.18
Jun	-0.09	0.07	0.12	0.18	0.03	0.08	0.1	0.16	0.19
Jul	-0.09	0.07	0.12	0.18	0.03	0.09	0.1	0.16	0.18
Aug	-0.09	0.07	0.13	0.18	0.03	0.1	0.11	0.16	0.18
Sep	-0.09	0.08	0.12	0.18	0.04	0.1	0.13	0.16	0.17
Oct	-0.09	0.07	0.12	0.18	0.04	0.09	0.12	0.16	0.18
Nov	-0.09	0.06	0.12	0.19	0.02	0.08	0.12	0.15	0.18
Dec	-0.09	0.05	0.13	0.2	0.02	0.07	0.14	0.15	0.18
Total	-0.09	0.06	0.12	0.18	0.03	0.08	0.11	0.16	0.18

5.2.3. WIND

In KZN, wind patterns are characterised by seasonal variability. South-westerly winds dominate during autumn and winter, while north-easterly winds prevail in spring and summer. The highest wind speeds are typically observed in spring, with lower speeds in winter. Compared to other coastal regions in South Africa, KZN generally experiences weaker winds, though coastal areas often have stronger winds than the inland regions (Kruger, 2014). During storms, strong winds can create large waves and storm surges, contributing to erosion and coastal flooding. This highlights the importance of understanding wind dynamics for coastal projects and climate adaptation planning.

Figure 5-3 illustrates the 10-meter (m) wind speed for the project area, representing the horizontal movement of air at 10 m above the Earth’s surface. Over the 30-year period (1991–2020), the data indicates that wind speeds have remained relatively stable, fluctuating within a range of approximately 4.78 meters per second (m/s) to 5.49 m/s, with an average of 5.19 m/s. There is no evident upward or downward trend, suggesting that external factors influencing wind speed, such as global wind patterns, ocean temperatures, or atmospheric pressure systems, have not changed significantly over this time. While year-to-year variations exist, the overall consistency in wind speed implies limited impact from large-scale climate drivers during the observed period.

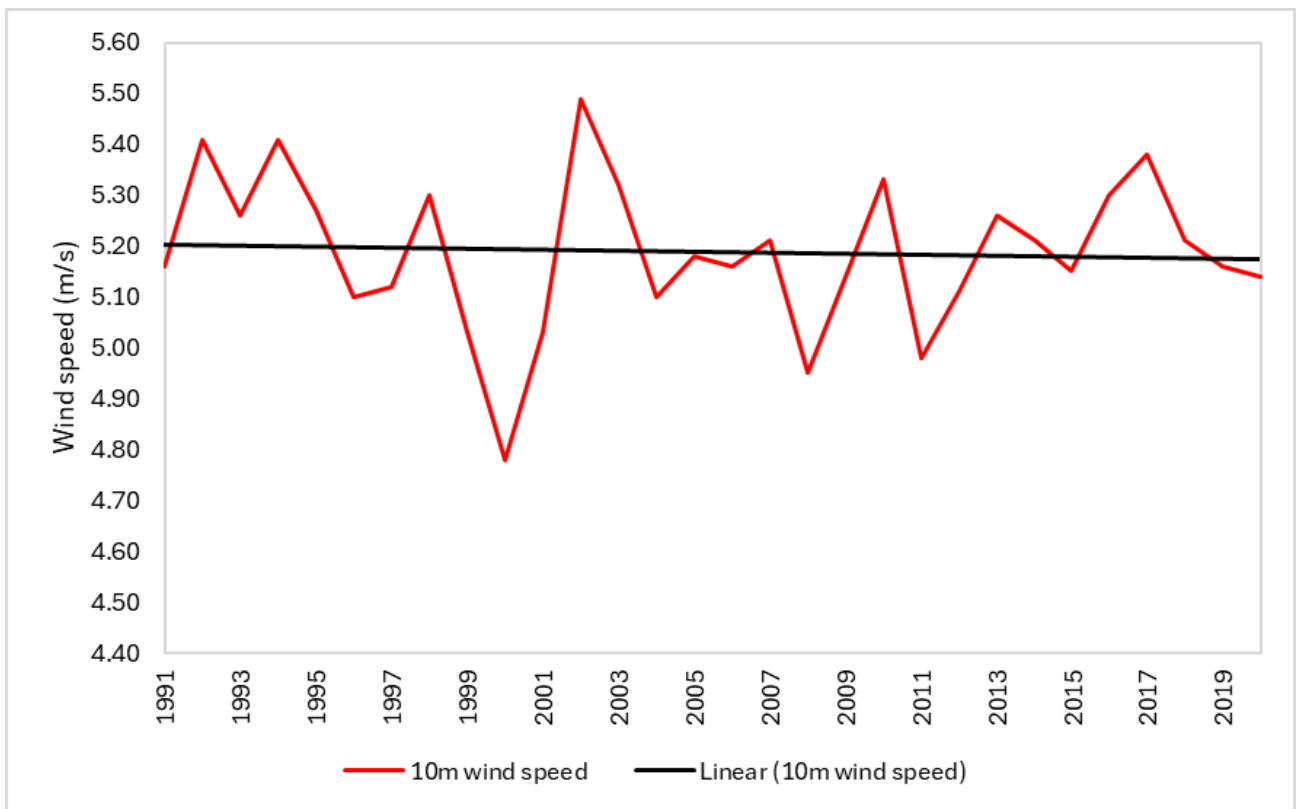


Figure 5-3 – 10m wind speed at Port of Richards Bay from 1991 to 2020. Source: Hersbach et al, 2023

5.2.4. SEA LEVEL RISE, TIDAL FLOODING DAYS AND TROPICAL CYCLONES

The current section presents sea level rise, tidal flooding and tropical cyclone data for Durban. There is no information on these variables for the Port of Richards Bay therefore the closest Port, Durban has been selected as it shares similar geographical and coastal characteristics as Richards Bay.

5.2.4.1 Sea Level Rise

Over the past century, the Earth's average surface air temperature has risen, leading to a global rise in sea levels.

Figure 5-4 presents the IPCC 6th Assessment Report Sea Level Projections for Durban. The projections indicate changes in sea level for the region, with greater increase under the worst-case scenario (SSP5-8.5). Sea level rise may also alter water depths around ports, modifying wave propagations and patterns potentially worsening or improving port operability (Sierra et al., 2017). This may lead to an increased coastal flooding and erosion challenges as well as greater tidal influences, particularly for coastal areas such as Durban, which characterised by its low elevation and number of rivers and tributaries (Mather & Stretch, 2012; Sierra et al., 2024). Furthermore, this could result in infrastructure damage as Durban has an average altitude of approximately 7 meters above sea level with certain areas lying even lower. These factors make the region area highly susceptible to flooding during periods of high tides and intense rainfall (Mgadle et al., 2022). On the other hand, sea level rise may also have positively affected ports by reducing dredging maintenance and costs or allowing for accommodation of larger vessels (Chhetri et al., 2016). These events are further influenced by tropical cyclones, tides, waves coastal storms and cut-off lows (COL) (Goshen, 2011; Madle et al., 2024). Recent studies indicate that the rate of global sea level rise has doubled since the early 1990s. As noted by Hamlington et al. (2024), this acceleration highlights the increasing risk of coastal inundation over the coming decades for Durban and Port of Richards Bay.

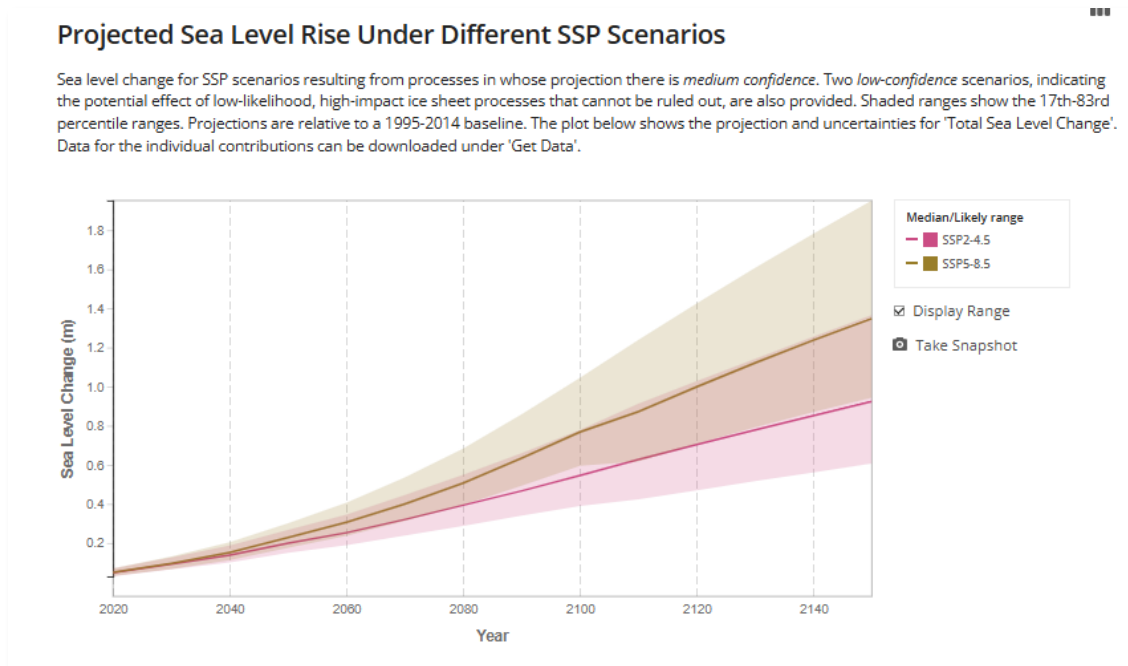


Figure 5-4 - IPCC 6th Assessment Report Sea Level Projections at Durban. Source NASA Sea level Change Portal

5.2.4.2 Tidal Flooding Days

Figure 5-4 shows the annual number of days when sea level at Durban exceeded the three defined thresholds: minor (40cm), moderate (60cm) and major (80 cm) above the average high tide. The chart provides time series that highlights how the frequency of exceedances has changed over the years, indicating the potential for increase flood severity as sea level rises.

The number of minor high tide flooding days has generally increased over the years. For example, the region experienced 6 minor flooding days in 1970, but by 2022 and 2023 this number has increased to 46 days. Moderate flooding days are less frequent but show occasional spikes for years such as 1997, 2002 and 2020. Major flooding days are rare with only one recorded event in 2007. There are years with no recorded flooding, highlighting variability in tidal flooding events. The notable increase in minor flooding days in recent years could be attributed to factors such as sea level rise and climate change. The increasing trend in minor flooding days indicates the need for improved coastal infrastructure and flood management systems in coastal regions such as Durban and Port of Richards Bay. The data aligns with the findings of recent studies on global trends of rising sea levels and frequent flooding events.

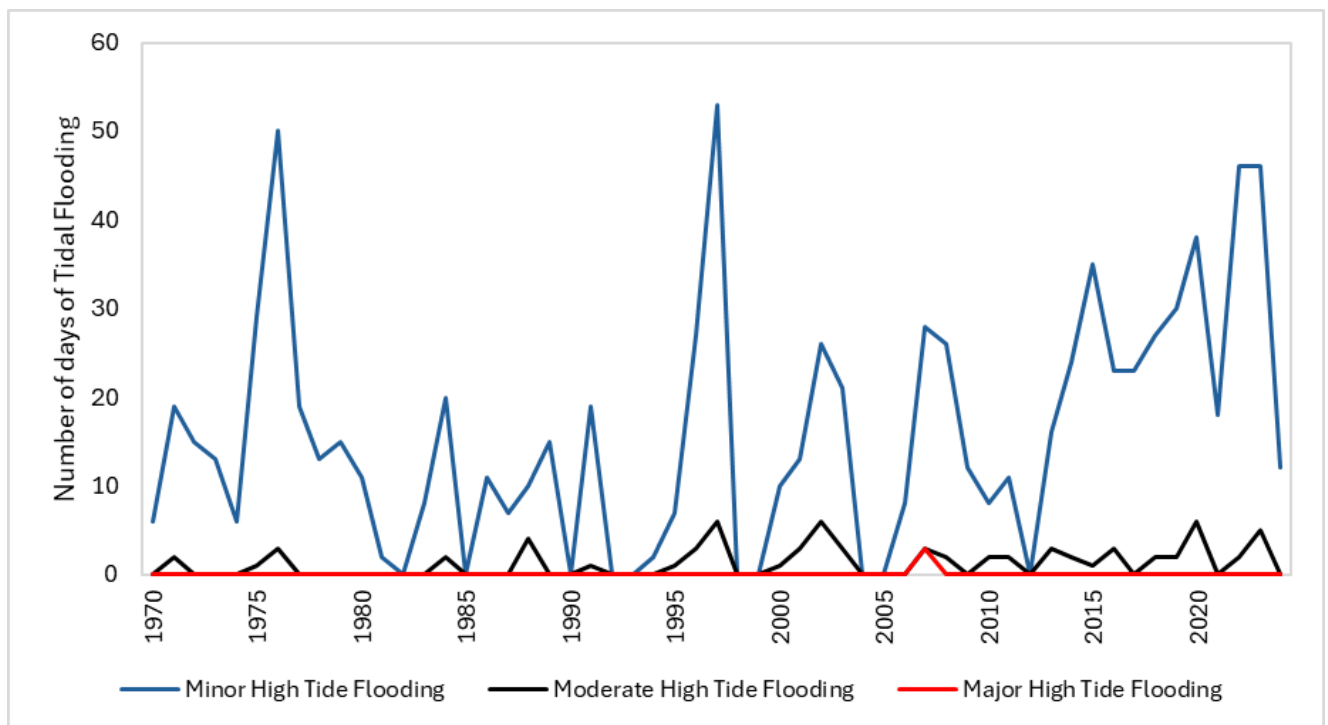


Figure 5-5 – High Tide Flooding Days for Durban Tide Gauge (19970-2024). World Bank CCKP, 2025

5.2.4.3 Tropical cyclones

Figure 5-6 illustrates the annual average number of tropical storms, minor cyclones (category 1&2) and major cyclones (category 3 and above) over the Indian Ocean where Durban is located for the period 1951-2014. Tropical cycles characterised by high winds, flash floods and heavy rainfall pose a significant risk to coastal regions around the globe (Sonet et al., 2024). The world bank uses the Saffir-Simpson-Hurricane Scale to classify Tropical Cyclones (CCKP, 2024). This scale is based on maximum sustained wind speed as follows:

- **Tropical Storm:** 34 to <64 knots (63 to <118.5 km/h)
- **Category 1:** 64 to <83 knots (118.5 to <154 km/h)
- **Category 2:** 83 to <96 knots (154 to <178 km/h)
- **Category 3:** 96 to <113 knots (178 to <209 km/h)
- **Category 4:** 113 to <137 knots (209 to <254 km/h)
- **Category 5:** ≥ 137 knots (≥ 254 km/h)

On average the occurrence of tropical cycles ranges between 11.8 to 12.5 storms per years. The data also reveals some fluctuations, with notable peaks for years such as 1979 which recorded 13.43 storms. Both the minor and major cyclones remain relatively stable though the years 1973 and 1996 experienced more intense major storms. Frequent tropical cyclones and coastal storms in Durban region are likely intensify the effects of sea level rise in the area. This impact becomes significantly more severe when such events coincide with high tidal activity further exacerbating sea level rise around Durban (Hamlington et al., 2024). Those most significant impacts of tropical cycles include casualties, infrastructure damage and disruption to communication systems.

