TotalEnergies EP South Africa B.V.

OFFSHORE PRODUCTION RIGHT AND ENVIRONMENTAL AUTHORISATION APPLICATIONS FOR BLOCK 11B/12B

AIR QUALITY SCREENING ASSESSMENT

41105306-359141-11
SEPTEMBER 2023

TotalEnergies EP South Africa B.V.

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REPORT PUBLIC

PROJECT NO. 41105306

OUR REF. NO. 41105306-359141-11

DATE: SEPTEMBER 2023

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APPENDICES

APPENDIX A

SPECIALIST CURRICULUM VITAE

APPENDIX B

LITERATURE REVIEWED

ACRONYMS AND ABBREVIATIONS

Abbreviation	Explanation
AEL	Atmospheric Emission Licence
AP-42	Compilation of Air Pollutant Emissions Factors
BAT	Best Available Techniques
C_6H_6	Benzene
CA	Competent Authority
CBD	Central Business District
CO	Carbon Monoxide
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DFFE	Department of Forestry, Fisheries, and the Environment
DMRE	Department of Mineral Resources and Energy
DoE	Department of Energy
DP	Dynamic positioning
EA	Environmental Authorisation
EEA	European Environment Agency
EETM	Emission Estimation Technique Manual
EF	Emission Factor
EIA	Environmental Impact Assessment
EMEP	European Monitoring and Evaluation Programme
EMPr	Environmental Management Programme
ESIA	Environmental and Social Impact Assessment
Eskom	Eskom Hld SOC Ltd
FSV	Fast Supply Vessels
GHG	Greenhouse Gas
GRDM	Garden Route District Municipality
GTL	Gas To Liquids
GTP	Gas To Power
H_2S	Hydrogen Sulphide
HC	Hydrocarbons
HFO	Heavy fuel oil
I&APs	Interested and Affected Parties
IFC	International Finance Corporation
IMO	International Maritime Organisation
LA	Licencing Authority
MES	Minimum Emissions Standard
MGO	Marine gas oil
n/a	Not applicable

Abbreviation	Explanation
NAAQS	National Ambient Air Quality Standards
NAEIS	National Atmospheric Emissions Inventory System
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NEM:AQA	National Environmental Management: Air Quality Act, 1998 (Act 39 of 2004)
NH_3	Ammonia
NO	Nitrogen Monoxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
NPI	Australian National Pollutant Inventory
O_2	Oxygen
O_3	Ozone
OELs	Occupational Exposure Limits
Pb	Lead
PCDD/Fs	Dioxins and Furans
PetroSA	Petroleum Oil and Gas Corporation of South Africa
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 µm
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 µm
PM	Particulate Matter
PR	Production Right
ROV	Remotely Operated Vehicle
SAAELIP	South African Atmospheric Emission Licensing and Inventory Portal
SAAQIS	South African Air Quality Information System
SANAS	South African National Accreditation System
SDS	Safety Datasheet
SLR	SLR Consulting (South Africa) (Pty) Ltd
SO_2	Sulphur Dioxide
SO_x	Sulphur Oxides
SST	Sea surface temperature
TEEPSA	TotalEnergies Exploration and Production South Africa B.V.
US EPA	United Stated Environmental Protection Agency
VOCs	Volatile Organic Compounds
VSP	Vertical Seismic Profiling

UNITS OF MEASURE

Unit	Explanation
°C	Degree centigrade
ft^3	Cubic foot = 0.028 cubic metres
ft^3/mol	Cubic foot per mol
g	Grams
g/kg	Grams per kilogram
g/Sm^3	Grams per standard cubic metres
kg/kl	Kilograms per kilolitre
km	Kilometre
km^2	Square Kilometre
km/h	Kilometres per hour
L/ft^3	Litres pet cubic foot
lb	Pound = 0.454 kilograms
lb/t	Pound per tonne
m	Metre
m^2	Square metre
m^3	Cubic metre
m^3/day	Cubic metres per day
MMBtu	Million British Thermal Units
mg	Milligrams
mg/Nm^3	Milligrams per normal cubic metre
$MMSm^3$	Millions of standard cubic metres = 1,000,000 Sm^3
m/s	Meters per second
ppm	Parts per million
Scf	Standard cubic feet
Sm^3	Standard cubic metres
Tcf	Trillion Cubic Feet
t	Tonne = 1,000 kilograms
t/yr	Tonnes per year
t/d	Tonnes per day
t/h	Tonnes per hour
%	Percentage
µg	Microgram
$µg/m^3$	Micrograms per cubic metre
µm	Micrometre

DETAILS OF THE SPECIALIST

A comprehensive CV is included in **Appendix A**.

Details of Specialist	
Name:	Natasha Shackleton
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Email:	Natasha.Shackleton@wsp.com
Company Name:	WSP Group Africa (Pty) Ltd

QUALIFICATIONS

Specialist Qualifications	
Education:	BSc Honours: Meteorology
Professional affiliations:	Professional Natural Scientist (Pr. Nat. Sci.) with the South African Council for Natural Scientific Professions (SACNASP)
Summary of experience:	Natasha has over twelve years of experience undertaking air quality studies including monitoring and sampling equipment deployment / installation, measured data analysis, emissions quantification, simulations using a range of dispersion models, impacts assessment, the development of air quality management plans, as well as modelling and data preparation for health impact and radiation impact assessments. Whilst most of her working experience has been in South Africa, she has worked on many projects within various countries in Africa which required international financing, providing her with an inclusive knowledge base of IFC guidelines and requirements pertaining to air quality and greenhouse gases emissions.

DECLARATION OF INDEPENDENCE BY SPECIALIST

I, Natasha Shackleton declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the TEEPSA Offshore Production Right and Environmental Authorisation Applications for Block 11B/12B.
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed.
- Do not have nor will have a vested interest in the proposed activity proceeding.
- Have no, and will not engage in, conflicting interests in the undertaking of the activity.
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan, or document.

SPECIALIST REPORT REQUIREMENTS IN TERMS OF NEMA

This report is compiled in such a manner that it adheres to the EIA Regulation requirements as detailed in Appendix 6 of the NEMA EIA Regulations of 2014, as amended. This report is a supporting document that will be appended to the ESIA and some of the sections in the below table are incorporated into the ESIA report. Sections that are incorporated in more detailed in the ESIA report are excluded from this report.

Section	Requirements	Section in Report
(a)	Details of:	
	(i) the specialist who prepared the report.	This is provided above.
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.	This is provided above with the CV in Appendix A.
(b)	A declaration that the specialist is independent in a form as may be specified by the competent authority.	The text declaration is provided above. The signed form will be submitted as part of the ESIA.
(c)	An indication of the scope of, and the purpose for which, the report was prepared, the quality and age of base data used for the specialist report and a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change.	The scope is described in Section 1.2. The data used is provided in Sections 4, 5 (baseline), 6.1 (emissions inventory), 6.2 (dispersion modelling), and Appendix B. Baseline conditions are described in Section 5. Cumulative impacts are discussed in Section 6.4 and levels of acceptable change in Section 3.1.3; as well as in the model prediction discussion in Sections 6.2.1 and 6.2.3 as well as the impacts significance section (8).
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment.	No site visits were undertaken for this study.
(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used.	Section 4.
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative.	The sensitivities are discussed in Sections 5.1, 5.3 and 8 . Alternatives are discussed in Section 7 and 9.2.
(g)	An identification of any areas to be avoided, including buffers (if and where applicable).	Not applicable but potential impacted area and alternatives are included in Section 6 and Section 7, respectively.