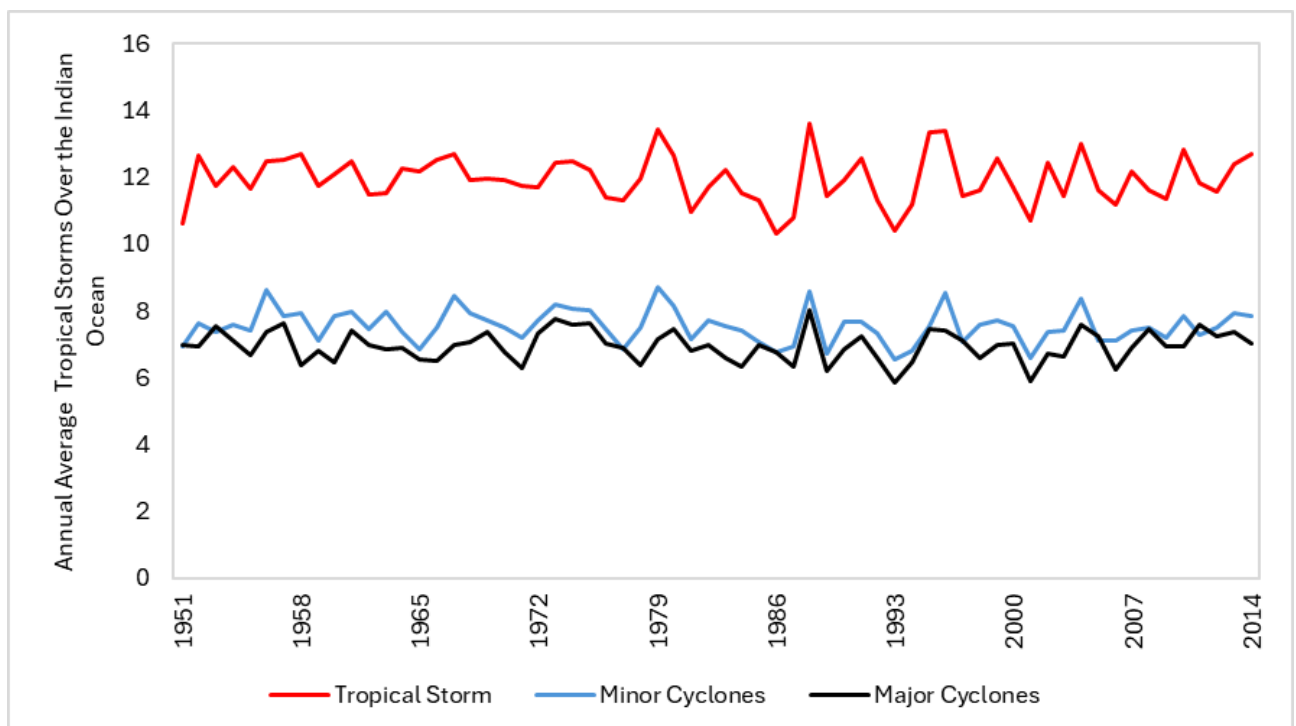


Figure 5-6 – Simulated Annual Time Series of Cyclone Counts for Tropical Storms, Minor Cyclones (Category 1&2) and mjr Cyclones category 3 and above) over the Indian Ocean World Bank CCKP, 2025

5.2.5. WAVES

The east coast of South Africa has experienced significant coastal developments recently, necessitating a detailed analysis of the local wave climate (Corbella & Stretch, 2012) due to its impact on ocean and coastal activities and marine safety (SAWS, 2024). Wave data is important as coastal erosion is primarily driven by sea level rise and increasing wave heights (Smith et al., 2014). Notably, a high swell in March 2007 produced a wave height of 8.5 meters off Richards Bay which caused significant coastal erosion and unprecedented damage to coastal property, estimated at more than one billion rand (Smith et al, 2007). Considering the impact that waves may have on coastal projects such as Berth 605, the baseline wave conditions are presented in the following sections.

5.2.5.1 Wind Waves

Figure 5-7 presents the significant height of wind waves at the Port of Richards Bay for the period 1991-2020. Over the 30-year period from 1991 to 2020, the significant height of wind waves ranged from 0.51 m in 2000 to 0.68 m in 2002. Wind wave heights remained relatively constant throughout the years, showing no significant upward or downward trends, although there was some annual variability, with higher values observed in the early 2000s. Although the wind wave data remains relatively stable wind-generated waves can cause sea level fluctuations at the coast, which can contribute to coastal flooding and erosion. Additionally, wind waves may cause wave storms which are intense oceanic conditions characterised by powerful waves. Wave storms significantly affect port activities (de Alfonso et al., 2021) and studies predict an increase frequency of extreme events which may potentially cause adverse effects on harbour operations. Change in wave storm patterns may disturb or impact on the movement of water within a port (Lesani and Niksokhan, 2019), may affect stability of port breakwaters and port siltation (Sierra et al., 2023). Furthermore sea level rise exacerbates these challenges by increasing the overtopping of port breakwaters (Maravelakis at al., 2021), reducing freeboard levels in berthing areas which affect port operability (Hansonand Nicholls, 2020; Jebbad et al., 2022).

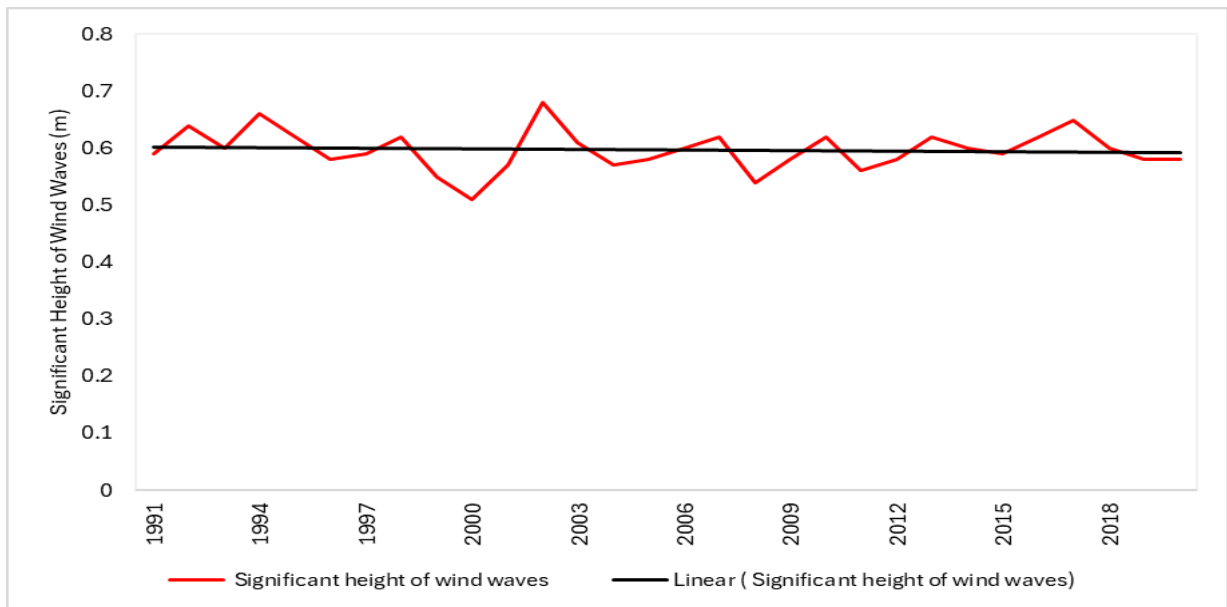


Figure 5-7 - Significant Height of Wind Waves at Port of Richards Bay from 1991 to 2020.

Source: Hersbach et al, 2023.

5.2.5.2 Maximum Height of Individual Wave

Figure 5-8 presents the maximum individual wave height at the Port of Richards Bay for the period 1991-2020. Over a 30-year period, the maximum height of individual waves (H_{max}) has shown a slight increase, with values ranging from 3.05 m in 2004 to 3.42 m in 2017. This is a narrow range, indicating relatively stable conditions the conditions that affect wave height (such as wind, tides, and weather patterns) did not undergo significant long-term changes. However, certain years, like 1995 and 2017, experienced stronger wave conditions, possibly due to specific climatic factors. Furthermore, the gradual increase in maximum wave height from 2010 to 2017 may suggest changes in sea state conditions such as stronger storms, higher wind velocities, or changes in sea level.



Figure 5-8 - Maximum Individual Wave Height (H_{max}) at Port of Richards Bay from 1991 to 2020. Source: Hersbach et al, 2023.

5.2.5.3 Total Swell

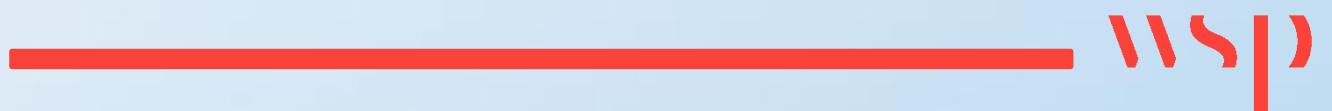
Figure 5-9 presents the significant height of total swell at the Port of Richards Bay for the period 1991-2020. Over the 30-year period from 1991 to 2020, the significant height of the total swell ranged from 1.41 m in 2004 to 1.62 m in 2011. There was a slight increase in the early years, followed by minor fluctuations. The trend remained relatively stable, with small annual variations that were less pronounced than those of the maximum wave height. The total swell values showed minor increases in the early 2000s before stabilising.



Figure 5-9 - Significant Height of Total Swell at Port of Richards Bay from 1991 to 2020.
Source: Hersbach et al, 2023.

6

CLIMATE HAZARDS



6.1 FIRE DAYS

Figure 6-2 presents the fire danger days and the potential increases in exposure to wildfire. The map on the left depicts the Projected number of fire danger days for an 8 x 8 km grid-point under an RCP 8.5 low mitigation (worst case) scenario. A fire danger day is described as a day that exceeds a value of 24 of the McArthur fire-danger index. The map on the right depicts the settlements that are at risk of increases in wildfires by the year 2050.

Using the approximate location of the site, the fire danger days for the site is approximately between 0 - 20 days and the potential increase in exposure of wildfires is rated as between very low and moderate. Furthermore, the projections show an increasing trend in temperature and the number of hot days, which are conditions that favour wildfire occurrences. Even though the risk of wildfire is between very low and moderate, the impact of wildfires should be considered across all Project phases, especially during design and construction as even areas with very low or low wildfire hazard exposure may experience an increase in wildfires.

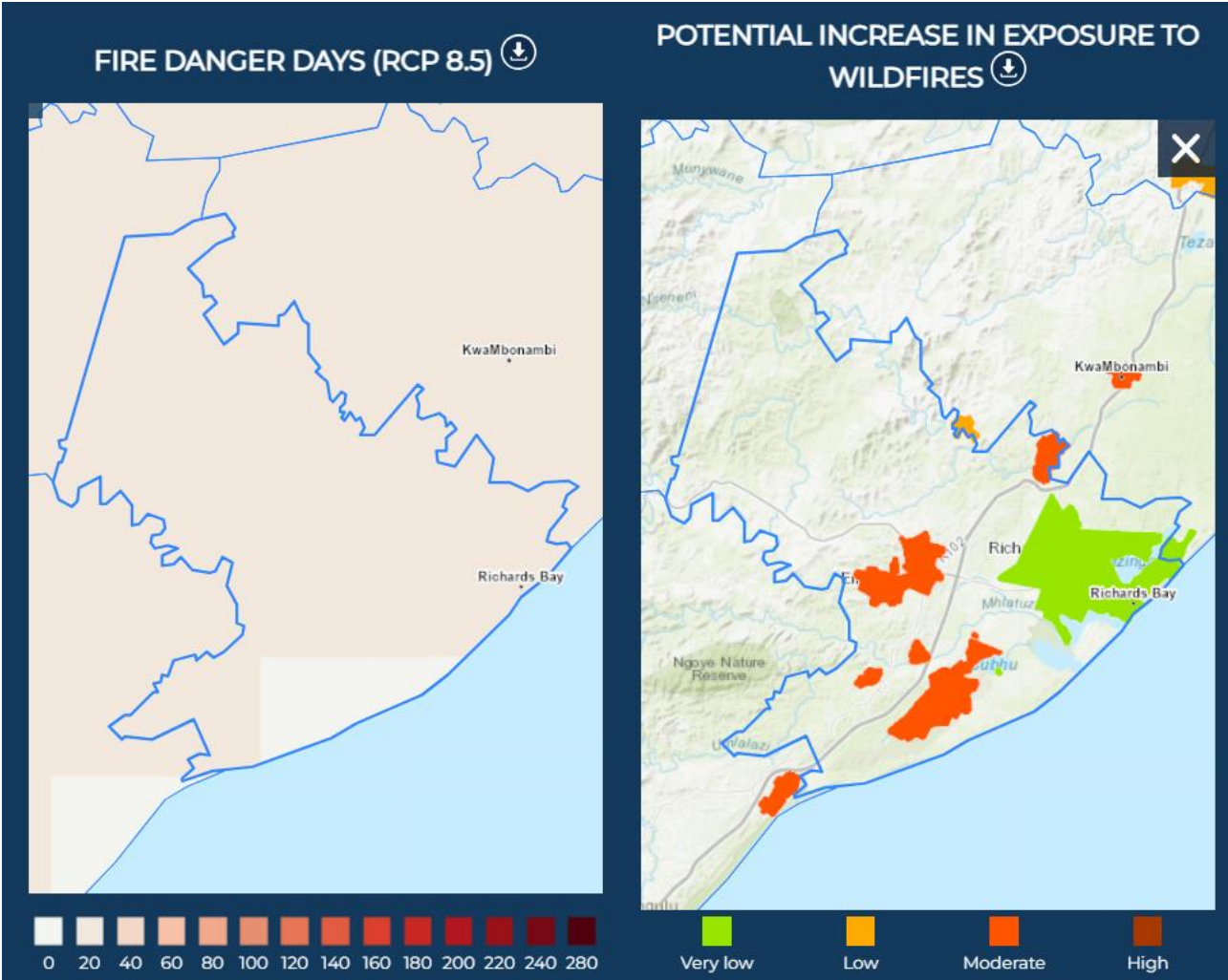


Figure 6-2 – Fire danger days and increase exposure to wildfires. Source: CSIR Greenbook, 2024

6.2 HEAT EXTREME

Figure 6-3 presents the potential increase in heat exposure under RCP8.5 (low mitigation scenario) for the uMhlathuze local municipality for 2050. The data shows that some settlements will be exposed to a low potential increase in heat extremes while others may not be exposed to such conditions. An increase in and exposure to very hot days and heatwave increases the risk of heat stress which may affect physical work capacity, cause dehydration and other occupational health problems.

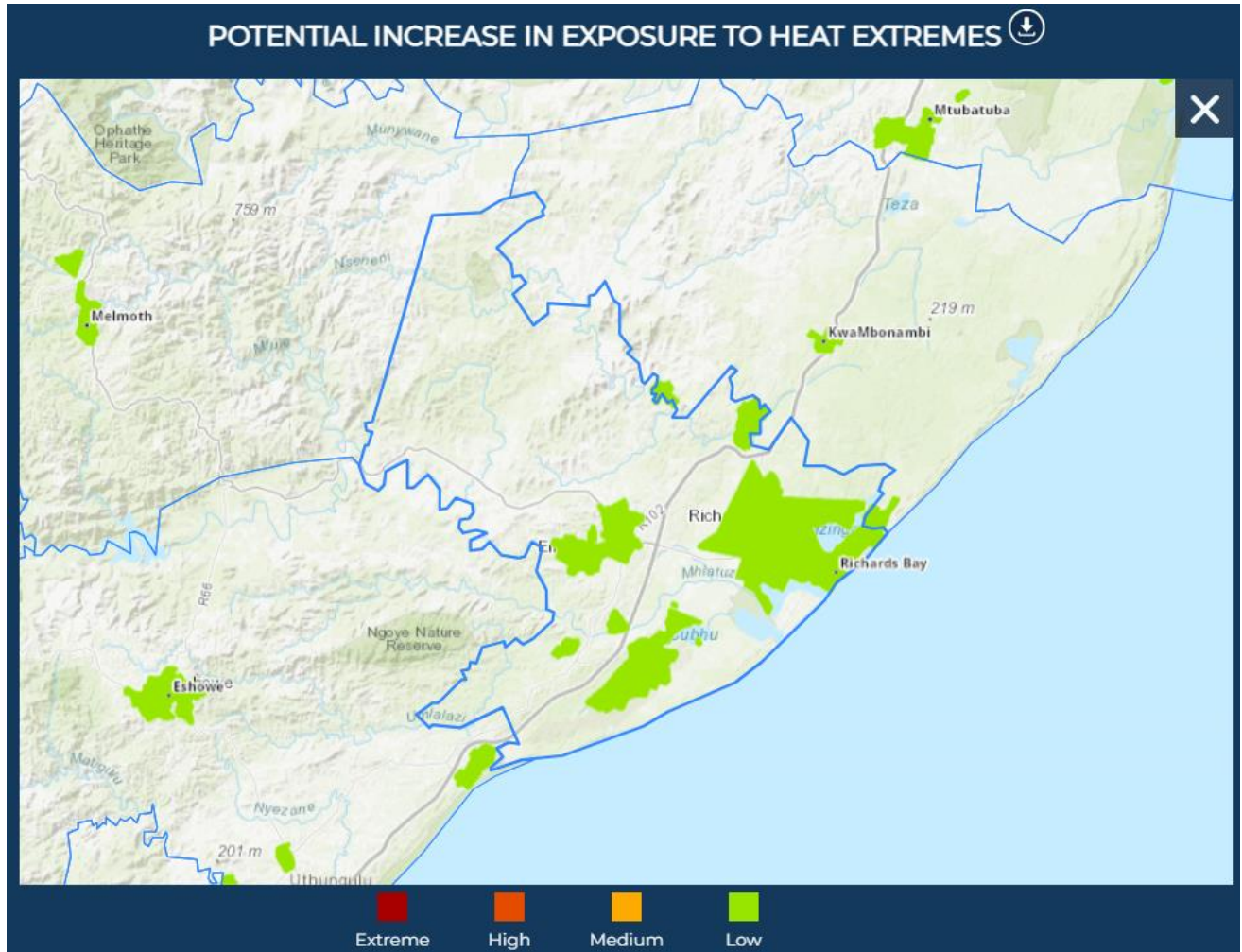


Figure 6-3 – Map showing the potential increase in exposure to heat extreme in the uMhlathuze local municipality. Source: CSIR Greenbook, 2024

6.3 FLOODING

Figure 6-4 presents the Projected change in extreme rainfall days (left) and settlements in the uMhlathuze local municipality that are at the risk of increased urban flooding (right) under RCP 8.5 worst case scenario for 2050. This was calculated by comparing the degree of change of future rainfall extremes (e.g. 95th percentile of daily rainfall) and current rainfall. A value of more than 1 indicates an increase in extreme daily rainfalls.

An extreme rainfall event (including severe thunderstorms and lightning) is defined as an instance whereby 20mm of rain occurs within 24 hours over 8 x 8 km grid point (CSIR, 2024). Extreme or intense rainfall can lead to flooding; however, the data shows that some settlements located within the local municipality will experience a very low to low potential increase in flooding exposure while others may not be affected by such conditions.

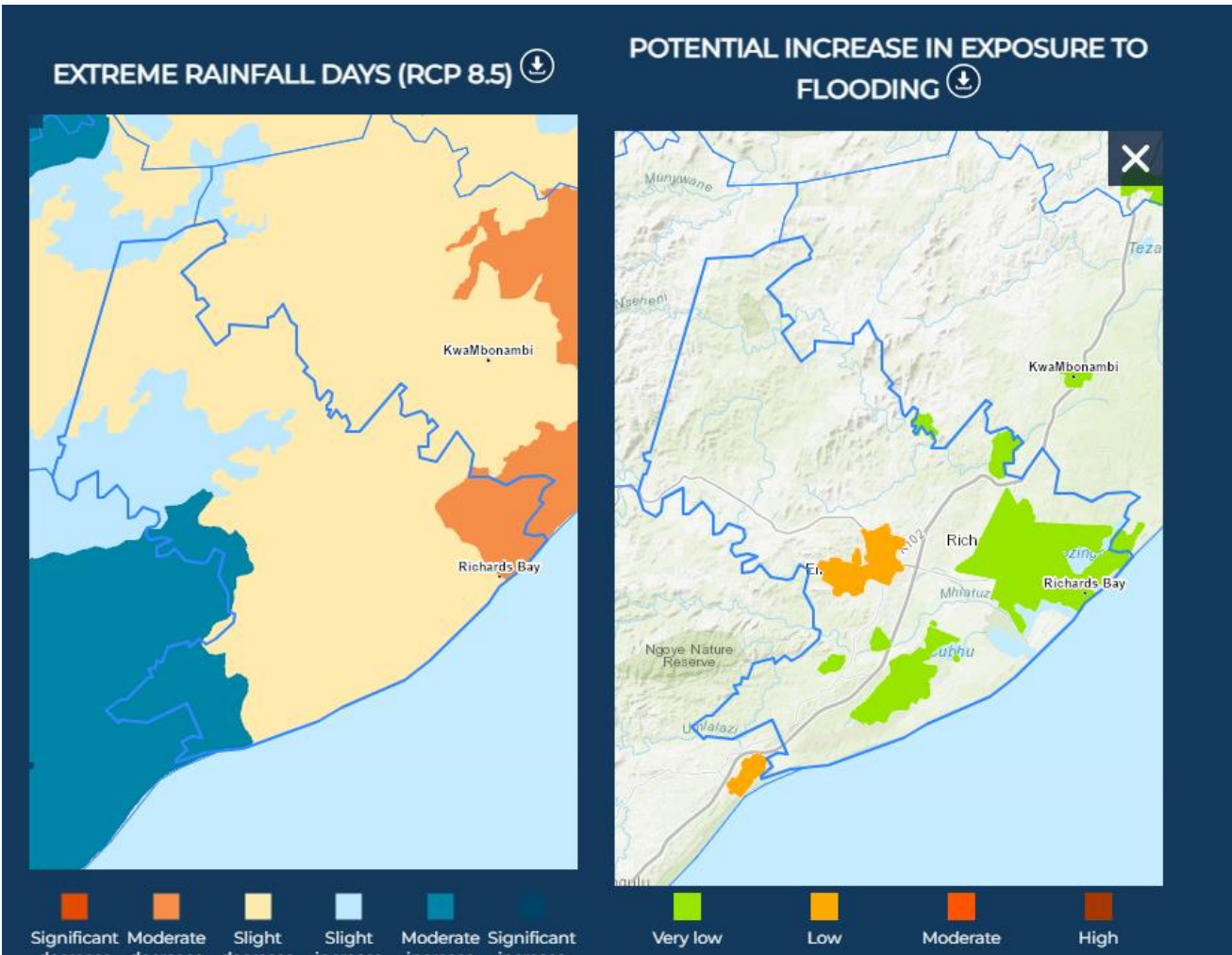


Figure 6-4 – Map showing Projected change in extreme rainfall days (RCP 8.5) and areas at risk of potential increase in exposure to flooding. Source: CSIR Greenbook, 2024

6.4 DROUGHT

Figure 6-5 presents the drought Standardised Precipitation Index (SPI) index and the potential increase in exposure of drought. The map on the left depicts the projected change in drought tendencies (i.e. the number of cases exceedingly near normal per decade) under the low mitigation scenario (RCP 8.5). A negative value is indicative of an increase in drought tendencies per 10 years (more frequent than baseline). The map on the right shows that the settlements that around the uMhlathuze municipality will be exposed to low to moderate potential increase in drought while others may not experience such conditions.

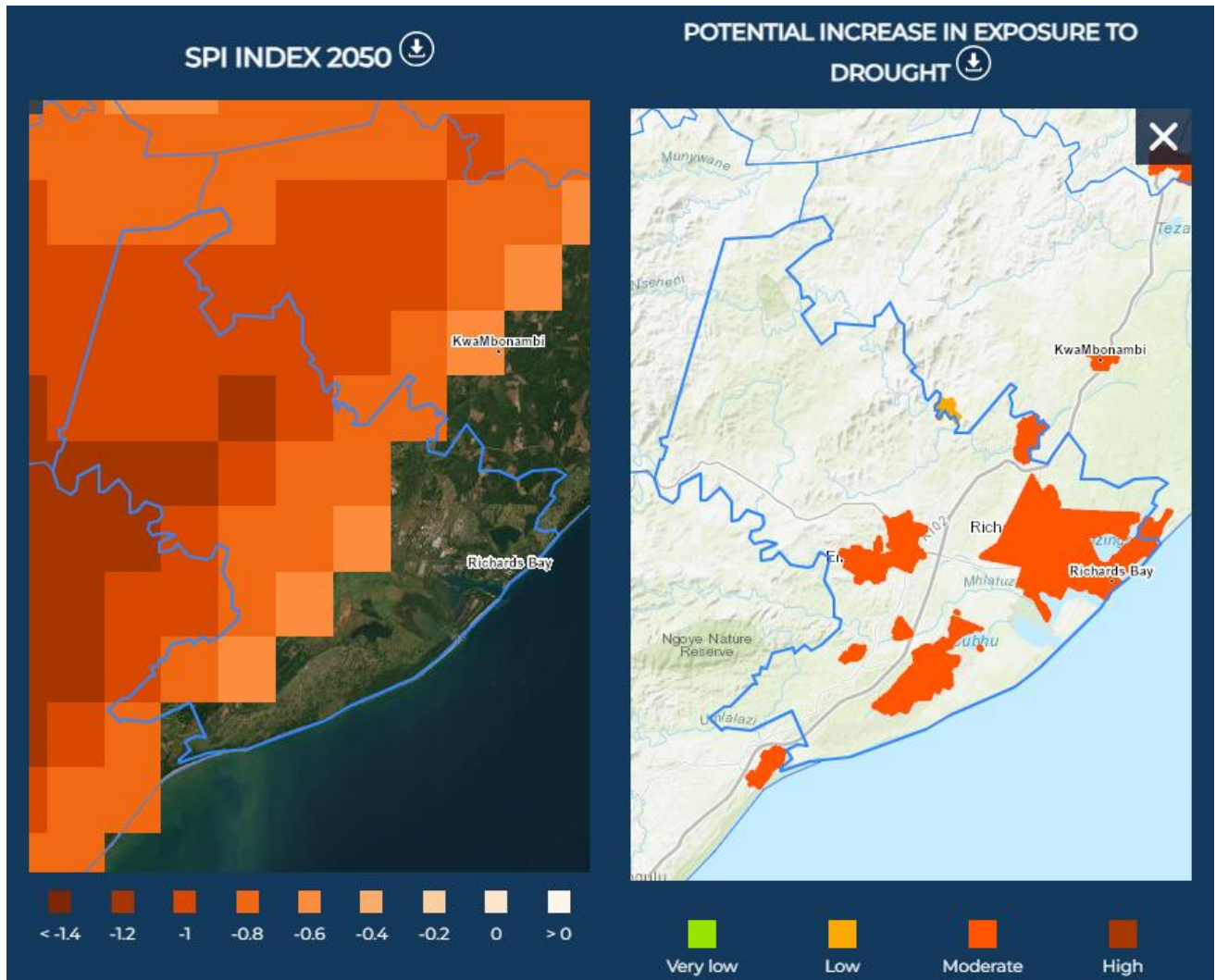


Figure 6-5 – Map showing SPI Index (left) and potential increase in exposure to drought for uMhlathuze Local Municipality. Source: CSIR Greenbook, 2024

6.5 PHYSICAL CLIMATE RISK ASSESSMENT

This section provides a high-level semi-quantitative assessment of the significance of the potential impacts of climate change on the Project. The outcomes of the assessment will provide a basis to identify the key risk drivers and make informed decisions on the way forward to ensure that these risks do not result in unacceptable social or environmental risk. The purpose of this physical risk assessment is therefore to identify the potential impacts and associated risks posed by the climate on the current and future planned phases of the proposed Project. The assessment uses a methodological framework developed by WSP to meet the combined requirements of international best practice and NEMA, Environmental Impact Assessment Regulations.

As required by the EIA Regulations, the determination and assessment of impacts will be based on the following criteria:

- Nature of the impact.
- Significance of the impact.
- Consequence of the impact.
- Extent of the impact.
- Duration of the impact.
- Probability of the impact; and
- Degree to which the impact
 - can be reversed.
 - may cause irreplaceable loss of resources; and
 - can be avoided, managed or mitigated.

Following international best practice, additional criteria have been included to determine the significant effects. These include the consideration of the following:

- **Magnitude:** The extent to which environmental resources will be impacted.
- **Sensitivity:** The sensitivity of the resource or receptor, rated as high, medium, or low. This considers the importance of the receiving environment (international, national, regional, district, and local), its rarity, the benefits or services provided by the environmental resources, and the perception of the resource or receptor.
- **Severity:** The severity of the impact, determined by the significance of the consequences of change (high, medium, low, negligible). This considers factors such as magnitude, duration, intensity, likelihood, frequency, and reversibility of the change.

It should be noted that the definitions given are for guidance only, and not all the definitions will apply to all the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

6.5.1. METHODOLOGY

The assessment of impacts and mitigation examines the probable extent and significance of potential impacts on identified receptors and resources, using defined assessment criteria. This process aims to develop and describe measures to avoid, minimise, or compensate for any adverse environmental impacts, enhance positive impacts, and report the significance of residual impacts that remain after mitigation. The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed Project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct², indirect³, secondary⁴ as well as cumulative⁵ impacts.

A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e., residual impact). The significance of environmental aspects is determined and ranked by considering the criteria⁶ presented in **Table 6-1**

² Impacts that arise directly from activities that form an integral part of the Project.

³ Impacts that arise indirectly from activities not explicitly forming part of the Project.

⁴ Secondary or induced impacts caused by a change in the Project environment.

⁵ Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

⁶ The definitions given are for guidance only, and not all the definitions will apply to all the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

Table 6-1 – Impact Assessment Criterion and Scoring System

Criteria	Score 1	Score 2	Score 3	Score 4	Score 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without intervention		Recoverable: Recovery with intervention		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ <i>Significance = (Extent + Duration + Reversibility + Magnitude) × Probability</i>				
Total Score	4 to 15	16 to 30	31 to 60	61 to 80	81 to 100
Environmental Significance Rating (Negative (-))	Very low	Low	Moderate	High	Very High
Environmental Significance Rating (Positive (+))	Very low	Low	Moderate	High	Very High

6.5.2. RESULTS

The results of a comprehensive risk assessment are presented in **Table 6-2**, focusing on the potential impacts arising from climate change onto the proposed Berth 605 Project.

Table 6-2 - Risk assessment for the proposed Berth 605 Project

Construction Phase:

CONSTRUCTION																					
Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Mitigation	Pre-Mitigation							Post-Mitigation							
							(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating	
Impact 1:	Construction phase activities	Increased rainfall intensity and frequency, including extreme precipitation events, may cause flooding at construction sites. This could lead to waterlogging, erosion, and damage to materials and equipment, impacting construction activities such as the shared road and quay wall. These impacts may result in significant delays in the project schedule	Construction	Negative	moderate	Ensure project schedules are flexible to account for unavoidable delays during extreme rainfall events	4	1	3	2	3	30	N2	3	1	3	2	2	18	N2	
						Install sandbags and water-filled barriers as flood defence strategy to stop approaching floodwater															
						Create temporary drainage channels to divert rainwater away from the construction site															
						Use real-time weather monitoring tools or subscribe to meteorological services for early warnings of heavy rainfall.															
Significance							N2 - Low								N2 - Low						
Impact 2:	Personnel Health and Safety	Projections show an increase in temperature and slight increase in the number of hot days (>35°C). This may result in heat wave conditions leading to heat stress, dehydration, and reduced productivity among the workforce, ultimately affecting worker well-being and potentially causing delays to the project schedule during the construction phase	Construction	Negative	moderate	Consider modifying work schedules to minimise outdoor activities during the hottest parts of the day, such as rescheduling strenuous tasks to cooler morning or late afternoon hours	4	1	3	2		40	N3	3	1	3	2	3	27	N2	
						Monitor weather conditions during construction to prepare for extreme conditions such as high temperatures															
						Conduct training sessions to educate workers and create awareness about the signs of heat stress, preventive measures, and the importance of early intervention as well as the importance of drinking water to stay hydrated															
Significance							N3 - Moderate								N2 - Low						
Impact 3:	Construction activities and personnel safety	Strong winds and storm events during the construction phase may damage temporary installations (e.g.,	Construction	Negative	moderate	Develop wind monitoring systems to anticipate extreme wind events	3	1	3	2	3	27	N2	2	1	3	2	3	24	N2	

Operational Phase

OPERATIONAL																				
Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Mitigation Measures	Pre-Mitigation							Post-Mitigation						
							(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 1:	Personnel health and safety	The projections show an increase in mean temperatures under worst case scenarios and more increase in the future. Additionally, the number of very hot days show minor increases however an increase in mean annual temperature and the number of hot days (>35°C) may increase the likelihood of heat stress, dehydration, and heat stroke among workers. These conditions could reduce workforce productivity and compromise health and safety at Berth 605 and the port.	Operational	Negative	Low	Develop and implement a comprehensive heat stress management plan that outlines procedures, responsibilities, and actions to prevent and address heat-related health issues	4	1	3	4	4	48	N3	3	1	3	4	3	33	N3
						Develop and implement an early warning system to help employees prepare for and respond to climate change risks such as high temperatures and extreme heat														
						Consider modifying work schedules to minimise outdoor activities during the hottest parts of the day, such as rescheduling strenuous tasks to cooler morning or late afternoon hours														
						Monitor weather conditions during operations to prepare for extreme conditions such as high temperatures														
						Conduct training sessions to educate workers and create awareness about the signs of heat stress, preventive measures, and the importance of early intervention as well as the importance of drinking water to stay hydrated														
Significance						N3 - Moderate							N3 - Moderate							
Impact 2:	Personnel health and safety	Extreme precipitation events, storm surges, and rising sea levels may cause localised flooding, restricting worker mobility and disrupting site operations. Persistent flooding and wave action may also weaken infrastructure over time, leading to higher maintenance needs and operational downtime at Berth 605 and the Port.	Operational	Negative	Low	Send out timely communication to workers regarding unsafe work conditions due to extreme weather events to ensure their safety	3	1	3	4	3	33	N3	2	1	3	4	2	20	N2
						Identify and incorporate emergency response policies and protocols into the Project. This should also include an evacuation plan to help move workers from site during unsafe work conditions														
Significance						N3 - Moderate							N2 - Low							
Impact 3:	Personnel health and safety	Projections show minor increases in extreme precipitation days. However, an increase in rainfall intensity and frequency as well as extreme precipitation days may lead to flooding, causing damage to the rail siding and making the new shared road temporarily inaccessible. This would negatively impact the movement of personnel to, from, and around the location of Berth 605, restrict vehicle access to the Port of Richards Bay and the container handling facility. This may lead to increased need, to repair and	Operational	negative	Moderate	Regular road maintenance on internal roads and new shared road	3	1	3	4	3	33	N3	2	1	3	4	2	20	N2
						Implement regular inspection, and maintenance programs for stormwater and road infrastructure														
						Collaborate with transport authorities to develop contingency plans for critical road and rail links.														
						Regularly maintain the drainage systems to management surface water runoff and flooding														

		reconstruct the road, increased costs, inefficiencies at Berth 605 and Port operations and may also impact the transportation of dredged material to the authorised site				Where possible elevate roadways to protect them from flooding													
						Establish alternative transport routes and staging areas for cargo.													
Significance							N3 - Moderate							N2 - Low					