Section	Requirements	Section in Report
(h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers (if and where applicable).	Figure 1-1 (project infrastructure), Figure 5-1 (Mossel Bay Port receptors) and Figure 6-1 (locality map).
(i)	A description of any assumptions made and any uncertainties or gaps in knowledge.	Section 4.
(j)	A description of the findings and potential implications of such findings on the impact of the proposed activity or activities.	Sections 6, 8 and 10.
(k)	Any mitigation measures for inclusion in the EMPr;	Section 9.
(l)	Any conditions for inclusion in the environmental authorisation;	Section 10.
(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorization.	Section 9.
(n)	A reasoned opinion:	
	(i) whether the proposed activity, activities or portions thereof should be authorized regarding the acceptability of the proposed activity or activities.	Section 10.3.
	(ii) if the opinion is that the proposed activity, activities, or portions thereof should be authorised, an avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan.	Section 10.3.
(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report.	Included in ESIA report.
(p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto.	Included in ESIA report.
(q)	Any other information requested by the competent authority.	Included in ESIA report.

EXECUTIVE SUMMARY

TotalEnergies EP South Africa B.V. (TEEPSA), together with its joint venture partners, QatarEnergy, Canadian Natural Resources International South Africa Limited, and a South African consortium, MainStreet 1549 held an Exploration Right (Exploration Right Ref. No.: 12/3/067) over Block 11B/12B, located offshore from the Southern Cape coast, South Africa. To date the exploration programme for Block 11B/12B has focused on the south-western part of the block and has resulted in gas and associated condensate discoveries in the Brulpadda and Luiperd areas (hereafter referred to as the Project Development Area). TEEPSA now seeks to convert the Exploration Right into a Production Right (PR) to develop Block 11B/12B for the sale of the gas onto the domestic market.

WSP Group Africa (Pty) Ltd (WSP) has been appointed to undertake an air quality screening assessment as input into the Environmental and Social Impact Assessment (ESIA) which will be used to provide Interested and Affected Parties (I&APs) or stakeholders, including the Authorities, with information on the potential influences on air quality as a result of the proposed development related activities in Block 11B/12B, as well as exploration in the eastern portion of the block.

Although The Petroleum Oil and Gas Corporation of South Africa (PetroSA) will be responsible for obtaining operational permits and licences to ensure compliance with safety and environmental standards for the PetroSA F-A Platform, an indicative review of emissions associated with the platform has been included in this assessment to provide insights into cumulative operations.

Pollutants considered in the study included Particulate Matter (PM) (PM_{10} - Particulate matter with an aerodynamic diameter of less than 10 micrometres (µm), $PM_{2.5}$ - Particulate matter with an aerodynamic diameter of less than 2.5 µm); Carbon monoxide (CO); Oxides of nitrogen (NO_x) / Nitrogen Dioxide (NO_2); Sulphur dioxide (SO_2); Volatile organic compounds (VOCs) including benzene.

To assess the dispersion of pollutants from the operations, WSP has used the regulatory screening model SCREEN3, a Level 1 dispersion model, to assess single stationary sources of emissions. SCREEN3 calculated the worst-case 1-hour concentrations for flaring, vessel exhausts, and generator engine exhausts. These results were combined to estimate the cumulative operational concentrations which was presented in a table format.

Although the logistics base will potentially be located at the ports of Mossel Bay, Gqeberha and/or Cape Town, the preferred and most likely port that support activities and equipment will operate from is Mossel Bay. The shipping operations at the ports of Mossel Bay, Gqeberha and Cape Town are approximately 150 m, 350 m, and 300 m from the closest sensitive receptors, respectively.

At Mossel Bay, based on 2020 data, air temperatures average in the mid-teens to mid-twenties. The predominant winds are those from the southwest, northeast, and south. Spring and autumn winds are mainly from the north-east, south-west and south. Summer winds mainly originate from the north-easterly sector, while south-westerly winds are dominant during winter. Calm conditions (wind speeds < 1.0 m/s) occurred for more than a quarter of the year, with the majority occurring in Autumn. Summer had the lowest frequency of calm conditions.

Ambient air quality data was available on the South African Air Quality Information System (SAAQIS) for the 2022 calendar year from the Eskom Hld SOC Ltd (Eskom) owned Gourikwa Station in Mossel Bay (Department of Forestry, Fisheries, and the Environment, 2023). A minimum data recovery of 90% must be achieved to assess compliance as stipulated by SANAS (2012) in TR-03. Data recovery for the monitoring periods was low (between 15.3% and 26.8%), less than the minimum SANAS requirement of 90% and therefore compliance with the National Ambient Air Quality Standards (NAAQS) could not be assessed.

From the dispersion modelling simulations, key highlights include:

- Certain scenarios indicated the possibility of exceedances of the NAAQS occurring offshore. It is important to note that the NAAQS are designed for human health impacts, and specifically relates to residents' exposure to certain pollutants on a long-term, consistent basis. This will not be the case offshore, with individuals exposed comprising those working at the offshore operations, in which case the occupational act will apply, or those traversing the operational area, in which case exposure will be very short-lived and comparison against the NAAQS is inappropriate.
- Onshore concentrations due to offshore activities with Project controls remained well below the relevant NAAQS for all pollutants.
- Ambient concentrations due to emissions associated with port activities remain low, well below their respective NAAQS for all pollutants, with little to no impact on neighbouring sensitive receptors.

Based on the findings of this assessment, key recommendations include:

- The project should operate based on current design with all planned mitigation, management and monitoring measures in place and correctly enforced; the details of which are contained in this document.

Based on the above key findings, WSP is of the opinion that the Project be authorised provided that the final design includes all the planned Project controls.

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1 INTRODUCTION

TotalEnergies EP South Africa B.V. (TEEPSA), together with its joint venture partners, held an Exploration Right (Exploration Right Ref. No.: 12/3/067) over Block 11B/12B, located offshore from the Southern Cape coast, South Africa. To date the exploration programme for Block 11B/12B has focused on the south-western part of the block and has resulted in gas and associated condensate discoveries through the Brulpadda-1AX and Luiperd-1X wells areas (hereafter referred to as the Project Development Area).

TEEPSA's Exploration Right for Block 11B/12B expired in September 2022 and TEEPSA now applied for a Production Right (PR) to the Competent Authorities (CA) on 05 September 2022. TEEPSA is planning to develop Block 11B/12B if a PR is granted and if commercial agreements for the sale of the gas onto the domestic market can be achieved.

The Project triggers listed activities in terms of the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended), which require Environmental Authorisation (EA) in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (Republic of South Africa, 1998) (NEMA) (as amended). To comply with the regulatory requirements, an Environmental and Social Impact Assessment (ESIA) process is required to obtain the EA prior to commencing with the proposed activities in Block 11B/12B.

WSP has been appointed to undertake an air quality screening assessment in support of the ESIA. This air quality assessment has been compiled as input into the ESIA which will be used to provide Interested and Affected Parties (I&APs), including the Authorities, with information on the potential influences on air quality because of the proposed development related activities in Block 11B/12B, as well as exploration in the eastern portion of the block.

1.1 PROJECT BACKGROUND

The Block 11B/12B application area is located offshore of the south coast of South-Africa and covers approximately 12 000 square kilometres (km^2). The closest north-eastern point of the application area is about 75 km offshore from Cape St Francis, whereas the closest north-western point is about 120 kilometres (km) offshore from Mossel Bay.

Within the western portion of Block 11B/12B, in the Project Development Area (**Figure 1-1**), the following development related activities are proposed:

- Drilling of up to six (6) development and appraisal wells.
- Laying of deep-water subsea manifolds and flowlines connecting wells within the Project Development Area.
- Connection of these manifolds and flowlines to The Petroleum Oil and Gas Corporation of South Africa (PetroSA) existing F-A Platform at Block 9 offshore field, via a subsea production pipeline of approximately 109 km in length (base case).

The gas will be processed using the existing processing facilities on F-A Platform and the gas and associated condensates will be exported via two existing pipelines connecting the platform to the shore in Mossel Bay. Production is expected to last up to 25 years. Any construction, modification, or upgrades at the F-A Platform or at any onshore facility, if required by the off-taker of gas or condensates, will be subjected to a separate EA Application.