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Mitigation Measures	Pre-Mitigation							Post-Mitigation						
							(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 4:	Sewage systems and water quality	Strong winds combined with rising sea levels and storm surges may result in the overtopping of sewage systems, leading to potential contamination of surrounding areas and disruption of water quality management.	Operational	Negative	Moderate	Consider the construction on breakwater as structures to protect the Berth 605 location and coastline from the force of waves and extreme events like storm surges	3	1	3	4	3	33	N3	2	1	3	4	2	20	N2
						Where possible consider the construction of green infrastructure, such as constructed wetlands, to help manage stormwater and improve water quality from contaminated runoff														
Significance							N3 - Moderate							N2 - Low						
Impact 5:	Sewage systems and water quality	Extreme weather events, such as heavy rainfall, can overwhelm wastewater treatment plants or sewage systems, causing untreated sewage to flow into bodies of water. This can lead to contamination of water supplies such as groundwater surface water bodies affecting public health.	Operational	Negative	Low	If possible, consider having a weather station on site for real time monitoring of extreme climate events such as extreme precipitation.	3	1	3	4	3	33	N3	2	1	3	4	3	30	N2
						Regular maintenance and cleaning of pipes to prevent blockage from any material sewage. Ensure regular maintenance of stormwater drainage systems on site														
Significance							N3 - Moderate							N2 - Low						
Impact 6:	Infrastructure	Sea level rise may lead to flooding which may possibly damage infrastructure such as sewage systems	Operational	Negative	Low	If possible, consider sea level monitoring to prepare for high sea levels which may cause damage to infrastructure	3	1	3	4	4	44	N3	3	1	3	4	3	33	N3
Significance							N3 - Moderate							N2 - Low						
Impact 7:	Stormwater management	Although projections show variability in rainfall and minor increases in extreme precipitation days; increased rainfall intensity, extreme precipitation, and rising sea levels may lead to surface water run off thus exceeding the capacity of stormwater drainage systems around Berth 605 and the Port. This can result in surface level flooding as elevated water levels reduce drainage efficiency, surcharging drainage pipes and impeding their	Operational	Negative	Moderate	Identify and use existing Early Warning Systems (EWS) in your project area. EWS are designed to provide communities with advanced notice of imminent flood events based on weather forecasts, recorded rainfall, or rising water levels upstream. They also help in implementing protocols for mitigating flood impacts	3	1	3	4	3	33	N3	2	1	3	4	2	20	N2
						Construction and maintenance of diversion channels around the site to prevent mixing of 'clean' and 'dirty' stormwater runoff														

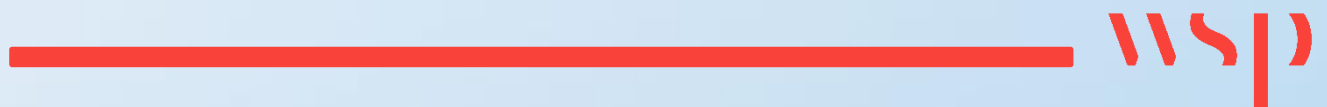
Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Mitigation Measures	Pre-Mitigation							Post-Mitigation						
							(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 11:	Operations	An increase in rainfall intensity and storm surge may lead to flooding and coastal erosion	Operational	Negative	Moderate	Consider the construction of infrastructure that manages coastal flood and erosion risks, e.g., higher or stronger embankments or dunes or vegetation as erosion and flood buffering techniques	4	1	3	4	4	48	N3	3	1	3	4	3	33	N3
Significance							N3 - Moderate							N3 - Moderate						
Impact 12:	Operations	Increased winds and storm surge will lead to delays in berthing	Operational	Negative	Low	Operations should be halted during extreme wind conditions	4	1	3	4	4	48	N3	3	1	3	4	4	44	N3
						Invest in infrastructure can withstand extreme wind and other weather conditions														
Significance							N3 - Moderate							N3 - Moderate						
Impact 13:	Operations	High winds during storms can restrict port operations. For instance, cranes cannot be moved when winds exceed a certain threshold as such conditions can cause damage	Operational	Negative	Low	Implement procedures to follow during extreme wind conditions	4	1	3	4	3	36	N3	3	1	3	4	3	33	N3
						Ensure that equipment is sufficiently secured from damage during extreme conditions such as strong winds and storms														
Significance							N3 - Moderate							N3 - Moderate						
Impact 14:	Power Supply	A decrease in average annual precipitation combined with an increase in average annual temperatures, is not expected to have significant impact on the power supply for the proposed Project. However extreme precipitation may affect electrical lines and lead to power cuts	Operational	Negative	Low	Consider onsite standby generators if not currently available Uninterruptible Power Supplies (UPS) for temporary power during power outage while the generator kicks if the Project does not have such measures in place	4	1	3	4	3	36	N3	3	1	3	4	2	22	N2
Significance							N3 - Moderate							N2 - Low						
Impact 15:	Water Supply and Availability	The provincial projections show variability in annual mean and monthly rainfall and a very low likelihood of drought events for the local municipality where Berth 605 is located. However, a combination of decrease in rainfall combined with an increase in average annual temperatures and number of hot days will lead to higher rates of evaporation increasing the risk of drought and further reducing water availability and supply for the ships at the Berth 605 and the port.	Operational	Negative	Low	Develop a Water Conservation and Water Demand Management plan for the site to maximise re-use and recycling of water	4	1	3	4	3	36	N3	3	1	3	4	2	22	N2
						Consider designing stormwater and rainwater harvesting systems. Where possible encourage the use of these systems as alternative water sources to meet water supply and demand														
						Consider water awareness campaigns to educate employees and affected parties on water conservation techniques														
						Where possible design systems to recycle water in order to maximise water recycling and reuse to reduce reliance on portable water														
						Incorporate climate change Projections into water supply planning and infrastructure design to account for potential changes in water availability.														
Significance							N3 - Moderate							N2 - Low						

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Mitigation Measures	Pre-Mitigation							Post-Mitigation						
							(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 16:	Quay wall and Quayside Operations	Increase in rainfall intensity and extreme precipitation can cause flooding and disrupt quayside operations if stormwater drainage systems are overwhelmed. The quayside, where ships are loaded and unloaded, can be affected by higher water levels.	Operational	Negative	Low	The construction and design of the quay wall height should consider water level exceedances and sea level rise to ensure or limit disruption during extreme sea level conditions	3	1	3	4	3	33	N3	2	1	3	4	2	20	N2
Significance						N3 - Moderate							N2 - Low							
Impact 17:	Quay wall and Quayside Operations	Sea level rise and storm surge (higher than usual waves as a result of sea level rise and strong winds) around the Port will lead to higher water levels which may affect infrastructure at Berth 605, may lead to delays in berthing and may damage quay wall	Operational	Negative	Low	Consider constructing and designing a quay wall with enough capacity and height to cope with various water levels	4	1	3	4	4	48	N3	3	1	3	4	2	22	N2
Significance						N3 - Moderate							N2 - Low							
Impact 18:	Port Vessels	The entry and exit of vessels into and from a port, are sensitive to wind and wave conditions. Therefore, strong winds can affect the loading and unloading as well as movement of vessels. Furthermore, very strong winds can topple container stacks and port equipment such as cranes	Operational	Negative	Low	Halt operations during period of very strong or extreme wind conditions	3	1	3	4	3	33	N3	2	1	3	4	3	30	N2
						Ensure empty containers are properly secured														
Significance						N3 - Moderate							N2 - Low							
Impact 19:	Operations and Port Infrastructure	Long-term exposure to sea-level rise, wave action and storm surges can lead to gradual coastal erosion which could weaken port structures (e.g., quay walls, breakwaters and other coastal infrastructure) increasing maintenance costs, disrupting operations, and reducing structural stability over time.	Operational	Negative	Low	Conduct regular structural integrity assessments of coastal infrastructure	4	1	3	4	4	48	N3	3	1	3	4	3	33	N3
						Incorporate erosion-resistant materials and protective measures														
Significance						N3 - Moderate							N3 - Moderate							
Impact 19:	Air Quality	High temperatures and strong winds increased dust emissions and machinery exhaust could degrade air quality, impacting worker health, nearby communities, and compliance with environmental regulations.	Operational	Negative	Low	Monitor air quality regularly and ensure compliance with regulations.	3	1	3	4	3	33	N3	3	1	3	4	2	22	N2
						Implement dust suppression systems, such as sprinklers or vegetative buffers.														
Significance						N3 - Moderate							N2 - Low							

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Mitigation Measures	Pre-Mitigation							Post-Mitigation						
							(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 20:	Infrastructure integrity and lifespan	Ocean acidification can lead to an accelerated corrosion of underwater structures (e.g., pilings, quay walls) may increase maintenance costs, reduce structural life expectancy, and lead to operational inefficiencies	Operational	Negative	Low	Conduct regular inspections and maintenance to address early signs of corrosion.	3	1	3	4	2	22	N2	2	1	3	4	1	10	N1
						Use corrosion-resistant materials for underwater infrastructure.														
Significance						N2 - Low							N1 - Very Low							
Impact 21:	Water Quality	Ports handle various materials and equipment that can produce hazardous runoff during heavy rains. This has the potential to lead to contamination of nearby marine and freshwater ecosystems, regulatory fines etc.	Operational	Negative	Low	Upgrade stormwater treatment systems	3	1	3	4	2	22	N2	2	1	3	4	1	10	N1
						Use spill containment measures for hazardous materials														
						Monitor runoff quality and establish response protocols to prevent events														
Significance						N2 - Low							N1 - Very Low							
DECOMISSIONING																				
The impacts of climate change on the decommissioning phase will be similar to the construction phase, however, would need to be assessed closer to the time once relevant details are available.																				

7

IMPACT OF THE PROJECT ON CLIMATE CHANGE (GREENHOUSE GAS ASSESSMENT)



7 IMPACT OF THE PROJECT ON CLIMATE CHANGE (GREENHOUSE GAS ASSESSMENT)

Ports are critical nodes in global trade and transportation systems, but their operations and supporting infrastructure are associated with considerable greenhouse gas (GHG) emissions. These emissions arise not only from port-specific activities such as cargo handling, equipment use and electricity consumption, but also from upstream and downstream supply chain activities. Using the Greenhouse Gas Protocol classification, port-related emissions are typically categorised into Scope 1 (direct emissions from fuel use), Scope 2 (indirect emissions from purchased electricity) and Scope 3 (indirect emissions from vessel movements, the supply chain, and auxiliary services). Globally, maritime transport accounts for approximately 3% of total GHG emissions, with emissions increasing by 20% over the past decade, highlighting the urgency for decarbonisation in the sector (UNCTAD, 2023). There is increasing recognition within the maritime sector of the need to decarbonise port operations. As a result, ports around the world are implementing initiatives aimed at reducing their emissions footprints.

The International Maritime Organization (IMO), a specialised agency of the United Nations responsible for regulating international shipping, has recently adopted a landmark global emissions pricing mechanism. Starting in 2027, ships exceeding emissions thresholds will be required to pay a penalty of up to \$380 per metric ton of CO₂, with an additional surcharge for surpassing stricter limits. The agreement also introduces a carbon credit trading system, encouraging ship operators to adopt cleaner technologies or purchase allowances from lower-emitting vessels. These measures are part of the IMO's strategy to reduce GHG emissions from shipping by up to 30% by 2035, compared to 2008 levels. While primarily aimed at shipping companies, the implementation of this policy is expected to influence port infrastructure through increased demand for low-emission support services, shore power and alternative fuel readiness, particularly at berths where vessels dock, and emissions can accumulate during idling or auxiliary operations (UN News, 2025). In response, ports worldwide are implementing mitigation strategies to lower their emissions footprints and support the maritime energy transition. These include electrification of cargo-handling equipment, integration of hybrid or battery-powered systems, sourcing renewable energy, and enhancing energy efficiency in port operations and buildings. The International Association of Ports and Harbors (IAPH) has noted growing uptake of green certification standards and emissions reduction initiatives, although adoption remains uneven across regions (IAPH, 2022; GCA, 2023).

The following section presents the impact the proposed Berth 605 Project may have on climate change (i.e., GHG assessment). The section begins with an overview of the South African country trends followed by the methodology to quantify emissions. The current assessment employs a literature-based estimation approach, leveraging data from comparable infrastructure Projects and peer-reviewed emission factors to estimate likely emissions. This is followed by a high-level decarbonisation plan, which outlines mitigation measures and potential emission reduction strategies throughout the Project life.

7.1 CURRENT BASELINE

7.1.1. BACKGROUND INFORMATION ON NATIONAL GHG INVENTORY

South Africa's national GHG inventory was developed in alignment with international best practices and evolving IPCC guidelines. The first official inventory was published in 1998 using data from 1990. (Van der Merwe & Scholes, 1998). Since then, the national inventory has been updated and expanded to include subsequent years, with improvements to methodology and consistency. The 2000 inventory (DEAT, 2009), published in 2009, adopted the 2006 IPCC Guidelines (IPCC, 2006) to enhance transparency and comparability across sectors. Subsequent inventories, covering the period from 2000 to 2010, were released in 2014 (DEA, 2014), with updates for 2011 and 2012 compiled in 2016 (DEA, 2016). Annual inventories for 2013 through to 2020 have since been completed, with the most recent dataset released in 2023. An update was completed for 2011 and 2012 in 2016 (DEA, 2016), for 2013 to 2015 in 2019 and 2017 in 2021 (DEFF, 2021).

The inventories for 2018, 2019 and 2020 were compiled in 2023 (DFFE, 2023). The latest inventory is compiled in accordance with the guidelines of the United Nations Framework Convention on Climate Change (UNFCCC), 2006 IPCC Guidelines (IPCC, 2006), IPCC Good Practice Guidance (GPG) (IPCC, 2000; IPCC, 2003; IPCC, 2014) and the 2019 Refinement to the 2006 IPCC Guidelines (IPCC, 2019). The key trends from 2000 to 2022 discussed below were calculated using the Fifth Assessment Report (AR5) Global Warming Potentials (GWPs).

7.1.2. EMISSION TRENDS EXCLUDING LAND USE, FORESTRY AND LAND USE CHANGE (LULUCF)

The emissions trends presented below are based on South Africa's 9th National Greenhouse Gas Inventory Report (DFFE, 2024), which covers the period from 2000 to 2022. In 2000, the country's GHG emissions were estimated to be 489,188.3 Gg CO₂e. By 2020, emissions had decreased to 471,858.3 Gg CO₂e, reflecting a 5.7% reduction over the 20-year period. In 2022, emissions increased to 478,300.9 Gg CO₂e, reflecting a 6,442.5 Gg CO₂e (+1.4%) increase over two years. Between 2000 and 2022 emissions fluctuated peaking at 546,704.2 Gg CO₂e in 2009 and reaching their lowest levels in 2020, potentially due to the COVID-19 pandemic.

7.1.3. Overall Emissions Including Land Use, Forestry and Land Use Change (LULUCF)

South Africa's GHG emissions including Land Use, Land-Use Change and Forestry (LULUCF) were estimated at 461,341.8 Gg CO₂e in 2000 and 435,119.6 Gg CO₂e, in 2022, reflecting a 5.7% decrease. Emissions fluctuated between 2000 and 2022, peaking at 529,157.1 Gg CO₂e in 2008 and reaching the lowest levels in 2022. In 2020, emissions were estimated at 436,765 Gg CO₂e, representing an 8.3% decrease from the previous year (476 302.8 Gg CO₂e), likely due to the COVID-19 lockdown restrictions.

7.1.4. SECTOR CONTRIBUTIONS

Sectoral emission trends provide a critical insight into distributions and patterns of GHG emissions across various sectors. These trends highlight sources and intensities of emissions. Below is an overview of sector-specific emissions contributions, complemented by **Figure 7-1** which visually represents the emissions attributed to each sector.

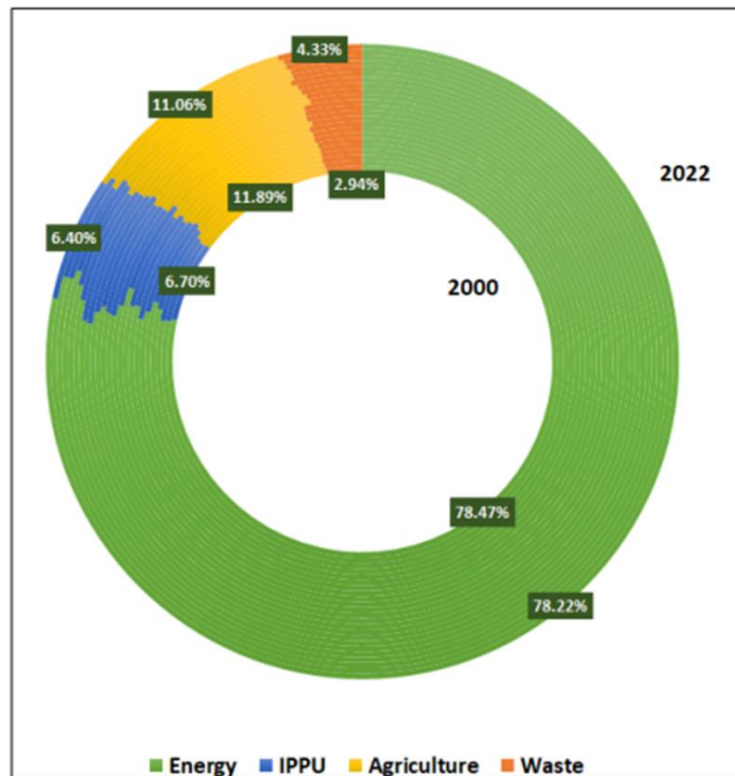


Figure 7-1 - Sector contribution to total emissions (excluding LULUCF) in South Africa between 2000 and 2022

7.1.4.1 Energy

2022

The Energy sector is the main source of the country's overall emission accounting for 78 % excluding LULUCF and 86 % including LULUCF. Most emissions within the energy sector originate from energy industries (60%) and transport (14%), while the smallest emissions come from Solid Fuels (0.6%) and oil and natural gas activities (0.03%).