Furthermore, TEEPSA proposes to conduct further investigations in the eastern portion of the block, referred to as the Exploration Priority Area including exploration and appraisal drilling and related activities within Block 11B/12B, to enable further refinement of the geological and reservoir understanding.

The following activities are proposed:

- Additional drilling of up to four (4) exploration and appraisal wells, including vertical seismic profiling (VSP) and well flow testing, where necessary.
- Bathymetry and sonar surveys.
- Seafloor sampling surveys.
- Metocean surveys.

Offshore support to the exploration and production related activities will be by support vessels, departing from the ports of Mossel Bay, Gqeberha and/or Cape Town, with helicopters operating from George airport. Logistics, laydown areas and support will be undertaken from Mossel Bay port using port infrastructure and facilities for all offshore activities.

1.2 SPECIALIST SCOPE OF WORK

The intention of the air quality approach was to provide a professional opinion regarding Project activities and potential impacts on the receiving environment. Following receipt of Project information and several stakeholder comments received indicating concerns of reduction in ambient air quality, the preferred approach was to provide a semiquantitative screening assessment. This assessment being inclusive of emissions estimation and dispersion model predictions to provide better insights into potential impacts associated with the project. This specialist scope of work is therefore presented as an Air Quality Screening Assessment.

With this in mind, the scope of work comprised:

- A review of local by-laws, national legislation, international guidelines, and policies, as well as applicable TEEPSA standards and policies relevant to this topic.
- A description of baseline conditions through:
  - An overview of meteorological conditions using available information.
  - A review of potential, existing sources of emissions in the area.
  - Analysis and interpretation of available measured ambient air quality data.
- The compilation of an emissions inventory of activities within Block 11B/12B PR through:
  - Identification of potential sources of emissions associated with Project activities.
  - Researching available emission factors and emission rate research studies; and the identification of those most appropriate to estimate emissions from Project specific sources.
  - Calculation of emission rates related to Project activities, inclusive of exploration and development well drilling, construction, offshore support activities throughout production, and decommissioning.
  - Calculation of emission rates for sources related to the operation of the FA-Platform associated facility utilising the Block 11B/12B resources, based on data provided by TEEPSA and identified emission factors.
- The assessment of pollutant concentrations at sensitive receptors arising from the Project operations through:

- Simulation of emissions in the Tier 1 SCREEN3 dispersion model.
- Comparison of predicted concentrations with relevant National Ambient Air Quality Standards, as applicable.

- The same approach was undertaken to assess pollutant concentrations at sensitive receptors arising from the calculated emissions from the F-A Platform associated facility operations.
- A professional opinion of emissions, and associated impacts, that may arise from the use of the processed gas and condensate at either PetroSA Gas To Liquids (GTL) Plant or the Eskom Hld SOC Ltd (ESKOM) Gourikwa Power Plant, approximately 15 km west of the Mossel Bay Central Business District (CBD).
- The significance of the potential impacts estimated using the ESIA significance rating methodology.
- Based on severity of impacts, the provision of mitigation measures to reduce emissions associated with the Project.
- Where deemed necessary, recommendations to establish monitoring networks to verify impacts on neighbouring sensitive receptors.

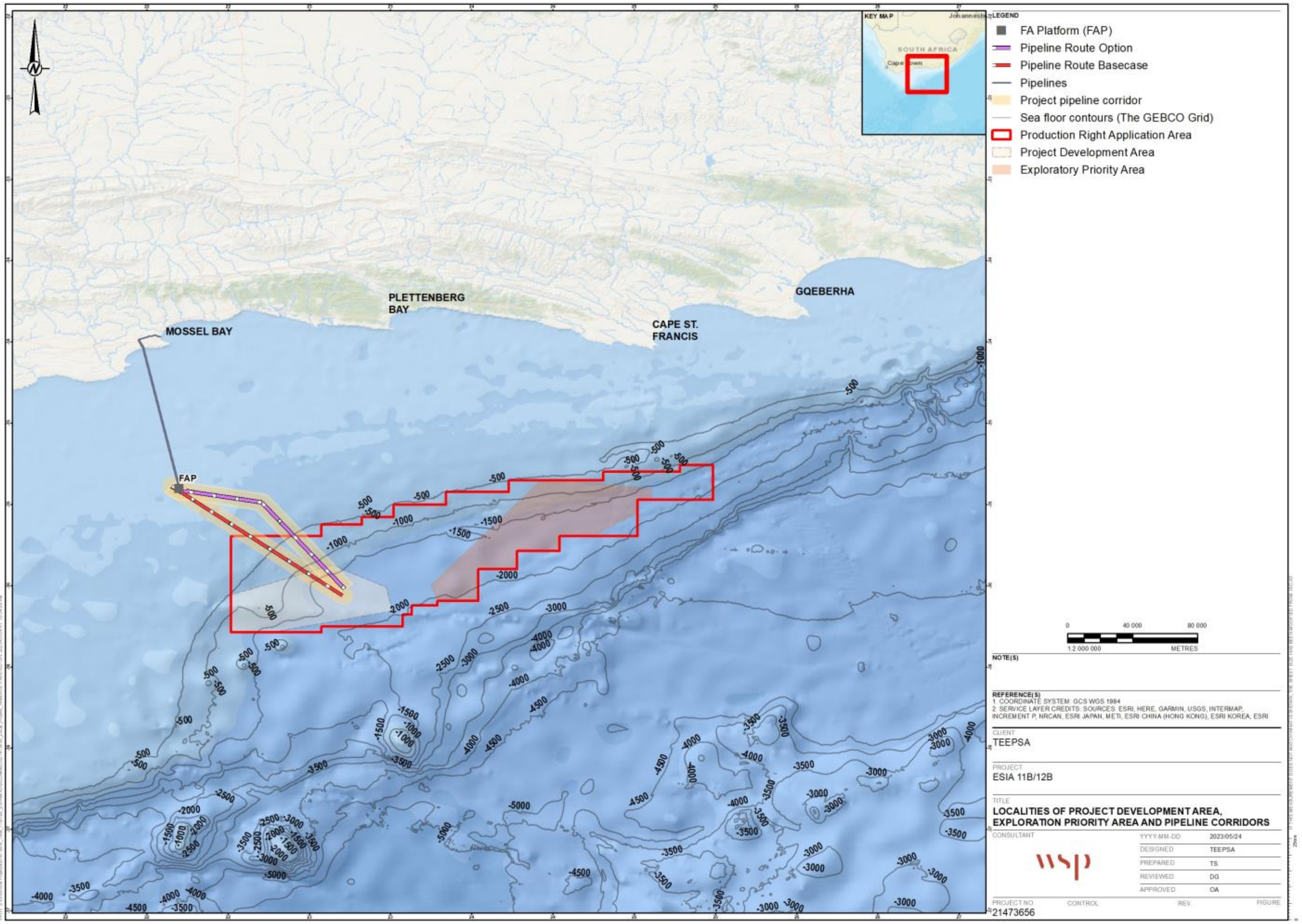


Figure 1-1: Localities of project development area, exploration priority area and pipeline corridors

2 PROJECT DESCRIPTION

The section below and **Table 2-1** provide more information regarding Project activities in terms of air quality, together with phasing information.

Table 2-1: Details of project activities in terms of air quality

Aspect	Details
Proposed exploration and appraisal drilling activities (Eastern Portions of Block, Exploration Priority Area)	▪ Drill unit fuel combustion.[a] ▪ Flaring (well flow testing) – gas combustion. ▪ Support vessels fuel combustion.[b] ▪ Helicopter fuel combustion.[c] ▪ Onshore support.
Proposed offshore surveys (Whole Block)	▪ Survey vessels fuel combustion.[b] ▪ Onshore support.
Proposed production and development activities (Western Portion of Block)	
Construction phase	Offshore Activities
	▪ Drill unit fuel combustion.[a] ▪ Flaring (well flow testing) – natural gas and associated gas combustion. ▪ Drilling support vessels fuel combustion.[b] ▪ Helicopter fuel combustion.[c] Construction and support vessels fuel combustion.[b][d]
	Onshore Activities
	▪ Establishment of logistics base within the Mossel Bay port. ▪ Support and construction vessels manoeuvring, towing, and hotelling[e] as well as refuelling, off/loading, and maintenance. ▪ Helicopter operations. ▪ Fuel delivery and storage.
Production operations phase	Offshore Activities
	▪ Support vessels fuel combustion[b]; for maintenance and inspection of subsea infrastructure and flowlines. ▪ Operation of F-A Platform and associated infrastructure[f]: gas auto consumption for turbines and process flaring.
	Onshore Activities
	▪ Support and construction vessels manoeuvring, towing, and hotelling[e] as well as refuelling, off/loading, and maintenance.
Decommissioning phase	Offshore Activities
	▪ Drill rig fuel combustion.[g] ▪ Support vessels fuel combustion.[b] ▪ Decommissioning vessels fuel combustion.[b] ▪ Helicopter fuel combustion.[c]
	Onshore Activities
	▪ Support and decommissioning vessels manoeuvring[b], towing[g], and hotelling[e] as well as refuelling, and off/loading.

Aspect	Details
	▪ Helicopter operations. ▪ Salvage of retrieved equipment and shipping to Gqeberha and/or Cape Town port.

Notes:

(a) Fuel combustion consists of main and auxiliary engines marine fuel combustion for dynamically positioning (DP)
(b) Fuel combustion consists of main and auxiliary engines marine fuel combustion.
(c) Fuel combustion consists of engine kerosene fuel combustion.
(d) Periodic bulk delivery (equipment) from Gqeberha and/or Cape Town port.
(e) Fuel combustion consists of diesel fuel combustion for utilities.
(f) F-A Platform operations are outside this application as these are not under TEEPSA's operation and control; however, the related emissions calculated and predicted concentrations are assessed for the cumulative impact.
(g) Fuel combustion consists of marine fuel combustion for auxiliary engines.

The timeframes associated with the Project activities are indicated in **Table 2-2**.

Table 2-2: Proposed project timeframes

Project Component	Phase	Timeframe	Duration of Activities	No. of wells
Exploration	Operations, including plugging and abandonment	To be determined	120 days per well	Up to four (4)
Offshore Surveys (for Development and Exploration areas)	Operations	To be determined	**Sonar**: 15 – 30 days for 1 survey **Seafloor sampling**: 15 – 30 days for 1 survey **Metocean Buoy**: 7 – 15 days for deployment for 1 year monitoring	Not applicable
Development[(a)]	Final well site selection, pipeline alignment selection	To be determined	To be determined	Not applicable
	Construction	Year 0	216 days	Two (2)
		Year 1	113 days	One (1)
		Year 10	250 days	Two (2)
	Production	Year 1 to Year 25	-	Year 1 - 2 wells Year 2 to 10 – 3 wells Year 11 to 25 – 5 wells
	Decommissioning (including plugging and abandonment, and demobilisation)	Year 26	-	Five (5)

Notes: (a) At this stage of the engineering design, five production wells will be drilled in the Production Development Area with the option for a sixth well should it be required. This Air Quality study assesses the five well option.

2.1 OFFSHORE SURVEYS AND DATA COLLECTION ACTIVITIES – WHOLE BLOCK

Various offshore surveys and data collection will be conducted in Block 11B/12B subject to identification of specific needs. One vessel could be mobilised for each survey for a duration between 1 to 4 weeks depending on the scope.

2.2 EXPLORATION AND APPRAISAL DRILLING ACTIVITIES – OFFSHORE EASTERN AREA

In addition to the development of the gas field in the western section of Block 11B/12B, TEEPSA intends undertaking exploration and appraisal drilling work to assess the potential for additional hydrocarbon resources. This programme may include:

- Drilling of up to four (4) exploration and appraisal wells in the eastern section of Block 11B/12B.
- One flow test would be undertaken per well if a resource is discovered. Testing may take 3 to 4 days to complete and involves burning hydrocarbons at the well site. An estimated gas rate of 900 000 cubic metres per day (m^3/day) could be flared per test. A high-efficiency flare will be used to maximise combustion of the hydrocarbons and minimise emissions to air and unburnt droplets at sea.
- It is unlikely that all 4 wells will be drilled in 1 year as the proposed workflow is to operate one drill unit, drilling wells in sequence. A maximum of three wells could be drilled in one year, where drilling will occur for 360 days; depending on which operational year the drilling will take place.

2.3 DEVELOPMENT AND PRODUCTION ACTIVITIES – OFFSHORE WESTERN AREA

The proposed development and production project in Block 11B/12B is adjacent to the existing F-A Platform in offshore Licence Block 9 and the F-O field. The proposed Project assumes no further production from this field, enabling the Block 11B/12B development to exclusively use the offshore installation for the treatment and export of gas and condensate. Based on current yield estimates, the gas and condensate production period will be up to 25 years.

The Project development area is located approximately 110 km southeast of the existing F-A Platform. The Project development concept comprises wells and a subsea production system (SPS) in the south-west corner of Block 11B/12B to produce gas and associated condensates. The development concept includes a subsea pipeline to carry the gas and condensate to existing treatment and export facilities on the F-A platform where it will go to shore via the existing pipelines.

The proposed development concept will connect up to six wells in the Project development area via a multiphase pipeline carrying both gas and associated condensates from the wells up to the F-A Platform. From there, it will be carried for further treatment and exporting via the existing PetroSA-operated gas and condensate pipelines onshore.

Any construction, modification, or upgrades at the F-A Platform or of any onshore facility, if required by the off-taker of gas or condensates, will be subjected to a separate EA application.

The production activities part of this EA applicable to the air quality study include:

- Drilling and well flow test of up to six (6) wells in the development area.
- Installation of the subsea production system including pipeline and connection to the F-A Platform.

2.4 SUPPORT ACTIVITIES AND COMPONENTS

The project will include various support operations. This will include a series of support and specialised vessels for specific activities and a logistics base. Other supporting activities will also include helicopter transportation from existing airport facilities to move personnel to and from the offshore facilities.

2.4.1 LOGISTICS BASE

During all project phases, support operations will include transportation of equipment, supplies, and personnel by vessel. The transport of bulk equipment will be done from the ports of Gqeberha and/or Cape Town. It is anticipated that the logistics base(s) will be in the port area and make use of existing port facilities. The logistics base(s) operations will likely include:

- Equipment and material storage.
- Operations and maintenance centres.
- Quayside services to support vessels.
- Loading/offloading of supplies and equipment being transported to and from the Project offshore operational areas.

Helicopters will operate from George airport or other existing heliports to support offshore activities.

2.4.2 SUPPORT AND SPECIALISED VESSELS

Patrol boats, crew vessels/boats, supply vessels, and specialised vessels, as well as tugboats will support the well drilling, construction and installation activities, and decommissioning. A supply vessel will provide support during production years. The vessels will very likely operate from the Mossel Bay Port. Drilling operations will make use of a drill unit and tugboat(s) which will not return to Port and is serviced by the support vessels. All vessels will need to comply with applicable International Maritime Organization (IMO) standards relevant to their proposed use (e.g., double-hulled vessels for tankers, use of low sulphur marine fuel etc.).

2.5 SCENARIOS CONSIDERED

Some years comprise of activities for more than one Project component; consequently, for the air quality study, the years of simultaneous components have been considered in addition to the separate components. The years and related activities are detailed in **Table 2-3**.