2000-2022

Since 2000, energy sector emissions have decreased by 2.5%, while emissions from the 'other sectors' category have dropped significantly by 62% primarily due to reductions in the 'residential sector'. This decline is potentially due to increased electrification and the growing use of renewable energy sources. Emissions from domestic aviation and petroleum refining have also seen a notable decreases of 70% and 73% respectively since 2000. Although energy sector emissions slightly decreased from 2000-2022 emissions from electricity production increased by 11.5% driven by an 8.7% increase in power generation during that period.

2020-2022

Energy emissions decreased by 0.2% between 2020 and 2022. While emissions increased by 3.5% in 2021, they subsequently decreased in 2022 to levels like those observed during the COVID-19 Pandemic. This decrease (-6.5%) is mainly due to emissions from the energy industries sub-sector, which on average accounts for 67% of the energy sector's total emissions.

7.1.4.2 Industrial Processes and Product Use (IPPU)

2022

IPPU emissions accounted for 6.4% of South Africa's emissions (excluding LULUCF) in 2022. The metal industry category was the largest contributor, responsible 51.2% to the total IPPU sector emissions. The mineral industry and the product used as substitutes for ozone depleting substances contributed 19.8% and 19.4%, respectively, to the sector's emissions.

2000 - 2022

Between 2000 and 2022, IPPU emissions decreased by 6.7%, largely due to a 39% decline in metals productions, particularly iron and steel and aluminium as a result the declining economy. Emissions from the chemicals industry decreased significantly (-31.4%). However, emissions cement production and non-energy product use from fuels and solvents increased by 2,081 Gg CO₂e.

2020-2022

Since 2020, IPPU sector emissions have increased by 23.1% since 2020, primarily due to the restoration of production in the minerals (26.8%) and metals (26.8%) industry post covid. Additional contributions came from the increased replacement of ozone depleting substances by fluorinated gases (12.5%). Furthermore, emissions from the chemicals industry decreased by lower emissions 22.5% due to lower production.

7.1.4.3 Agriculture

2022

In 2022, agriculture emissions accounted for 11% (excluding LULUCF) and 12% (including LULUCF) of South Africa's total emissions. Most of these emissions were from enteric fermentation (68%), agricultural soils (18%) and manure management (8.0%), with the smallest emissions from field burning of agricultural residues (0.1%).

2000 - 2022

Since 2000, Agriculture sector emissions decreased by 9.1%. Emissions from enteric fermentation decreased the most (by 14%) during this period mainly because of the reduced non-dairy cattle total emissions. This is likely due to decreased livestock population numbers since 2000. On the other hand, emissions from manure management increased by 8% and driven by to the increase in N₂O emission. The rise in N₂O emissions from handling manure was largely attributed to the storing of manure in dry lots or kraals across various livestock categories. As a result, the storage of dry-based manure predominantly contributed to increased N₂O production.

2020-2022

Since 2020 the agriculture sector emissions have declined by 0.6% and mainly due to declining livestock population.

7.1.4.4 Land Use, Forestry and Land Use Change (LULUCF)

2022

In 2022, the Land Use, Land-Use Change, and Forestry (LULUCF) sector acted as a sink of 43,181 Gg CO₂e emissions. Forest lands were the largest contributors to this sink, with thickets and woodlands being the dominant contributors. Harvested wood products (HWP) also served as a sink

in 2022 (2,346 Gg CO₂e). Meanwhile, all other land sectors were estimated to be overall sources of emissions.

2000 - 2022

Between 2000 and 2022, the LULUCF sector increased its carbon sink by 55%. Forest lands were the largest contributor to this increased sink, showing a steady increase from 2009. Additionally, the conversion of grasslands to woodlands between 2014 and 2022 further increased the carbon sink. However, *grasslands* led to increased emissions between 2000 and 2022 due to land conversions between low shrublands and grasslands.

2020-2022

The LULUCF sink grew by 23% between 2020 and 2022. Although there was a decline in 2021 caused by increased losses from fires, the sink recovered in 2022. An increase in the conversion of *grassland* to *forest land* produced an increased *forest land* sink.

7.1.4.5 Waste

2022

In 2022, South Africa waste sector emissions accounted 4% (excluding LULUCF) and 4.8% (including LULUCF) of the total emissions. Most emissions within the sector were from wastewater treatment and discharge which contributed 44.7% to the total sectoral emissions. This is followed by Solid waste disposal which contributed 41.5% while *biological treatment of solid waste and Incineration* and *open burning of waste* accounted for 12.2% and 1.6% respectively.

2000 – 2022

Waste sector emissions have increased by 44.1% since 2000. Solid waste disposal emissions have increased by 47.6% and those from incineration and open burning of waste emissions increased by 53.1% since 2000. Wastewater treatment and discharge emissions increased slightly during the 2000-2022 period, largely due to increases of 35.6% in domestic wastewater treatment and discharge emissions, whilst there was a 9.4% decline in Industrial wastewater treatment and discharge emissions.

7.2 METHODOLOGY

The GHG Assessments are commonly undertaken in accordance with the NGERs (Government Notice 710 of Government Gazette 40996) of 3 April 2017 and the most recently published Methodological Guidelines for Quantification of GHG Emissions (Government Notice 2598 of Government Gazette 47257) of 7 October 2022. Additionally, the GHG Protocol has been sourced for added context. This standard was developed by the World Resources Institute and World Business Council for Sustainable Development, in consultation with businesses, non-governmental organisations and governments (WBCSD and WRI, 2004). The aim was to develop an internationally accepted GHG accounting and reporting standard for organisations preparing a GHG inventory.

The framework covers the six GHGs included by the Kyoto Protocol. This includes CO₂, CH₄, N₂O, HFCs, PFCs, and SF₆.⁷ The GHGs applicable for this assessment include CO₂, CH₄ and N₂O.

No activity-level data was provided for emission-generating activities across any of the Project phases. As a result, a full GHG inventory could not be developed. However, a high-level screening based on literature, benchmarks from comparable port infrastructure projects was considered.

7.2.1. PROJECT BOUNDARIES

In determining the GHG emissions inventory for the Project, it is necessary to firstly define the organisational and operational boundaries of the assessment.

7.2.1.1 Organisational Boundaries

Organisations vary in their legal and organisational structures and like financial accounting, reporting on the GHG emissions of operations is dependent on the structure of the organisation and whether the operations are wholly owned, joint ventures or subsidiaries (WBCSD and WRI, 2004). It is expected that the organisations boundaries will state the makeup of the company, and the operations that the organisation owns or controls.

In defining the organisational boundaries, there are generally two distinct approaches. These are equity share and control (WBCSD and WRI, 2004). With the equity share approach, the organisation accounts for GHG emissions from operations according to its equity share in the operation. Typically, the equity share is equivalent to the organisation's percentage ownership. With the control approach, an organisation accounts for 100% of the GHG emissions from the operations over which it has control. In terms of this approach, an organisation is not accountable for operations in which it owns a percentage but has no control. Control can be in the form of either financial control, in which the organisation directs the financial and operational policies of the operation, or operational control, where the organisation has the full authority to introduce and implement operational policies.

⁷CO₂: Carbon Dioxide, CH₄: Methane, N₂O: Nitrous Oxide. HFCs: Hydrofluorocarbons, PFCs: Perfluorocarbons, and SF₆: Sulphur Hexafluoride

This assessment reports on the GHG emissions for the Berth 605 Project, in terms of the control approach, where TNPA accounts for 100% of the estimated GHG emissions from the operations associated with the Project.

7.2.1.2 Operational Boundaries

In defining the operational boundaries, the GHG emissions associated with the organisation's operations are identified and characterised as either direct or indirect emissions (WBCSD and WRI, 2004).

To help with the characterisation of direct and indirect emission sources, three 'scopes' are used for GHG emissions accounting and reporting. The use of scopes not only improves transparency and consistency in reporting but also ensures that organisations do not account different emissions in the same scope (i.e., double counting). A brief description of the three scopes is provided below:

- **Scope 1 (Direct GHG emissions):** Occur from sources that are owned or controlled by the organisation. This includes for example, emissions from combustion in boilers, furnaces, generators, and company-owned vehicle.
- **Scope 2 (Indirect GHG emissions):** Occur from the generation of purchased electricity or steam that is brought onto the organisation's property.
- **Scope 3 (Other indirect GHG emissions):** Occur from sources that are not owned or controlled by the organisation. This included for example, purchased materials, transportation of materials, and the use of products sold to consumers.

Figure 7-2 presents an overview of Scope 1, Scope 2, and Scope 3 emissions across the value chain of an organisation. However, this assessment is limited to Scope 1 and 2 emissions.

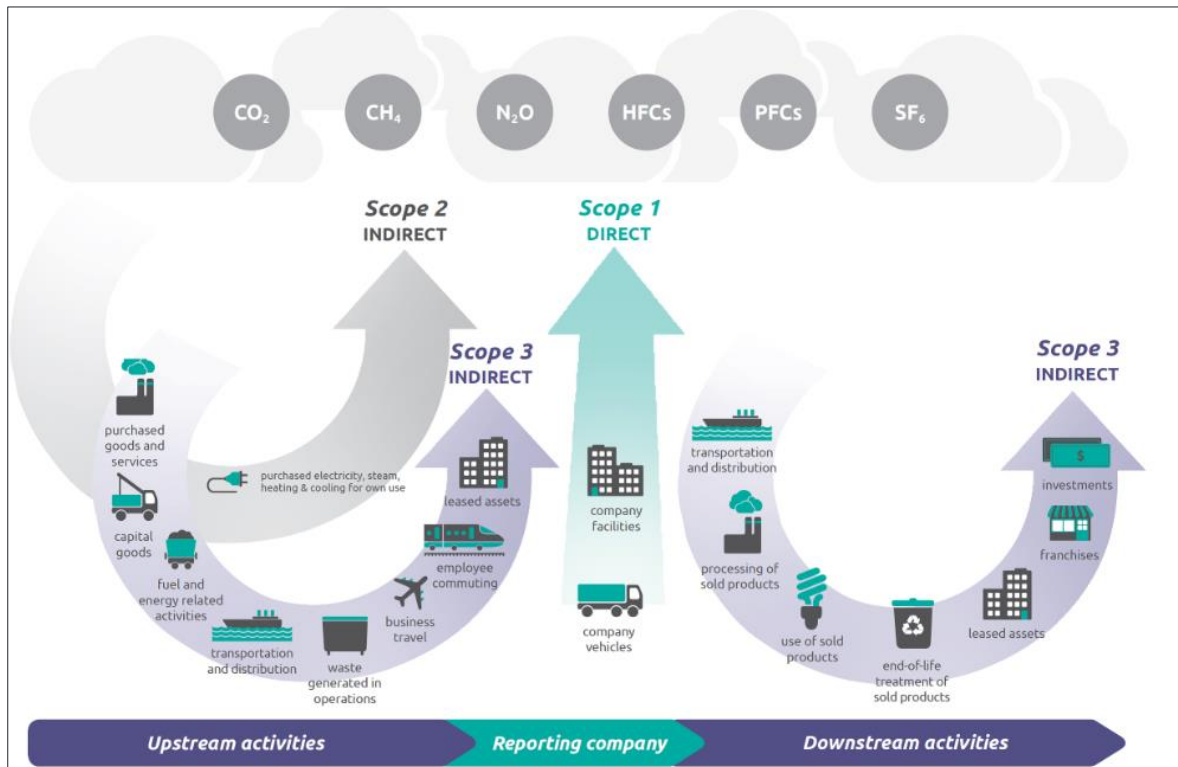


Figure 7-2 - Overview of Scope 1, Scope 2, and Scope 3 Emissions across the Value Chain

7.2.2. EMISSION TIER APPROACH

The methodology for the estimation of the GHG emissions from the operations is in line with the 2006 IPCC Guidelines and the prescribed tier method post the transitional period for each activity as defined in Annexure 1 of the National GHG Emission Reporting Regulations.

The Tiers are defined as follows:

- Tier 1: A bare minimum method using readily available statistical data on the intensity of processes (activity data) and default emission factors. This method is the simplest method and has the highest level of uncertainty.
- Tier 2: This tier is similar to Tier 1 technology or country specific emission factors are used to reduce the level of uncertainty. There are provisions within the NGERs for data providers to seek approval of country specific emission factor.
- Tier 3: Tier 3 is defined as any methodology more detailed than Tier 2 and might include amongst others, process models and direct measurements. Tier 3 methods have the lowest level of uncertainty. Some of the requirements for a Tier 3 approach may include:
 - Chemical analysis.
 - Carbon content analysis.
 - Carbon balances.
 - Abatement equipment in use to determine any losses to the system.
 - Literary evidence to support assumptions.
 - The measured values of flows and chemical composition of the fuels used.

Figure 7-3 below presents the Tiered approach.

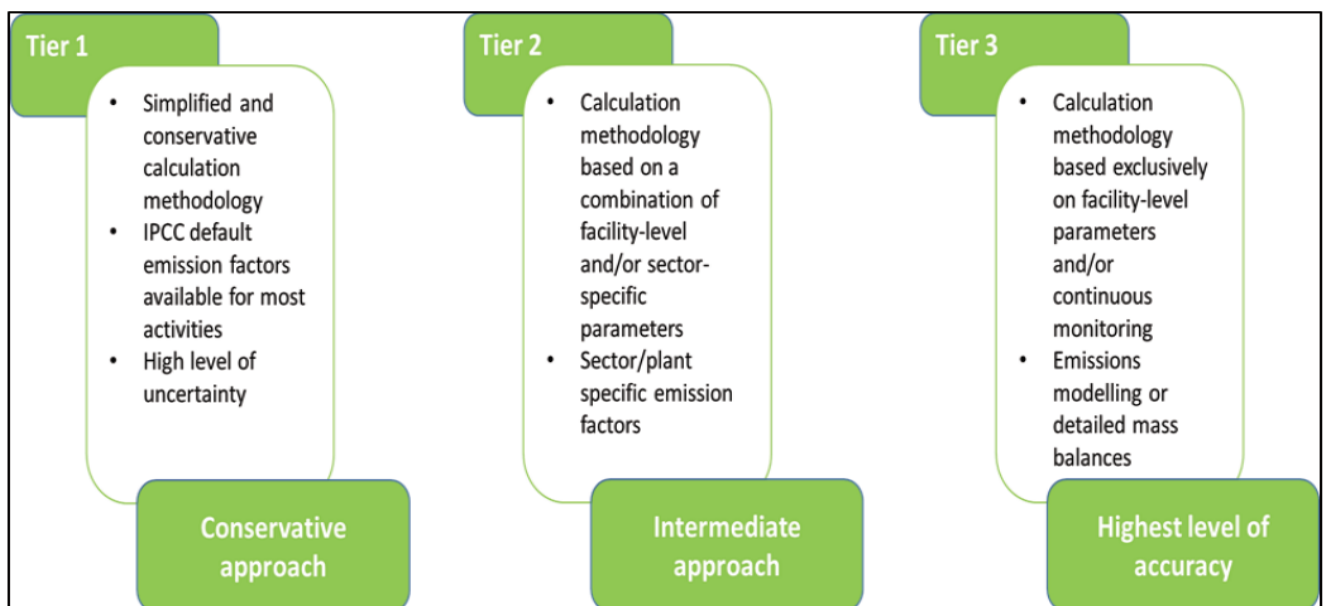


Figure 7-3: Tiers as per the 2006 IPCC Guidelines (NGERs, 2022)

7.2.3. REPORTING PERIOD

The reporting period for the proposed Project is defined as 2025 to 2027, corresponding to the construction phase. At the time of this assessment, the timeframes for the operational and decommissioning phases had not been confirmed. No activity-level data was provided for fuel use, electricity consumption, or other emission-generating activities across any Project phase. As a result, a full GHG inventory could not be developed. This assessment therefore presents a high-level screening based on literature, benchmarks from comparable port infrastructure projects and published emission factors. It provides an indicative emissions profile and identifies potentially material sources associated with the berth development.

It is recommended that a project-specific GHG inventory be established once detailed activity data becomes available. The baseline should be reviewed and updated periodically, particularly during the operational phase and informed by actual fuel and electricity use records.

7.3 GREENHOUSE GAS (GHG) EMISSIONS INVENTORY FOR THE PROPOSED BERTH 605 PROJECT

GHG inventories are reported in terms of CO₂e, in which all the GHGs are converted to an equivalent basis relative to their global warming potential. The global warming potential is a measure of a compound's radiative efficiency, or the compound's ability to trap heat, over a certain lifetime in the atmosphere, relative to the effects of the same mass of CO₂. The CO₂e value also considers the likelihood of indirect effects from other GHG precursors or compounds formed. While relatively constant, occasionally global warming potentials are adjusted slightly as scientific understanding of radiative forcing, atmospheric lifetime and indirect effects improves. Emissions expressed in equivalent terms highlight the contribution of the various gases to the overall inventory for the purposes of accounting emissions. Therefore, global warming potential is a useful statistical weighting tool for comparing the heat trapping potential of various gases (API, 2021).