Table 2-3: Details of sources of emission per operational scenario

Sources / Scenario	Year 0	Year 1	Year 2-9 and 11-25	Year 10	Year 26	Exploration	Surveys
TEEPSA Block 11B/12B Related Operations							
Drill unit	X	X		X	X	X	
Flaring (well flow testing)	X	X		X		X	
Support, construction, or decommissioning vessels	X	X	X	X	X	X	X
Helicopters	X	X		X	X	X	
F-A Platform Operations							
Process Flaring		X	X	X			
Gas auto combustion (engines / turbines / heaters)		X	X	X			

3 APPLICABLE POLICIES, LEGISLATION, GUIDELINES AND STANDARDS

This section provides an overview of key environmental legislation and regulations applicable to the Project and related to the topic of this report.

3.1 LOCAL LEGISLATION

3.1.1 SOUTH AFRICAN CONSTITUTION

The South African Constitution (Republic of South Africa, 1996) protect the rights of the citizens, refugees and immigrants living in South Africa. The constitutional laws relevant to air quality in the context of this project are that everyone has the right to, while promoting justifiable economic and social development:

24.(a) an environment that is not harmful to their health or wellbeing.

(b) have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:

(i) prevent pollution and ecological degradation.

(iii) secure ecologically sustainable development and use of natural resources.

3.1.2 NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998

3.1.2.1 Environmental Impact Assessments and Associated Specialist Report Requirements

The EIA Regulations, 2014 (as amended), were promulgated in terms of Sections 24(5), 24M and 44 of the NEMA and subsequent amendments. The Department of Environmental Affairs (DEA), now the Department of Forestry, Fisheries, and the Environment (DFFE), developed the National web-based Environmental Screening Tool to flag areas of potential environmental sensitivity related to a site and development footprint and produces a screening report required in terms of regulation 16 (1)(v) of the EIA Regulations, 2014 (as amended). The web-based environmental screening tool can be accessed at https://screening.environment.gov.za/screeningtool to generate a report that shows environmental features and sensitivities near the proposed project and identifies recommended specialist studies.

Based on the Screening Tool Report for the current project, there are no additional requirements for an Air Quality specialist assessment, and it is only required to conform to Appendix 6 of the EIA regulations.

3.1.2.2 Duty of Care

The *Duty of Care* obligations set out in Section 28 of the NEMA (Republic of South Africa, 1998), stipulates that '*every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment*'.

As such, any person or organisation must undertake the following necessary measures, set out by NEMA, to minimize or contain atmospheric emissions:

- Investigate, assess, and evaluate the impact on the environment.
- Inform and educate employees about environmental risks of their work and the way their tasks must be performed to avoid causing significant pollution or degradation of the environment.
- Cease, modify or control any act, activity or process causing the pollution or degradation.
- Eliminate any source of the pollution or degradation.
- Remedy the effects of the pollution or degradation.

Failure to comply with the above conditions and / or directives is in breach of the Duty of Care, and the guilty party will be subject to the sanctions set out in section 28 of NEMA.

3.1.3 NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT, 2004

The objectives of the National Environmental Management: Air Quality Act, 1998 (Act 39 of 2004) (NEM:AQA) (Republic of South Africa, 2005) are to:

- Protect the environment by providing reasonable measures for:
  - The protection and enhancement of air quality.
  - The prevention of air pollution and ecological degradation.
  - Securing ecologically sustainable development while promoting justifiable economic and social development.
  - Give effect to everyone's right "to an environment that is not harmful to their health and well-being" (Republic of South Africa, 1996).

Significant functions detailed in NEM:AQA include:

- The National Framework for Air Quality Management (Department of Environmental Affairs, 2018).
- Provision of institutional planning matters.
- Air quality management measures, with measures potentially relevant to the Project being:
  - The listing of activities that result in atmospheric emissions and which have the potential to impact negatively on the environment and the licensing thereof through an Atmospheric Emissions License (AEL).
  - The declaration of Controlled Emitters.
  - The declaration of Controlled Fuels.

3.1.3.1 Listed Activities and Controlled Emitters

Based on project design information available at this stage, the activities associated with the proposed development and operation related activities in Block 11B/12B, as well as explorations in the eastern portion of the block do not trigger any activities listed under Section 21 of NEM:AQA (Department of Environmental Affairs, 2013a; Department of Environmental Affairs, 2018; Department of Environmental Affairs, 2019); nor will there be any controlled emitters under Section 23 (Department of Environmental Affairs, 2013b).

As the Project does not trigger any listed activities it is not required to have a AEL or to comply with Minimum Emission Standards (MES). Likewise, as there are no controlled emitters associated with the Project, the registration of equipment with (and acquisition of a certificate from) the Local Authorities (LA) as well as compliance with emission conditions is not required.

TEEPSA has indicated that the F-A Platform flaring, and gas auto consumption would be routine processes. If routine flaring and auto gas consumption takes place at the F-A Platform, the F-A Platform associated facility could trigger listed activities, resulting in the requirement of an AEL and compliance with MES. Similarly, with if contractors' incineration waste within the port limits, this could be subject to obtaining an AEL and complying with MES. Any EAs or AELs at the F-A Platform, or at any onshore facility, or contractors' operations, will be subjected to a separate application and the onus of the owning entity / operators.

3.1.3.2 National Emissions Reporting Regulations

If the final operational design and equipment register includes listed activities, controlled emitters or any other activity noted in the local by-laws, TEEPSA, and /or their service providers, may have to report emissions using the National Atmospheric Emissions Inventory System (NAEIS) module and / or the compliance reporting module on the South African Atmospheric Emission Licensing and Inventory Portal (SAAELIP).

3.1.3.3 National Ambient Air Quality Standards (NAAQS)

Section 9 of NEM:AQA tasks the Minister of the DFFE with the responsibility of identifying substances or mixtures of substances in the ambient air which, through ambient concentrations, bioaccumulation, deposition or in any other way, present a threat to health or well-being and the subsequent establishment of national standards for ambient air quality for these substances.

Ambient air quality standards are defined as "targets for air quality management which establish the permissible concentration of a particular substance in, or property of, discharges to air, based on what a particular receiving environment can tolerate without significant deterioration" (Department of Environmental Affairs, 2000). The aim of these standards is to provide a benchmark for air quality management and governance. Ambient air quality criteria apply to areas where the Occupational Health and Safety regulations (Republic of South Africa, 1993) do not apply, which is generally outside the property or lease area.

Hydrocarbons (HCs) would be emitted from the Block 11B/12B operations. Volatile organic compounds (VOCs), which are a group of HCs, comprise a vast array of compounds, emitted during exploration and appraisal drilling, and the production and development operations. No local standards or international guidelines have been set for cumulative ambient VOCs concentrations. Therefore, where appropriate, the benzene component of the liquid fuels, gas and condensate VOCs have been assessed.

The National Ambient Air Quality Standards (NAAQS) (Department of Environmental Affairs, 2009; Department of Environmental Affairs, 2012) applied in this study are presented in **Table 3-1** and became applicable for air quality management from their promulgation.

Table 3-1: South African National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Period	Concentration (µg/m^3)	Permissible Frequency of Exceedance per Year
Carbon monoxide (CO)	1-hour	30 000	88
Nitrogen dioxide (NO_2)	1-hour	200	88

Pollutant	Averaging Period	Concentration (µg/m³)	Permissible Frequency of Exceedance per Year
	1-year	40	0
Particulate matter (PM_{10})	24-hours	75	4
	1 year	40	0
Particulate matter ($PM_{2.5}$)	24-hour	40	4
		25[a]	4
	1 year	20	0
		15[a]	0
Sulphur dioxide (SO_2)	1-hour	350	88
	24-hours	125	4
	1-year	50	0
Benzene	1-year	5	0

Notes:

(a) Effective date is 01 January 2030.

3.2 TEEPSA POLICIES AND STANDARDS

3.2.1 PROJECT STANDARDS

The TEEPSA projects standards require the Project operations to comply with National Legislation as well as general and special conditions specified by the Authorities in the Project EA. The Project should operate according to the TEEPSA "General Specification for Environment – Environmental Requirements for Project Design and Exploration and Production Activities (GS EP ENV 001)"; which has been formulated to reduce impacts by identifying and selecting the most appropriate mitigation measures, based on the Company Best Available Techniques (BAT) concept.

3.2.2 TOTALENERGIES SUSTAINABLE PERFORMANCE

TotalEnergies aim at reducing emissions to atmosphere and air quality impacts. The applicable strategies are provided below and the methods to achieve these described in **Section 8**.

For new projects, installations shall be designed to comply with the following principles:

1. To reduce the emission of gaseous or solid compounds that affect the air quality and human health: Carbon Monoxide (CO), Oxides of Nitrogen (NO_x), Hydrogen Sulphide (H_2S), Sulphur Oxides (SO_x), Particulate Matter (PM), and VOCs, etc.
2. To monitor the flow and the characteristics of significant emissions before releasing them to the atmosphere.

4 STUDY METHODOLOGY

A semiquantitative air quality screening assessment was compiled to support the ESIA, and associated EA application. This section describes the approach undertaken for this.

4.1 EMISSIONS ESTIMATION

The emissions were calculated using the information provided by TEEPSA, and studies for similar operations; the United States Environmental Protection Agency (US EPA) Compilation of Air Pollutant Emissions Factors (AP-42) Emissions Estimation Technique Manuals (EETMs) and the data from the 1983 Flare Efficiency Study conducted for the US EPA (McDaniel, 1983), the Australian Government National Pollutant Inventory (NPI) EETMs and the European Monitoring and Evaluation Programme (EMEP) / European Environment Agency (EEA) air pollutant emission inventory guidebook. References for the source of data used per source / operation is provided in **Section 6.1**. These sources and emissions were used as input into the dispersion model.

4.2 DISPERSION MODELLING

As a semiquantitative approach to assess the dispersion of pollutants from the Project, WSP applied the screening model SCREEN3, a single source gaussian plume model recognised as an approved model in the Dispersion Modelling Regulations of South Africa for Level 1 assessments. SCREEN3 calculated the worst-case 1-hour concentrations for the possible point sources individually. These results were combined to estimate operational concentrations for each scenario, presented in tables in **Section 6.2**.

Modelling simulations were limited to the assessment of:

- CO.
- NO_x with an 80% conversion to NO_2.
- PM, assessed using the guidelines for:
  - PM_{10} - Particulate matter with an aerodynamic diameter of less than 10 micrometres (µm).
  - $PM_{2.5}$ - Particulate matter with an aerodynamic diameter of less than 2.5 µm.
- SO_2.
- Benzene.
  - Given the lack of local or international guidelines for total VOCs comparisons, only the benzene component of VOCs was assessed.

4.3 ASSESSMENT OF IMPACTS

This impact of applicable emissions on the receiving environment were assessed through the comparison of predicted ambient concentrations with the NAAQS.

The assessment of the significance of the impacts was based on the ESIA methodology.

4.4 STUDY UNCERTAINTIES

This semi-quantitative air quality screening assessment comprises certain limitations. To negate these gaps and limit the uncertainty in the study findings, reasonable assumptions were made using offshore gas exploration and production operations impacts assessments, management plans, research studies, and engineering books; as well as studies relating to the support operations and equipment datasheets from several manufacturing/supply companies.

Key limitations and assumptions are presented below. Given the precautionary approach to these, this assessment is considered environmentally conservative i.e., it presents the worst-case scenarios.

Importantly, where specific activities are discussed and referenced to a particular year of the Project, the reference of this year must be viewed with caution and does not imply the assessed activity will occur within that particular year. The design of the scenarios, linked to certain years, are indicative only, with those activities potentially occurring in another year if any shift within the project lifecycle occurs.

The following assumptions and limitations are applicable to the emissions inventory and dispersion modelling:

Limitations:

- Up to 6 production wells will be drilled in the development area but by design 5 wells should suffice. The Project Lifecyle data reflects 5 wells. It is anticipated that the drilling of a 6^{th} well will result in similar impacts to Year 1 and for this reason has not been included as a stand-alone scenario.
- Fuel use was provided by TEEPSA for the drill unit and the support, construction, and decommissioning vessels specific to this Project. Fuel use for the F-A Platform associated facility support vessels was not available and these have been excluded from the cumulative predictions in **Section 6.2.1**.
- There is the possibility incineration of certain wastes onboard the drilling rig and support vessels will occur; however, given the early design phase of the project, details are unknown. This incineration will produce emissions however since this will be over very short periods in small quantities, the impacts of these are deemed to be negligible and therefore excluded.
- Emissions relating to offshore survey and helicopter operations were calculated and presented but were excluded from modelling given they are generally low emissions, infrequent, and covering a large area.
- As the exploration will take place in the eastern portion of the block, and the development and production operations in the western portion of the block, the combined exploration and development and production concentrations from offshore operations are unlikely to occur and was screened out of the modelling.
- The SCREEN3 model has the capability to simulate concentrations up to 100 km from the point of release. Based on the concentration reduction / pollutant depletion trend from 60 km to 100 km, the potential concentrations up to 160 km were calculated.
- The dispersion model used estimates worst-case 1-hour concentrations. To estimate the 24-hour and 1-year averaged concentrations, the 1-hour concentrations were multiplied by the scaling ratios provided in the Regulations Regarding Air Dispersion Modelling (Department of Environmental Affairs, 2014) for SCREEN3; these being 0.4 for 24-hours and 0.08 for annual. This is a worst-case estimate for annual concentrations as few activities are operational every day or for an extensive portion of the year. Flaring from well flow testing for example takes place for up to 5 days per flare event and for up to 20 days in a year based on similar operations.
- No national guidelines are available on safe exposure limits for fauna, flora, and heritage artifacts.

Assumptions:

- Fuel usage provided by TEEPSA for the support vessels is for main and auxiliary engines only and excludes the boilers or generators fuel used at the port during hotelling. Therefore, the Australian National Pollutant Inventory (NPI) emission estimation technique manual (EETM) for marine operations suggests that a fuel consumption of 0.0125 tonnes/hour should be used if generator use is unknown. This is based on the United Stated Environmental Protection Agency (US EPA) 2006 "Current Methodologies and Best Practices in Preparing Port Emission Inventories" document.
- The F-A Platform process flared gas composition was provided by TEEPSA.
  - It is expected to be similar to the natural gas flared during non-routine flaring for development well flow testing at the drill unit during. The VOCs and benzene emissions were estimated using this composition.
  - The C_6 component was used to determine the benzene emitted during flaring. This is an overestimation as benzene content would be less than the total C_6 compounds. The percentage of C_6 was applied to the VOCs emission for the:
    - Non-routine flaring of associated gas at the development wells.
    - Non-routine flaring of gas at the exploration wells.
- Benzene emissions were estimated by applying the percentage benzene content of the different liquid fuels to the calculated VOCs emissions.
- Despite sulphur contents in the western block being tested by geochemists, and found to be non-existent, WSP has assumed a worst-case approach by applying the sulphur content detected in the eastern block, where only exploration will occur. Importantly, there is no relationship between the eastern and western block gas compositions, with WSP only applying the eastern block sulphur content to the western block. As mentioned, this is an environmentally conservative approach to predict SO_2 concentrations should trace amounts of sulphur occur in the gas, although in reality this is unlikely to occur given the comprehensive gas composition testing undertaken by the geochemists. As presented in this report, and despite this conservative approach, SO_2 concentrations associated with western block operations remain extremely low, well below all applicable ambient air quality standards.
  - The EETM for gas turbines indicates that where the sulphur content for of fuel gas is unknown, the emission factor of 3.4 E-03 pounds per million British Thermal Units (lb/MMBtu) should be used for natural gas turbines. The auto consumption (fuel) gas composition provided by TEEPSA indicated a H_2S content of 0.00% mol. The upper limit of the H_2S content (0.7 parts per million (ppm)) provided for exploration gas flared results is less than 0.0001% mol. and there is the potential of there still being this minimal sulphur content in the F-A Platform associated facility fuel gas. Therefore, SO_2 was considered for the F-A Platform auto consumption gas combustion emissions estimation making use of sulphur content based on the 0.7 ppm H_2S and not the default factor (for S = unknown); resulting in an emission factor well below the default.
  - The flare efficiency study and several countries emissions reporting provided emission factors for SO_2 for natural gas flaring. The flared (process) gas composition provided by TEEPSA indicated a H_2S content of 0.00% mol. (mol percent). The upper limit of the H_2S content (0.7 ppm) provided for exploration gas flared results is less than 0.0001% mol. and there is the

potential of there still being this minimal sulphur content in the flared gas associated with development drilling well flow testing and the F-A Platform associated facility flared process gas. Therefore, SO_2 was considered for the well development non-routine flaring (flow testing) and F-A Platform routine process gas flaring emissions estimation making use of sulphur content based on 0.7 ppm H_2S.