The general methodology, which is relevant for all, combines activity data (the extent to which a human activity takes places) with the emission factor (coefficients which quantify the emissions or removals per unit of activity). The basic equation for both tier 1 and tier 2 approaches are as follows:

$$\text{Emissions} = \text{Activity} \times \text{Emission Factor} \times \text{Global Warming Potential}$$

Where:

$$\text{Emissions} = \text{estimate of CO}_2\text{e or GHG emissions in tonnes/annum}$$

7.4 EMISSIONS IN THE AFRICAN PORT CONTEXT

GHG emissions associated with African ports remain under-documented, with few ports having formal inventories or decarbonisation frameworks in place (Freight News, 2025). Most ports across the continent continue to rely on diesel-powered infrastructure during both construction and operational phases. The transition to alternative fuels and renewable energy has been limited, primarily due to resource constraints, lack of regulatory enforcement and gaps in technical capacity. However, momentum is building across the region. In 2025, 35 African countries endorsed a continental net-zero shipping strategy aimed at accelerating emissions reduction within the maritime sector. Key actions include promoting the ratification of MARPOL Annex VI, developing national GHG action plans, investing in port electrification and preparing for the use of alternative fuels (Port Technology, 2025; Offshore Energy, 2025). These efforts also focus on training, technology transfer and port resilience, reflecting a shift toward coordinated climate action in African port infrastructure. In addition, several ports in South Africa, including the Port of Richards Bay, have begun to explore renewable energy integration and sustainability-linked infrastructure upgrades (TNPA, 2024).

7.4.1. SOURCES OF GREENHOUSE GAS (GHG) EMISSIONS

Emission sources are defined in the regulations as “*any process or activity which releases a GHG, an aerosol or a precursor of a GHG into the atmosphere*” which is identified by the IPCC code in Annexure 1 of the NGERs (DEA, 2016). The key GHG emissions associated with activities for the operations will include CO₂, CH₄, and N₂O. No detailed information was available at the time of the assessment to determine the amount of GHG emissions being emitted during the construction, operation and decommissioning phase of the Project. The current assessment employs a literature-based estimation approach to provide an overview of possible emissions associated with the Project (refer to Appendix A for further details). The development of Berth 605 development at the Port of Richards Bay, have distinct emissions profiles that differ across their lifecycle stages.

The construction and operational activities associated with the Project are expected to result in GHG emissions, primarily through the use of diesel-powered equipment (Scope 1) and grid-supplied electricity (Scope 2). As shown in the emissions table below, construction-phase emissions are typically higher due to the energy intensity of activities such as dredging, concrete works and earthworks. These emissions are concentrated over a shorter period but involve high fuel usage and continuous equipment operation. In contrast, operational emissions are sustained over time but generally lower in intensity, arising primarily from electricity usage.

While exact proportions vary by project, studies (Appendix A) on port infrastructure and marine terminal developments consistently indicate that the construction phase can represent a substantial share of total lifecycle greenhouse gas emissions. **Table 7-1** presents the possible emissions sources associated with a proposed Berth 605 Project.

Table 7-1 – GHG Emission Sources associated with Berth 605 Project

Activity	Scope Category	Scope Inclusion
Dredging	Scope 1	Direct emissions are expected from marine diesel used for dredging 2.5 million m ³ to deepen berth basin. Direct emissions are expected from on-site combustion of diesel fuel by dredging vessels and support equipment.
Quay Wall Construction	Scope 1	Direct emissions are expected from diesel powered machinery used in construction phase.
	Scope 2	Indirect emissions are expected from electricity use for on-site activities such as lighting or equipment, if sourced from the grid.
New Rail Sliding (2 x 370m)	Scope 1	Direct emissions are expected from diesel equipment during the construction phase.
	Scope 2	Indirect emissions are expected from electricity consumption for temporary facilities (if applicable).
Temporary Laydown / Stockpile Area (4.2 ha)	Scope 1	Direct emissions are expected from diesel powered equipment used in site preparation and material handling. The use of heavy machinery in preparing laydown areas.
New Access Road (735 m x 30m)	Scope 1	Direct emissions are expected from diesel-powered construction vehicles.
	Scope 2	Indirect emissions are expected from grid electricity used for temporary operations, if applicable.
Temporary Power and Site Facilities	Scope 1	Direct emissions are expected from diesel generators powering lighting and security systems during construction.
	Scope 2	Indirect emissions are expected from grid electricity for temporary facilities, if applicable.
Stormwater/Sewer/Water Extensions	Scope 1	Direct emissions are expected from excavation and installation equipment.
	Scope 2	Indirect emissions are expected from grid electricity for pump testing and small-scale trench works during network extensions within the Project boundary.
Electricity from 11kV Grid	Scope 2	Indirect emissions are expected from grid electricity for quay systems, pumps, floodlighting, and container handling equipment.
Water Pumping	Scope 2	Indirect emissions are expected from grid electricity if water supply system includes pressurised pumping within the Project boundary.

Activity	Scope Category	Scope Inclusion
Stormwater/Sewer Operations	Scope 2	Indirect emissions are expected from minor grid electricity uses from stormwater or sewer upgrades

7.4.2. GREENHOUSE GAS (GHG) EMISSIONS ASSOCIATED WITH THE PROJECT

Due to the early stage of Project development and the limited availability of design and procurement data, a full inventory was not feasible. This section identifies the anticipated sources of Scope 1 and Scope 2 GHG emissions associated with the development and operation of the proposed Berth 605. The classification is based on the available Project information, including planned dredging volumes, quay wall dimensions, site layout, infrastructure services and the electrical connection through the designated 11 kV supply. The assessment is limited to the defined Project boundary, which includes only the construction and operational activities occurring within the berth as illustrated in the submitted layout plan (**Figure 2-2**). Emissions associated with upstream or downstream infrastructure (such as rail sidings, road access and offsite utilities), as well as Scope 3 categories (such as material lifecycle emissions, staff commuting and tenant-related logistics), fall outside the scope of this assessment however literature has provided information on possible scope 3 emission sources associated with similar projects (Appendix A).

7.4.2.1 Construction Emissions

The construction phase of the proposed Berth 605 development is expected to generate GHG emissions from a combination of high-intensity marine activities and civil engineering works. Due to the absence of site-specific fuel or electricity consumption data, GHG emissions have been estimated only for those activities with clearly defined input quantities (**Table 7-2**). The materiality of other sources has been assessed qualitatively based on their expected contribution to the total construction-phase emissions.

Table 7-2 – Greenhouse Gas (GHG) Emissions for Construction Phase

Activity	Emissions	Category of materiality
Capital Dredging	<p>For the Berth 605 Project a depth of -14.5 PCD needs to be maintained for the design vessel. In addition to this, allowance has been made for sedimentation (between maintenance dredging campaigns) and for bathymetry sounding accuracy, leading to a required depth of -15.1 m PCD. To obtain this depth, dredging is required for the basin area.</p> <p>Dredging activity will be done using the Cutter Suction Dredger (CSD). This will include the excavation of 386,540 m³ in situ material (comprising of 350,000 m³ material from quay wall construction and 36,500 m³ from road construction). With a bulking factor of 1.3, these volumes are assumed to increase to approximately 502,500 m³. Additionally, 2,295,000 m³ will be excavated from Berth 605 berths and basin. Assuming a larger dredge volume that includes an allowance for potential over-dredging accuracy of 0.4 m, the volume from basin and berths</p>	High Materiality

Activity	Emissions	Category of materiality
	<p>will increase to 2,393,000 m³. Thus, resulting in a total volume of 2,895,000 m³.</p> <p>Using the emission factor of 8.35 kgCO₂e/m³ from the 2009 Gladstone Ports Corporation Greenhouse Gas Assessment Report for Western Basin Dredging and Disposal Project, it is assumed that a total of approximately 24,165.21 tCO₂e is expected from capital dredging. This estimate reflects direct (Scope 1) emissions only and does not include upstream or embodied emissions. The figure should be refined once detailed fuel usage data becomes available. This activity represents a high materiality source, as supported by literature from comparable port developments where dredging contributed most to the construction emissions.</p> <p>For further details on dredging activities refer to the XRB.E.0030-T001-RPT-0106 DREDGING AND DREDGE MATERIAL DISPOSAL MODELLING STUDY REV REPORT.</p>	
Quay Wall	<p>The quay wall will span approximately 300 metres, assumed to be constructed using diesel-powered piling rigs, cranes and concrete batching equipment. Scope 1 emissions from equipment use and Scope 2 emissions from temporary electricity demand. According to Maas et al. (2011), the life cycle emissions for a typical concrete quay wall, including material production, transport, and on-site construction, are estimated at approximately 42,000 kg CO₂e per metre, or 42 tCO₂e/m. This figure was derived from a comparative study of quay wall materials, where concrete structures showed the highest emissions due to the carbon intensity of cement and reinforcing steel. The value includes emissions from both upstream material production (e.g., cement, steel, aggregates) and diesel-powered construction activities.</p> <p>This estimate provides a reference point for assessing the materiality of emissions from quay wall development in similar port infrastructure projects. It should be noted that the estimate reflects a full life cycle perspective and includes both direct and embodied emissions. If only direct (Scope 1 and 2) emissions are considered, the construction-phase contribution would represent a smaller portion of the total.</p>	Medium Materiality
New Access Road Construction	<p>The new access road will span approximately 735 metres in length and 30 metres in width, consisting of two lanes in each direction and associated intersections. Construction of roads is a well-documented contributor to greenhouse gas (GHG) emissions, primarily through the use of heavy machinery and materials such as asphalt and cement. A study by Yu et al. (2022) found that emissions from road construction are largely attributed to raw material production and diesel equipment use (Yu et al., 2022). The U.S. Department of Energy (2024) also notes that road infrastructure accounts range between 10% and 30% across different nations and types of from operations of construction and maintenance equipment in total life cycle GHG impacts of roadway infrastructure (DOE, 2024). Given the road's scale, material use and the emission intensity of construction processes, this activity is reasonably assessed as having medium materiality in the context of the project boundary and Scope 1 and 2 emissions.</p>	Medium Materiality

Activity	Emissions	Category of materiality
New Rail Siding Construction	<p>The proposed development includes the construction of two new rail sidings, each approximately 370 metres in length, to accommodate container operations.</p> <p>Life Cycle Assessment (LCA) studies have identified the construction phase of railway infrastructure as a notable contributor to GHG emissions. For instance, a study on the Tours–Bordeaux high-speed rail line in France found that construction activities, including earthworks and material production, accounted for a significant portion of the total environmental impact, with primary steel production being a major contributor (de Bortoli et al, 2025). Another study emphasises that the construction phase, particularly the use of diesel-powered equipment and energy-intensive materials like steel and concrete, contributes substantially to the overall carbon footprint of railway projects (UIC, 2011). Given the scale and nature of the rail siding construction, it is appropriate to classify this activity as having medium materiality concerning GHG emissions during the construction phase.</p>	Medium Materiality
Temporary laydown and Stockpile Area	<p>The Project includes a 4.2-hectare temporary laydown area for material storage and logistics support. The preparation and operation of temporary laydown and stockpile areas involve activities such as site clearing, grading, compaction and the use of diesel-powered equipment for material handling. These processes contribute to GHG emissions primarily through direct fuel combustion (Scope 1) and, to a lesser extent, electricity consumption for temporary facilities (Scope 2).</p> <p>Given the relatively small scale, short-term nature, and low-intensity use, GHG emissions from this activity are expected to be minor and primarily limited to Scope 1 sources from occasional fuel combustion. Therefore, this activity is classified as having low materiality in the context of the project's overall GHG emissions. This aligns with findings by Yu et al. (2022), who noted that emissions from intermittent site-level construction activities, such as equipment staging and handling, are relatively low when compared to more intensive earthworks or structural activities (Yu et al. ,2022).</p>	Low Materiality
Temporary Facilities and Generator Use	<p>Diesel generators will be used to provide temporary power to site offices, lighting and security systems during construction. While temporary in nature, laydown and stockpile areas can contribute significantly to GHG emissions during the construction phase. A study by Krištofič et al. (2024) highlights that temporary site structures often exhibit high energy consumption, particularly for heating and lighting, leading to increased carbon footprints. The research emphasizes the importance of energy-efficient practices in temporary facilities to mitigate emissions. (Krištofič et al., 2024).</p>	Medium Materiality
Land clearance	<p>Approximately 30 ha of land will be cleared for the current project. Emissions from land clearance depends on factors such as type of land to be cleared and method used for clearing.</p>	Low Materiality

7.4.2.2 Operational Emissions

The operational phase of the Project is expected to result in Scope 1 and Scope 2 GHG emissions. This section identifies and classifies expected emissions sources based on available Project information, including confirmation of an 11 kV electrical connection, terminal footprint and operational activities related to container handling, yard equipment as well as on-site facilities. Where activity-level data (e.g., fuel volumes or electricity load) is unavailable, sources are assessed qualitatively based on their expected contribution to overall emissions (**Table 7-3**).

Table 7-3 - Greenhouse Gas (GHG) Emissions for Operational Phase

Activity	Emissions	Category of materiality
Berth Lighting, Pumps, and Operational Systems –	<p>The berth will be supplied by an 11 kV electrical connection, which will power high-mast lighting, water pumps and other low-intensity berth-side operational systems. These systems are expected to operate continuously or during night-time operations, drawing electricity from South Africa's grid, which has a relatively high emissions factor due to its coal dependency.</p> <p>Electricity consumption for lighting and utility systems is a sustained emission source throughout the operational phase. Although the berth is not expected to power container handling equipment lighting and essential operational systems can account for a non-negligible portion of Scope 2 emissions. This is supported by findings of Northern Corridor Transit and Transport Coordination Authority from the 2017 Port of Mombasa study which indicates that electricity use for lighting and site utilities represents a consistent source of emissions in port operations. Therefore, given the continuous demand and national grid intensity, the activity is assessed as having medium materiality under Scope 2 emissions.</p>	Medium Materiality
Water Supply Pumping	The planned extension of a 225 mm water supply line to the quay will involve the use of pumps to support operational needs. These pumps are expected to operate intermittently and at low energy intensity, resulting in limited electricity consumption. As such, emissions from this source are classified as having low materiality.	Low Materiality
Stormwater and Sewer Systems	<p>The stormwater and sewer systems installed at the Project site will support drainage and wastewater management during operations. These systems are expected to function mostly through gravity, with limited use of electric pumps if needed. Any electricity used would contribute to Scope 2 emissions.</p> <p>These systems are generally low-energy and operate only when needed, such as during heavy rainfall or for maintenance. It is assumed low energy use and infrequent operation, emissions from this activity are considered low in materiality.</p>	Low Materiality

7.4.2.3 Decommissioning Emissions

At this stage, it is unclear whether the Project will include a formal decommissioning phase at the end of its operational life. However, it is important to recognise that decommissioning of marine infrastructure such as berths can result in GHG emissions. These may arise from demolition works, heavy equipment uses, material transport and disposal or recycling activities. According to Davies and Hastings (2023), GHG emissions associated with the decommissioning of manmade structures in the marine environment are frequently underreported in life cycle assessments, due to limited data on dismantling processes and waste treatment pathways. While this Project has not included any detailed activity data or emission assumptions related to a potential decommissioning phase, it is recommended by Davies & Hastings (2023) that this be considered in future climate-related assessments, particularly if deconstruction or rehabilitation activities are formally planned.

7.4.2.4 Limitations

The above materiality assessment provides a screening-level evaluation of construction-phase GHG emissions. It is based on the best available input values and supported by literature from similar port infrastructure projects. The following limitations apply:

- Transport and disposal of dredged material is included within the dredging factor but may vary. This means that the emission factor used to calculate GHG emissions of the dredged material sometimes is inclusive of disposal.
- Maintenance dredging is not included in operational emissions but should be evaluated once confirmed.
- Trenching, utility installation and ancillary site works are excluded due to limited data but are expected to contribute marginal emissions.
- The contribution of the Project's overall emissions to the South African 2030 lower NDC target has not been estimated due to the lack of activity data provided.
- Embedded carbon in construction materials (Scope 3) is outside the scope of the current assessment.

This classification and materiality assessment is based on currently available Project inputs and assumes typical construction and operational conditions aligned with similar projects. Due to the lack of Project-specific activity data (such as fuel consumption, electricity consumption and volumes of dredged material), emission factors have not been applied and quantitative emission estimates (in tonnes CO₂e) have not been calculated at this stage. A detailed GHG inventory is expected to be developed during Project implementation as part of the Environmental and Social Management Plan (ESMP) which forms part of the EMP, using actual consumption data and in accordance with the GHG Protocol Corporate Standard and relevant national guidance.