- Due to limited information relating to emission factor particle size distributions, and as a worst-case, PM_{10} and $PM_{2.5}$ emissions are assumed to equal PM emissions.
- The impacts discussion is based on the predicted onshore concentrations. These concentrations being for the following closest distances:
  - 160 km from the coast to the northern boundary of the development area (western block).
  - 85 km from the coast to the exploration area (eastern block).
  - 160 km from coast to the eastern side of the development area (western block) and western side of the exploration area (eastern block); where the activities associated with the “worst-case” Year 10 scenario could occur.
  - 70 km from the coast to the PetroSA F-A Platform.
- The NO_x emissions comprise of both NO and NO_2, the ratio of which related to the project is unknown at this time. However, as per the Regulations Regarding Air Dispersion Modelling (Department of Environmental Affairs, 2014), the NO_2 portion was assumed to be 80% of NO_x.

5 BASELINE DESCRIPTION

5.1 SENSITIVE RECEPTORS

Sensitive receptors are identified as areas that may be impacted negatively by pollutant emissions to atmosphere associated with the proposed activities. Receptors associated with human health and nuisance impacts include, but are not limited to, schools, nursing homes, hospitals, clinics, specialised medical facilities treating patients with chronic illnesses, office blocks and residential properties.

The PR application area is located offshore, extending between Mossel Bay and Cape St. Francis, (**Figure 6-1**) with the closest north-eastern point of the PR application area about 75 km offshore from Cape St Francis, whereas the closest north-western point is about 120 km offshore from Mossel Bay.

Onshore support operations will be conducted from logistics base located at the ports of Mossel Bay, Gqeberha and/or Cape Town. It is anticipated these will make use of existent areas and facilities already established inside the ports. It is likely that transport of bulk equipment will be done from the ports of Gqeberha and/or Cape Town. All other vessels will operate from the Mossel Bay port and used the most for Project related vessel operations, consequently the sensitive receptors near the Mossel Bay port have been identified in detail. A helicopter will operate from George airport.

Additional to the commercial infrastructure and residential sites nearby, other receptors within the port area (seaside) are tourism activities, onshore natural vegetation and fauna, and marine life.

5.1.1 HIGH SENSITIVITY AREAS

These types of sensitive receptors within the onshore support area and surrounds, as well as along the coastal area north of Block 11B/12B include:

- Hospitals, clinics, hospice, chronic illness treatment centres, and retirement homes including frail care facilities.
- Schools and creches.
- Individual homesteads and farmsteads.
- Leisure and contractor accommodation.
- Residential areas.
- Conservation and tourism areas.
- Crop and livestock farming areas.

At Mossel Bay, the preferred Port to operate from, the closest residences and commercial operations are 150 m from the port. Within 3.5 km from the port, seven schools, one creche, three hospitals, one clinic and an emergency response services centre were identified (**Figure 5-1**).

The shipping operations at the ports of Gqeberha and Cape Town are approximately 350 m, and 300 m from the closest sensitive receptors, respectively.

5.1.2 MEDIUM SENSITIVITY AREAS

Natural landscapes including waterbodies not associated with conservation, tourism and farming would be considered of medium sensitivity.

In relation to dust fallout (coarse particulate matter), solar facilities will be of medium sensitivity as the large particles can reduce efficiency both by damaging panels and reducing energy absorption when dust settles on the panels. It is anticipated that the impact from other pollutants is insignificant or none.

5.1.3 LOW SENSITIVITY AREAS

These areas include industrial operations, and mines.

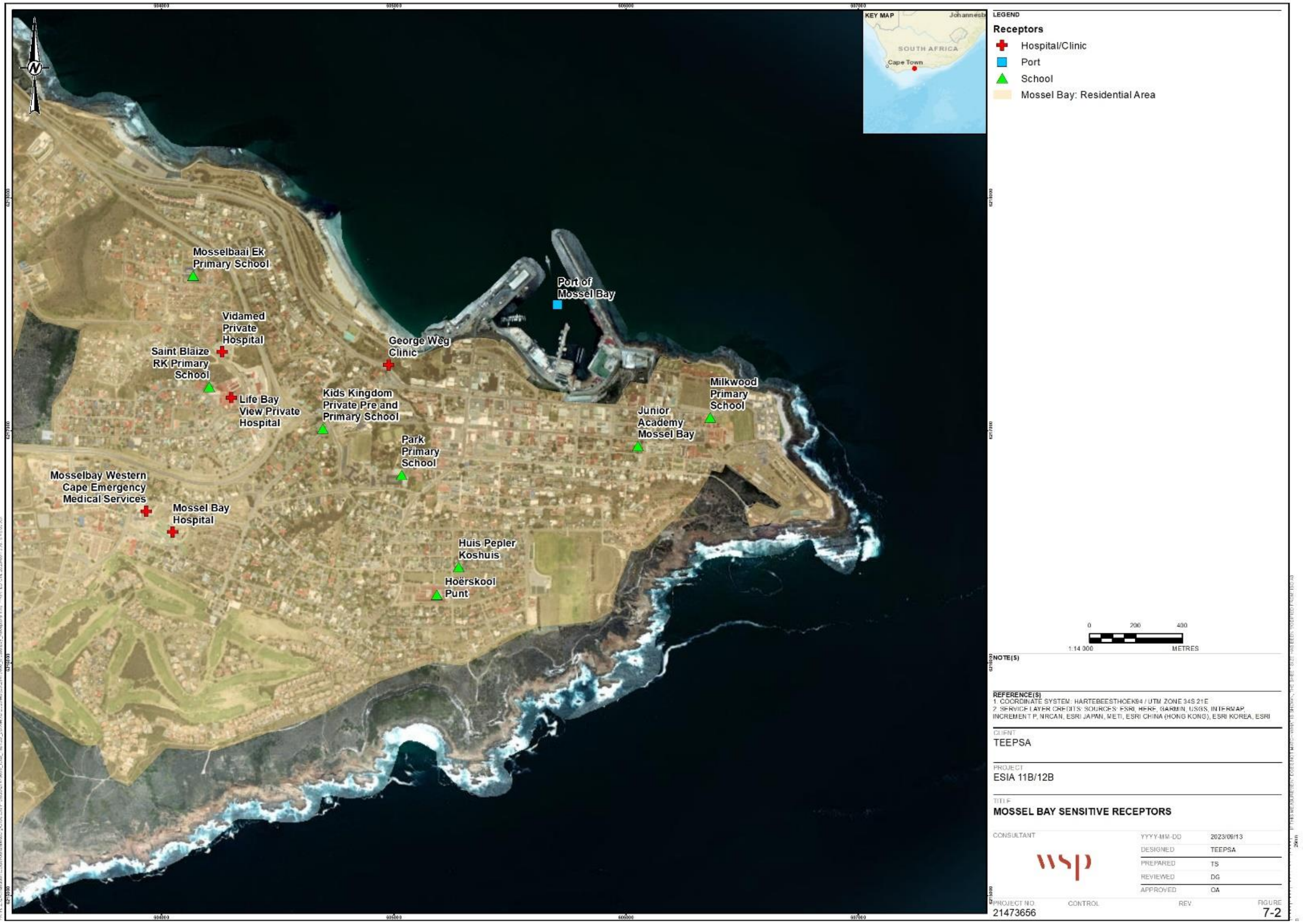


Figure 5-1: Mossel Bay Port location and nearby sensitive receptors

5.2 METEOROLOGICAL OVERVIEW

5.2.1 OFFSHORE CONDITIONS

The offshore conditions included was extracted from the Block 11B/12B Drilling ESIA Report based on local metocean data, using measurements, global hindcast models HYCOM (oceanography), CFSv2 (meteorology) and WW3 (wave conditions).