7.5 HIGH-LEVEL DECARBONISATION PLAN FOR THE PROPOSED BERTH 605 PROJECT

As part of the scope of this assessment, this section provides a high-level decarbonisation plan focused on identifying and addressing potential sources of Scope 1 and Scope 2 greenhouse gas GHG emissions associated with the construction and operational phases of the proposed Project. The purpose of this plan is to inform early-stage project considerations related to design, procurement, and environmental management by highlighting material emission sources and proposing context-relevant mitigation measures. While not aligned to any specific regulatory or voluntary framework, the

plan supports the broader objectives of national and international climate commitments, including South Africa's Nationally Determined Contribution (NDC), the Greenhouse Gas Protocol, the International Maritime Organization's Revised GHG Strategy (2023), and relevant guidance from the United Nations Conference on Trade and Development (UNCTAD). The plan is based on a materiality-led approach and is intended to serve as a preliminary contribution to understanding emissions management opportunities within the defined Project boundary.

7.5.1. CONTEXTUAL ALIGNMENT WITH TNPA DECARBONISATION AT THE PORT OF RICHARDS BAY

The proposed Berth 605 development is situated within a broader institutional effort led by Transnet National Ports Authority (TNPA) to decarbonise port operations at Richards Bay. Several initiatives are currently being implemented that reflect a shift toward more sustainable port infrastructure and operations and these provide important context for the Project's emission reduction strategy. Recognising and aligning with these efforts will enable the proposed development to integrate more effectively into the port-wide transition underway. TNPA is advancing the construction of a 20 MW solar photovoltaic (PV) plant within the Port of Richards Bay precinct. This initiative forms part of TNPA's Renewable Energy Purchase Programme and is aimed at reducing reliance on South Africa's carbon-intensive national grid, which remains predominantly coal-fired. Once operational, the solar installation is expected to supply clean electricity to port facilities, thereby lowering Scope 2 emissions from operations such as cargo handling and lighting (TNPA, 2024).

In addition, TNPA is collaborating with Zululand Energy Terminals on the development of the country's first liquefied natural gas (LNG) import terminal, which will include a floating storage unit and onshore regasification infrastructure. This project forms part of South Africa's broader energy transition strategy to diversify and reduce the emissions intensity of its energy mix, with LNG positioned as a transitional fuel for industrial and port-adjacent users (Enerdata, 2024). While the current Project does not rely on LNG, its presence may support future low-emission marine fuel use or backup energy applications, depending on downstream integration and regulatory pathways. In addition to energy-related interventions, TNPA has prioritised climate resilience upgrades at Richards Bay. This includes refurbishment of breakwater structures and replacement of dolosse to increase the port's ability to withstand higher wave heights and storm surges. These efforts form part of a broader climate adaptation strategy aimed at safeguarding core marine infrastructure from climate risks such as sea level rise and more frequent extreme weather events (Engineering News, 2024).

Together, these decarbonisation and resilience measures position the Port of Richards Bay as a key node in South Africa's just energy transition. The current development should therefore be designed and implemented in a manner that aligns with these initiatives. Specifically, where possible the project team should assess opportunities to procure renewable electricity directly from the solar PV facility or to integrate energy-efficient terminal systems that optimise compatibility with lower-carbon electricity. Construction-phase design should consider lessons from TNPA's breakwater resilience planning, while long-term operations may explore potential synergies with LNG infrastructure where appropriate. By aligning with TNPA's ongoing decarbonisation investments, the proposed development can not only reduce its own emissions, but also contribute to a more integrated, sustainable future for the Port.

7.5.2. PRIORITY EMISSION SOURCES AND RECOMMENDATIONS

Based on the materiality assessment conducted for this Project, the most significant emissions are expected to occur during dredging, quay wall construction and electricity consumption during terminal operations as presented in **Table 7-4**. These sources are associated with high or medium materiality, based on anticipated fuel and electricity intensities, duration and relevance to core functions within the defined Project boundary.

Table 7-4 – Significant Emission Sources and Recommendations

Source		Emission Source	Overview	Recommendation
Capital Dredging				
Capital Dredging	Scope 1	Capital dredging will involve the removal of approximately 2.5 million cubic metres of sediment to establish the berth pocket. Emissions are primarily driven by the combustion of marine diesel in large dredging vessels and auxiliary equipment. These activities are typically continuous over several weeks or months, depending on site conditions and vessel efficiency and constitute one of the most fuel-intensive components of marine infrastructure development.	Capital dredging is a major contributor to Scope 1 GHG emissions in port infrastructure projects, largely due to the use of diesel-powered cutter suction and trailing hopper dredgers. According to the Central Dredging Association (CEDA, 2019), emissions intensity can vary significantly depending on the choice of dredging method, equipment performance and site-specific conditions. The International Association of Dredging Companies (IADC) further highlights that operational emissions can be reduced through project planning, energy-efficient hull and pump designs, crew training and advanced automation systems (Gonçalves Castro et al., 2014). These sources consistently stress that emissions per cubic metre of dredged material can be lowered by optimising dredge routing, reducing idle time and selecting low-carbon fuels or hybrid propulsion technologies.	<p>Dredging operations are significant contributors to emissions due to the extensive use of diesel-powered equipment.</p> <ul style="list-style-type: none"> The Project should specify performance requirements in contracts for energy-efficient dredging in line with IMO emission standards. Where possible the Project should consider the used dredged material for reclamation or as infill where geotechnically and environmentally appropriate, reducing emissions from offshore disposal. Contractors should provide fuel logs and implement real-time monitoring to improve transparency and enable future benchmarking. Schedule operations to avoid unnecessary standby time and idle fuel use.
Quay Construction	Wall Scope 1 and 2	Quay wall and hardstand construction will result in emissions from diesel-powered piling rigs, cranes, concrete batching operations and generators used for temporary power supply. These activities generate Scope 1 emissions from fuel combustion and Scope 2 emissions where grid electricity is used during temporary power connections or testing phases. The materiality of this source is driven by the high energy intensity of heavy civil works, especially those involving reinforced concrete and continuous equipment use.	Ports globally are beginning to embed low-carbon construction principles into new infrastructure development. The Port of Valencia's life cycle assessment of quay infrastructure estimated emissions at over 40 tCO ₂ e per metre of quay wall, depending on material and equipment inputs (Maas et al., 2011). To reduce emissions from quay wall construction, developers are adopting low-carbon concrete mixes using fly ash and slag, (Maas et al., 2011). Precast concrete is increasingly used to reduce onsite energy use, while material-efficient designs (e.g. reduced reinforcement) are gaining traction (Hendler, 2020). For operational emissions, electric and hybrid piling equipment and use of shore power instead of diesel generators, are emerging mitigation measures (Maas et al., 2011). Ports are also piloting carbon modelling during early design phases to optimise materials and construction methods.	<p>Construction activities involve significant use of materials and equipment, leading to substantial emissions:</p> <ul style="list-style-type: none"> Where feasible all construction tenders should specify minimum engine standards for equipment, require the use of cement alternatives where available and encourage the replacement of standalone diesel generators with hybrid or grid-based alternatives. Where possible, select materials with lower embodied carbon, such as recycled steel or alternative concrete mixes, to reduce emissions during construction. Where possible, access to temporary grid connections from nearby substations should be pursued to reduce off-grid generator reliance. Design quay walls for extended service life to amortise emissions over a longer period and reduce the need for frequent rebuilds. Where feasible implement generator efficiency protocols or use hybrid/electric site power where grid access is unavailable.
New Access Road	Scope 1 and Scope 2	GHG emissions during the construction of the access road arise primarily from diesel-powered machinery used for land clearing, earthworks, grading, compaction and paving. Additional emissions stem from the production and transport of materials. These are mostly Scope 1 emissions (direct fuel combustion) and Scope 2 if grid electricity is used for any onsite equipment or lighting.	GHG emissions from road construction are largely associated with fuel use by earthmoving equipment and the production and transport of materials such as asphalt and aggregates. According to Yu et al. (2022), key mitigation opportunities include improving on-site fuel efficiency by reducing idle time, streamlining equipment scheduling and using reclaimed materials where feasible. The study highlights that early planning and well-managed site logistics can significantly reduce overall fuel consumption. The U.S. Department of Energy (DOE, 2023) similarly notes that emissions from road infrastructure can be lowered through the use of warm mix asphalt instead of traditional hot mix, which reduces combustion-related emissions by lowering production temperatures. The DOE report also emphasises the role of material selection, recommending locally sourced aggregates and energy-efficient equipment as practical steps to reduce construction-related emissions. These measures reflect current trends toward integrating low-carbon practices into civil infrastructure delivery.	<ul style="list-style-type: none"> The Project can consider enforcing reduced equipment idle time through scheduling protocols and engine-off requirements. Where available, the Project may consider specifying hybrid or fuel-efficient construction equipment for major activities such as clearing, grading and paving. Earthworks planning can be optimised to limit unnecessary excavation and reduce equipment runtime. Where technically feasible, locally sourced aggregates and asphalt should be prioritised to minimise transport emissions.
New Rail Sliding	Scope 1 and Scope 2	GHG emissions are expected to arise from diesel-powered earthworks machinery, ballast placement, rail installation and delivery of prefabricated components. Scope 1 emissions are dominant due to direct fuel use, with minor Scope 2 emissions possible if any grid-connected power is used for temporary facilities or equipment.	Recent literature highlights a growing emphasis on reducing the carbon footprint of rail infrastructure through improved material sourcing, construction efficiency and equipment performance. De Bortoli and Bouhaya (2021) identify that material production and transport, particularly for ballast, sleepers and steel rails, represent the most significant emissions sources. As a result, the adoption of local and recycled materials is emerging as a key mitigation strategy. In parallel, construction practices are shifting toward optimised design approaches that reduce unnecessary earthworks and the use of prefabricated track panels to minimise time and fuel spent on site. Additionally, the introduction of hybrid or low-emission construction machinery, along with improved site logistics (De Bortoli and Bouhaya, 2021).	<ul style="list-style-type: none"> The Project can consider optimising the rail alignment and earthworks design to reduce cut-and-fill volumes and associated diesel use. Equipment scheduling protocols can help reduce idling and maximise operational efficiency. Where feasible, locally sourced ballast, sleepers and steel components should be prioritised.



Source			Emissions Source	Overview	Recommendation
Temporary Systems (Diesel Generators)	Power (Diesel)	Scope 1	Diesel generators are assumed to be utilised to supply temporary power to construction site offices, lighting infrastructure and security systems throughout the construction phase. Emissions will arise from the continuous combustion of diesel fuel in off-grid power systems during both daytime and night-time operations.	Although generally considered a low-emission source, diesel generators often run continuously over the construction period and can result in avoidable Scope 1 emissions. Hybrid solar-diesel systems have been adopted in African infrastructure projects to improve efficiency and reduce diesel consumption, while temporary connections to nearby grid points have proven effective for longer-duration construction works.	<ul style="list-style-type: none">Where possible the Project should recommend the use of hybrid solar-diesel generators where grid connection is not feasible.Consider automatic shutoff controls to avoid unnecessary idling.Generators should be appropriately sized for their expected load to reduce fuel wastage.Where feasible, access to temporary grid supply should be prioritised to displace generator reliance.
Laydown Stockpile Preparation	and Area	Scope 1	The preparation of the designated 4.2-hectare laydown and stockpile area is assumed to involve the use of diesel-powered grading and compaction equipment. Emissions will result from fuel combustion in earthworks machinery used to level and stabilise the site prior to material storage and handling.	While short in duration, the equipment used for site preparation can produce concentrated emissions due to continuous diesel usage under load. The intensity of emissions is influenced by machine type, duration of use and operational efficiency. Project screening documents confirm that grading and compaction will be required prior to use.	<ul style="list-style-type: none">Where feasible Idle-reduction protocols could be enforced and equipment usage should be limited to essential operating periods.Where possible, operational hours should be restricted to periods of peak productivity and equipment should be monitored to prevent unnecessary use.
Operational Phase					
Terminal Use	Electricity	Scope 2	Within the defined project boundary, electricity consumption is expected to occur primarily through systems directly associated with the berth. While full terminal operations can contribute significantly to Scope 2 emissions, the energy demand from berth-specific systems is more limited in scale. Studies indicate that such systems can still be notable contributors to port emissions, particularly where refrigerated containers are plugged in over extended durations (Ahmed et al., 2023).	Internationally, ports are transitioning to energy-efficient terminal equipment and renewable electricity procurement to reduce Scope 2 emissions. The Port of Rotterdam and Singapore have integrated regenerative cranes, LED lighting and smart grid systems to reduce operational demand. In Africa, energy efficiency audits and solar energy pilots have been implemented at the Ports of Durban and Cape Town as part of Transnet's Green Port initiatives. However, widespread renewable electricity procurement remains constrained by regulatory and infrastructure barriers (Wang et al., 2020)	<ul style="list-style-type: none">Where feasible the Project should prioritise the use of energy-efficient cranes with regenerative systems and variable frequency drives.All fixed lighting infrastructure should use LED technology integrated with motion sensors and smart controllers where feasible.Over the medium term, the Project should procure renewable energy, such as via TNPA's planned 20 MW solar PV installation if feasible.
Yard Equipment		Scope 1	Diesel-powered yard equipment such as reach stackers, and terminal tractors will contribute to Scope 1 emissions during operations. These vehicles operate at high frequency and are essential for container stacking, internal movements and vessel loading activities. Their emissions are driven by prolonged idling, variable load conditions and lack of electrification options in many African ports.	There is a growing shift towards hybrid and electric yard equipment in international ports. Literature suggests that telematics, idle-reduction protocols, and hybrid transition plans can significantly reduce emissions during this phase (IAPH, 2022).	<ul style="list-style-type: none">A phased transition strategy should be developed to replace diesel yard equipment with hybrid or electric alternatives, starting with reach stackers.In the interim, vehicles should be monitored, for idling and fuel use, and procurement specifications should include lifecycle emissions criteria.South African-based suppliers are beginning to offer hybrid equipment, which improves feasibility over the Project lifecycle.

Source		Emission Source	Overview	Recommendation
Water Supply and Pumping	Scope 2	During operations, water will be conveyed through the extended 225m diameter main via electricity powered pumps. Emissions will result from the consumption of grid electricity to operate the pump systems needed	Water supply systems require electricity to operate booster pumps that maintain adequate pressure over distance. While the emissions from this activity are relatively low, they are continuous and can increase depending on the frequency and efficiency of pump operation. Literature supports the use of energy-efficient pumping systems to	<ul style="list-style-type: none">• All pump systems installed should meet high energy-efficiency standards and be fitted with pressure control or variable-speed drives.• The feasibility of operating pumps during off-peak grid periods or using solar-powered booster pumps for isolated segments should be explored during detailed design.

		to maintain adequate water pressure and supply across the terminal.	reduce lifecycle emissions, especially where systems are designed with long-term resilience in mind.	
Stormwater and Sewer Systems	Scope 2	Energy demand from extended stormwater and sewer networks will arise where gravity fed drainage is not feasible and electric pumps are used to manage runoff or wastewater discharge. Emissions will originate from the consumption of grid electricity used to power intermittent or permanent pumping infrastructure.	While most stormwater and sewer systems are gravity-driven, pumps may be required in low-lying areas or during high flow periods. If not optimised, these systems can consume unnecessary energy and increase Scope 2 emissions, particularly during the rainy season. Design-stage interventions can reduce or eliminate the need for pumped conveyance.	<ul style="list-style-type: none">• The Project should where possible prioritise gravity-fed design for new stormwater and sewer infrastructure to minimise electricity use.• Where pumps are necessary, energy-efficient motors and automated controls should be considered to reduce operational energy consumption.

7.5.3. INTEGRATION AND IMPLEMENTATION CONSIDERATIONS

To maximise the practical impact of this high-level decarbonisation plan, it is recommended that the mitigation measures identified in Section 6 be considered for integration into key project delivery processes. The following actions are proposed to support effective implementation, emissions tracking and alignment with broader institutional frameworks.

- It is recommended that relevant mitigation measures be reflected in the technical specifications and procurement documentation for the Project. Where appropriate, contractor terms of reference could include provisions related to minimum emissions performance standards, energy efficiency criteria, or the use of fuel tracking and reporting systems. Including these requirements at the procurement stage may help embed emissions mitigation into early Project decision-making.
- The EMPr could serve as a key vehicle for operationalising this decarbonisation plan. Recommended mitigation actions, such as the use of low-carbon materials or hybrid power systems, may be incorporated into the ESMP alongside roles, timelines and responsibilities for implementation. This would also support ongoing environmental compliance and integration with other sustainability management plans.
- To enable emissions tracking and future refinement of the Project's GHG assessment, the development of a simple emissions monitoring and reporting framework is advised. This may align with internationally recognised methodologies such as the GHG Protocol or ISO 14064.
- While this plan is based on screening-level estimates, collecting activity-level data during implementation (e.g. litres of diesel consumed, or kWh of electricity used) would provide a more robust and transparent basis for reporting Scope 1 and Scope 2 emissions.
- Lastly, it is recommended that the implementation of this plan be coordinated, where feasible, with TNPA's broader environmental and energy transition programmes. These include renewable energy procurement initiatives, port-level energy audits and emissions performance indicators being piloted across South African ports. Such alignment may enhance long-term coherence, leverage synergies and improve access to technical or policy support as national and institutional frameworks evolve.

7.5.4. HIGH LEVEL IMPLEMENTATION ROADMAP

The successful implementation of the proposed decarbonisation measures will require a phased and adaptive approach that aligns with the Project's planning, construction, and operational timelines. This section provides a high-level roadmap to guide the timing of key interventions and lay the foundation for more detailed decarbonisation planning as the Project progresses. The roadmap is intended to support early action where possible, while allowing for flexibility and refinement based on site-specific conditions, regulatory developments and evolving institutional priorities.

Table 7-5 - High Level Implementation Roadmap

Time Period	Recommendations
Short Term (Pre-construction and Design Phase)	Consider integrating emissions mitigation requirements into tender documentation, including specifications for low-emission dredging equipment, fuel use reporting and energy-efficient building and terminal systems.
	Review material choices (e.g. cement, steel) during design to identify opportunities for lower-carbon alternatives.

Time Period	Recommendations
	Assess the feasibility of connecting temporary construction activities to grid electricity or using hybrid power systems to reduce reliance on diesel generators.
	Establish a basic emissions monitoring framework aligned with recognised methodologies (e.g. GHG Protocol or ISO 14064) to enable consistent data collection from Project inception.
Medium Term (Construction Phase)	Monitor the implementation of recommended mitigation measures during construction, including equipment compliance, fuel use reporting and material sourcing.
	Ensure contractors are supported in adopting energy-efficient practices and complying with emissions-related provisions in their contracts.
	Track actual Scope 1 emissions from dredging, construction machinery and generator use using real-time or reported fuel data
Long Term (Operational Phase and Post-commissioning)	Transition to energy-efficient terminal operations, including the commissioning of regenerative cranes, LED yard lighting and smart control systems.
	Explore opportunities to procure renewable electricity through TNPA's energy programme or embedded generation arrangements.
	Initiate the gradual replacement of diesel-powered yard equipment with hybrid or electric models, guided by operational needs and equipment life cycles.
	Review and update the GHG inventory based on actual operational energy and fuel consumption data.
	Monitor potential emissions from maintenance dredging if required and integrate future activities into the emissions management framework.

This roadmap is intended to be indicative and may be refined in line with the Project's implementation schedule, permitting milestones and institutional review processes.

7.5.5. LIMITATIONS

This decarbonisation plan provides a high-level framework for identifying and mitigating Scope 1 and Scope 2 emissions associated with the proposed Project at the Port of Richards Bay. It has been developed using the best available information at the time of reporting and is intended to guide future action, inform early-stage design and procurement and support alignment with sustainability objectives. The following limitations are acknowledged.

- Emissions have been estimated in the absence of measured activity data for fuel and electricity consumption. Construction and operational energy demand was not yet quantified.
- There is no existing Scope 1 and 2 GHG inventory specific to the Project footprint. This limits the ability to benchmark or set reduction targets based on a baseline.
- The plan is limited to Scope 1 and 2 emissions only. It does not account for indirect (Scope 3) emissions from material manufacturing, waste management, logistics, or staff commuting, as this was outside the scope of work.
- Where data was unavailable, emissions were estimated using emission factors and benchmarks from similar projects. These may not fully reflect site-specific conditions.
- Alignment with existing internal TNPA policies, such as the energy policy, just transition strategy, or other institutional decarbonisation frameworks, was intended but could not be fully achieved, as these documents were not available to the Project team at the time of drafting. In their absence, the decarbonisation plan references publicly available information on ongoing initiatives at the Port



of Richards Bay, including renewable energy development and LNG infrastructure, to ensure contextual relevance and alignment where possible.

This plan should be revisited and updated as more granular Project data becomes available during detailed design and implementation.

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CONCLUSION



8 CONCLUSION

This report presents the findings of the CCIA and GHG screening for the proposed development of the new Berth 605 and associated infrastructure at the Port of Richards Bay. The assessment focused on two components: (i) the potential physical impacts of climate change on the Project footprint, and (ii) Scope 1 and Scope 2 emissions associated with the berth's construction and operation.

Projected climate changes in the Richards Bay region include increased average temperatures, more frequent hot days, changes in rainfall patterns and a gradual rise in sea level. These trends may increase the Project's exposure to extreme heat, coastal flooding and other climate-related hazards. Based on regional projections and municipal-level data, the Project area may experience low to moderate increases in drought, flood and heat stress. These risks were identified to inform future design and operational decisions. The GHG screening was based on publicly available emission factors and benchmarked assumptions, as no activity-level fuel or electricity consumption data was available at the time of reporting. Emission sources were categorised and assessed for materiality across both construction and operational phases. Scope 1 emissions are expected to arise from capital dredging, diesel equipment and temporary generators, while Scope 2 emissions are likely to result from electricity used to support berth-related infrastructure and systems. A set of mitigation recommendations was developed to support emission reduction efforts. These include the use of lower-emission fuels and equipment, energy-efficient construction practices and integration with TNPA's renewable energy initiatives. Where feasible, these measures may be incorporated into procurement processes, contractor requirements and the Project's EMPr.

This assessment was developed based on the information available at the time of drafting. The findings provide a baseline for integrating climate risks and emissions considerations into early-stage Project planning. As the Project progresses and more detailed data becomes available, there may be opportunities to refine both the risk and emissions analysis and to align further with TNPA's internal policies and decarbonisation goals.

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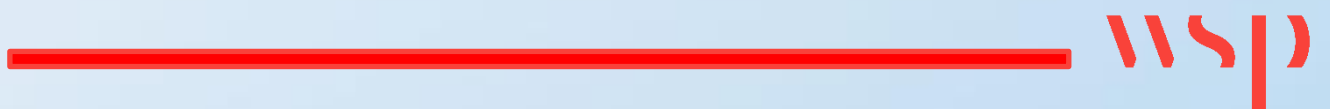
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APPENDIX A



APPENDIX A

Table 1: Literature review of similar berth Projects

#	Background	Key Findings
1	<p>WSP was requested by Nemaï Consulting to conduct a specialist study on climate related impacts associated with the upgrading of Berth 203 to 205 Pier Container Terminal Port of Durban. TNPA had proposed the deepening, lengthening and widening of Berth 203 to 205 to enhance safety of the berths as well as improve efficiency of the Port. Summary of project activities includes freight logistics emissions and construction related emissions. Construction related emissions included bulk earthworks, dredging, cement and concrete casting, transporting of building materials to and from the construction site etc. For the purposes of the assessment, construction related GHG emissions have been assessed qualitatively and relatively briefly, due to the lower amount of GHG emissions expected to be associated with this activity as compared to GHG emissions associated with freight logistics components of the development. Furthermore, Operational emissions associated with maintenance dredging, port terminal operations, tugboats etc. are excluded from the present analysis but are expected to be relatively modest</p> <p>To assess the climate related impacts of the project a carbon calculator model was built for the freight logistics network associated with three project development scenarios (Scenario A: No development., Scenario B Partial Development (deepening of berths but no extensions) and Scenario C: deepening and extension). The model covered GHG emissions for maritime freight, rail freight and road freight components associated with the project.</p> <p>The carbon calculator provides a theoretical calculation of GHG emissions for the period 2012:2024, for each component of the freight logistics journey across the three development scenarios. Important to note is that emissions associated with the construction of the Project were not quantified as there was inadequate data available for the estimation of GHG emissions associated with this phase</p>	<p>Total (cumulative) GHG emissions are essentially the same for the period 2012 – 2024, regardless of the development scenario selected (i.e. Scenarios A – C).</p> <p>Scenario C: Full Development exhibits the lowest cumulative GHG emissions (59,706,416 tCO₂e) of all the scenarios, but only by 0.2% less than the Scenario A: No Development option (59,828,646 tCO₂e). Scenario B: Partial Development records the highest emissions (60,713,379 tCO₂e), mainly due to the higher volume of freight diverted to Coega resulting in a 15% increase compared to Scenario A.</p>

#	Background	Key Findings																																																																																											
2	<p>The South Thomson Bay Barge Facility GHG Emission Assessment evaluated the greenhouse gas emissions associated with the proposed development at Rottneest Island. The assessment evaluated Scope 1, Scope 2, and Scope 3 emissions, covering activities such as diesel and LPG consumption, seagrass dredging, and emissions from associated operations.</p> <p>The facility aims to separate barge operations from public passenger transfer activities to reduce congestion at the ferry terminal. Supporting infrastructure includes overflow ferry berths for emergency passenger transfers during peak seasons.</p> <p>The assessment covered scope 1, 2 and 3 emissions from activities such as dredging, transportation of construction material and construction personnel to the island, diesel usage from trucks& tow motors, LPG folk lifts and barges construction of maritime infrastructure, and the establishment of onshore facilities.</p>	<p>Scope 1 emissions across Stage 1 and Stage 2 for the project during the construction phase are estimated to be 2,328 tCO₂e. Important to note there were no scope 2 emissions associated with the project as there was no consumption from the grid. Overall emissions were mostly from diesel consumption from transportation. Scope 3 emissions for construction and operational phase were estimated to be 4,542 tCO₂e, representing a small fraction of the project's total emission.</p> <table><tr><th>Total Scope 1 Emissions (CO₂-e)</th><th>Units</th><th colspan="2">Construction</th><th colspan="2">Operations</th><th>TOTAL</th></tr><tr><th></th><th></th><th>Stage 1</th><th>Stage 2</th><th>Annual</th><th>Over 50 Yrs</th><th></th></tr><tr><td>Diesel (Construction)</td><td>Tonne</td><td>1,388</td><td>284</td><td>-</td><td>-</td><td>1,672</td></tr><tr><td>Diesel (Transport)</td><td>Tonne</td><td>163</td><td>98</td><td>312</td><td>15,581</td><td>15,843</td></tr><tr><td>Seagrass disturbance</td><td>Tonne</td><td>395</td><td>0</td><td>-</td><td>-</td><td>395</td></tr><tr><td>LPG</td><td>Tonne</td><td>-</td><td>-</td><td>81</td><td>4,037</td><td>4,037</td></tr><tr><td>Total Scope 1 CO₂-e Emissions</td><td>Tonne</td><td>1,946</td><td>382</td><td>392</td><td>19,618</td><td>21,946</td></tr></table> <table><tr><th>Total Scope 3 Emissions (CO₂-e)</th><th>Units</th><th colspan="2">Construction</th><th colspan="2">Operations</th><th>TOTAL</th></tr><tr><th></th><th></th><th>Stage 1</th><th>Stage 2</th><th>Annual</th><th>Over 50 Yrs</th><th></th></tr><tr><td>Diesel</td><td>Tonne</td><td>382</td><td>94</td><td>77</td><td>3,828</td><td>4,305</td></tr><tr><td>Cement</td><td>Tonne</td><td>39</td><td>34</td><td>-</td><td>-</td><td>73</td></tr><tr><td>Steel</td><td>Tonne</td><td>39</td><td>125</td><td>-</td><td>-</td><td>164</td></tr><tr><td>Total Emissions</td><td>Tonne</td><td>460</td><td>253</td><td>77</td><td>3,828</td><td>4,542</td></tr></table>	Total Scope 1 Emissions (CO ₂ -e)	Units	Construction		Operations		TOTAL			Stage 1	Stage 2	Annual	Over 50 Yrs		Diesel (Construction)	Tonne	1,388	284	-	-	1,672	Diesel (Transport)	Tonne	163	98	312	15,581	15,843	Seagrass disturbance	Tonne	395	0	-	-	395	LPG	Tonne	-	-	81	4,037	4,037	Total Scope 1 CO₂-e Emissions	Tonne	1,946	382	392	19,618	21,946	Total Scope 3 Emissions (CO ₂ -e)	Units	Construction		Operations		TOTAL			Stage 1	Stage 2	Annual	Over 50 Yrs		Diesel	Tonne	382	94	77	3,828	4,305	Cement	Tonne	39	34	-	-	73	Steel	Tonne	39	125	-	-	164	Total Emissions	Tonne	460	253	77	3,828	4,542
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3	<p>The Gladstone Ports Corporation's report on the Western Basin Dredging and Disposal Project includes a comprehensive greenhouse gas (GHG) assessment. Key highlights from the assessment are:</p>	<p>The Gladstone Ports Corporation's report on the Western Basin Dredging and Disposal Project provides a comprehensive greenhouse gas (GHG) assessment. Key highlights from the assessment are:</p> <p>Construction Phase Emissions: The total GHG emissions during construction are estimated at approximately 300,600 tCO₂e, with nearly 97% of these emissions attributed to dredging activities</p> <p>Significant Sources: Major contributors include diesel fuel consumption for on-site equipment, transportation of materials, and emissions from dredging operations</p> <p>Statewide Impact: The construction phase emissions represented about 0.17% of Queensland's annual baseline GHG emissions.</p>																																																																																											
4	<p>The Viva Energy Gas Terminal Project is a proposed infrastructure development aimed at ensuring a secure and flexible supply of liquefied natural gas (LNG) to southeastern Australia. Located adjacent to the Geelong Refinery in Corio Bay, the project includes:</p> <ul style="list-style-type: none">Floating Gas Terminal: A vessel to store and convert LNG into natural gas.Refinery Pier Extension: Approximately 570 meters of extension to accommodate LNG ships and the terminal.Treatment Facility: Ensures the gas meets transmission standards, adding odorants and nitrogen as needed.	<p>Within the project's operational boundary, the total Scope 1, Scope 2, and Scope 3 construction emissions were estimated to be 62,168 t CO₂e, with Scope 1 and Scope 2 emissions during the construction phase amounting to 6,878 t CO₂e.</p> <p>The total annual Scope 1, 2 and Scope 3 operational emissions within the project's operational boundary for the project would be as follows:</p> <p>Under high gas demand, open loop mode (utilizing seawater to heat liquefied natural gas (LNG)) would generate 47,906 t CO₂-e annually, closed loop mode (using gas-fired boilers for heating) would produce 178,985 t CO₂-e annually, and combined loop mode would result in 65,280 t CO₂-e annually. These emissions represent 0.05% (open loop), 0.19% (closed loop), and 0.07% (combined loop) of Victoria's total annual greenhouse gas emissions.</p>																																																																																											

	<ul style="list-style-type: none">■ Pipeline: A pipeline to transport gas from the terminal to the Southwest Pipeline connection point. <p>The project involves localised dredging for ship berthing and turning and aims to address gas shortfalls in Victoria while supporting energy security.</p>																																									
5	<p>The Port of Mombasa's emissions inventory baseline report, published in June 2017, outlines strategies for reducing particulate matter and black carbon emissions. It identifies key emission sources including ships during maneuvering while at berth, port operations (including cranes, fuelling stations, commuters' activities, trucks and rail operations). The report further provided projections for future emissions and highlighted the global best practices for mitigation.</p> <p>Emissions were quantified using either the fuel consumed, or the distance moved during operations. For commuters accessing the port of Mombasa, the average data method was applied to estimate the emissions generated by cars and commuter buses.</p>	<p>Emissions from the Port of Mombasa arise from multiple sources. Although not all sources were thoroughly investigated, the emissions inventory baseline report covered the main emissions sources. However, emissions from port expansion were excluded from the analysis. A summary of the estimated emissions from the different sources are as follows:</p> <table><tr><th>Source</th><th>CO₂</th><th>NO_x</th><th>PM_{2.5}</th></tr><tr><td>Rail</td><td>288,262.36</td><td>4,379.70</td><td>117.88</td></tr><tr><td>Electricity use</td><td>7,876,095.00</td><td></td><td>--</td></tr><tr><td>Tug and mooring boats</td><td>400,205.28</td><td>8,473.61</td><td>--</td></tr><tr><td>Heavy Machinery</td><td>12,402,729.65</td><td>44,257.62</td><td>--</td></tr><tr><td>Trucks</td><td>4,178,958.00</td><td>14,903.68</td><td>--</td></tr><tr><td>Employees Personal cars</td><td>4,230,000.00</td><td>--</td><td>--</td></tr><tr><td>Commuter Buses</td><td>117,500.00</td><td>--</td><td>--</td></tr><tr><td>Emissions at the Port and anchoring</td><td>479,302,320.00</td><td>9,544,920.00</td><td>328,865</td></tr><tr><td>Emission for Maneuvering</td><td>43,396,080.00</td><td>774,360.00</td><td>107,221</td></tr></table> <p>The projections further indicated that the GHG emissions are projected to increase by 125%by 2032 in a business as usual (BAU) scenario at the Port of Mombasa. The report also highlighted the global best practices for mitigation options as follows.</p> <ul style="list-style-type: none">■ The mandatory use of low sulfuric fuel at berth, the mandatory use of low sulphur fuel within a given distance from the coast from vessels.■ Vessel Speed reduction to reduce consumption and emissions.■ The mandatory periodic inspection compliance checks and support of driver education to help reduce truck idling and the adoption or retrofit technologies through Diesel Retrofit program, targeting older vehicles.■ Liquefied Natural Gas (LNG) bunkering facilities to help reduce emissions of sulphur dioxide (SO₂), Nitrogen Oxide (Nox) and Particulate Matter 10 micrometres of less in diameter (PM10).	Source	CO ₂	NO _x	PM _{2.5}	Rail	288,262.36	4,379.70	117.88	Electricity use	7,876,095.00		--	Tug and mooring boats	400,205.28	8,473.61	--	Heavy Machinery	12,402,729.65	44,257.62	--	Trucks	4,178,958.00	14,903.68	--	Employees Personal cars	4,230,000.00	--	--	Commuter Buses	117,500.00	--	--	Emissions at the Port and anchoring	479,302,320.00	9,544,920.00	328,865	Emission for Maneuvering	43,396,080.00	774,360.00	107,221
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