5.2.1.1 Air temperature

The maximum estimated air temperature in the Block 11B/12B production development area is 26.9°C (February), the minimum 8°C (August) and the annual average is 19°C. The monthly statistics of humidity show large variations from 31% (minimum) to 100% (maximum), with a mean humidity of approximately 77%.

5.2.1.2 Prevailing Winds

Westerly winds predominate along the South Coast in winter and in spring, whilst southerly wind directions increase markedly in summer, resulting in roughly similar strength/frequency of east and west winds during that season (Jury, 1994, in SLR, 2020). Winds with gale force strengths (winds >60 kilometres per hour (km/hr)) are most common during winter whilst calm conditions are characteristic of autumn. Wind-driven upwelling occurs in the nearshore, especially when easterly winds blow during summer.

Tides and wind-upwelling affect the sea-surface-temperatures (SST) and accordingly the land-sea interaction (micrometeorology) and onshore meteorological conditions.

5.2.1.3 Water temperature

The water temperature in the Block 11B/12B Project development area and in Mossel Bay are presented in **Table 5-1**.

Table 5-1: Minimum and maximum sea temperatures at different locations near the project development area

Area	Min and Max Temperature (°c)
Project development area	
Surface	16 - 28
Mossel Bay	
Surface	13 - 24

5.2.2 ONSHORE CONDITIONS (MOSSEL BAY)

Data was obtained from the South African Air Quality Information System (SAAQIS) from the Eskom owned and operated Gourikwa Station in Mossel Bay (Department of Forestry, Fisheries and the Environment, 2023). The 2020 calendar year data is presented in this section as this was the only year with meteorological data for this station. Data recovery during this period is presented in **Table 5-2**. Data recovery was slightly below the required minimum of 90% as stipulated by the South African Accreditation System (SANAS, 2012) TR 07-03. However, given the recovery is only marginally below this requirement, the data is considered representative of onshore meteorological conditions at Mossel Bay.

Table 5-2: Meteorological data recovery (2020)

Parameter	Data Recovery (%)
Ambient Temperature	86.9%
Wind Speed	87.5%
Wind Direction	87.6%

5.2.2.1 Air Temperature

Figure 5-2 presents the temperature summary for 2020. A maximum daily average temperature of 25°C (maximum of 35°C), a minimum daily average temperature of 9°C (minimum of 8°C), and a daily average temperature of 17°C was recorded in 2020.

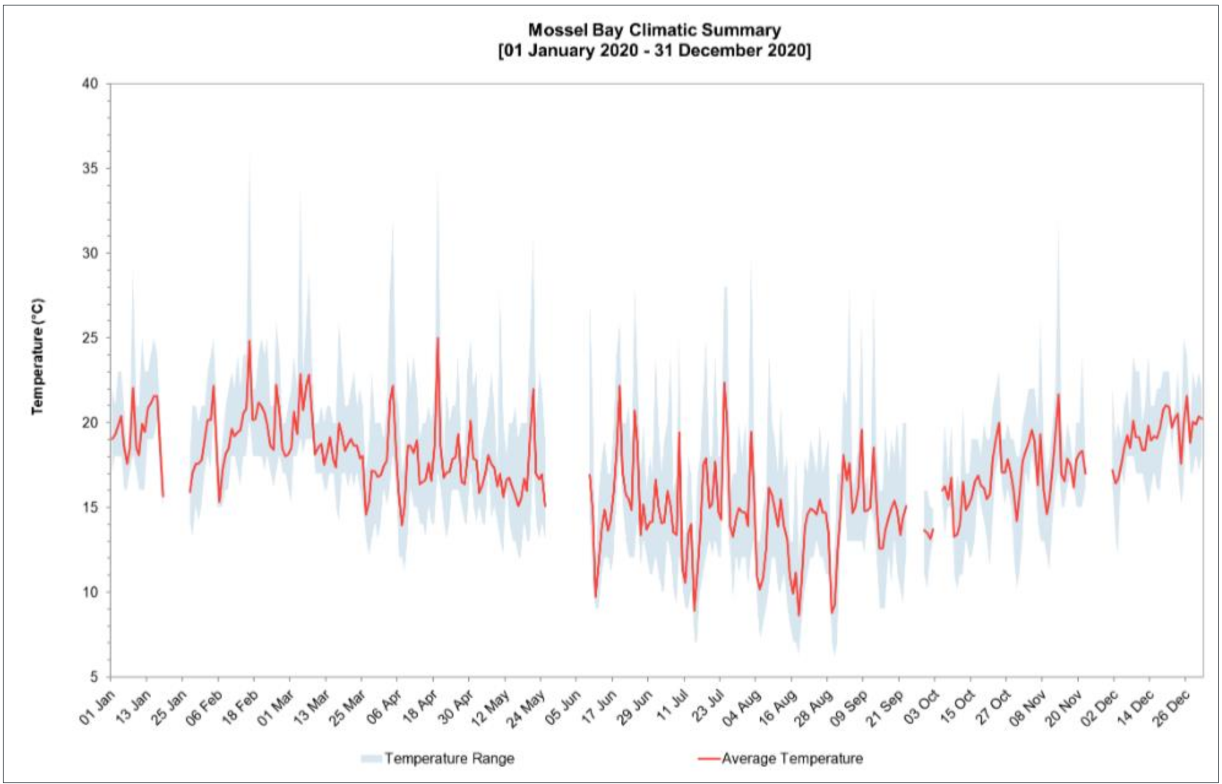


Figure 5-2: Mossel Bay ambient temperature (2020)

5.2.2.2 Prevailing Winds

Figure 5-3 presents the period (January – December 2020) surface wind rose, **Figure 5-4** presents the diurnal surface wind roses, while **Figure 5-5** presents the seasonal surface wind roses for Mossel Bay for 2020. From the 2020 dataset, the following key observations are noted:

- Winds originated predominantly from the southwest, northeast, and south. A maximum hourly wind speed of 5.5 m/s and an average hourly wind speed of 1.6 m/s was recorded. Calm conditions (wind speeds < 1.0 m/s) occurred 27.5% of the time.
- Diurnal trends indicate that south-westerly winds were predominant during the night (00:00 – 06:00) and morning (06:00 – 12:00). Southerly winds become dominant during the afternoon (12:00 – 18:00) as well as an increase in north-easterly winds occurring during this period. In the

evenings (18:00 – 24:00), south-westerly winds return as the predominant winds, with winds from the northeast continuing. The lowest frequency of calm conditions occurred during the afternoon (10.8%), while the highest frequency of calms conditions occurred during the evenings (38.3%).

- Seasonal trends in winds indicate that during spring and autumn, winds occur predominantly from the north-easterly, south-westerly and southerly sectors. During summer, winds occur predominantly from the north-easterly sector, while south-westerly winds are dominant during winter. The lowest frequency of calm conditions occurred during summer (20.2%), while the highest frequency of calm conditions occurred during autumn (37.7%).

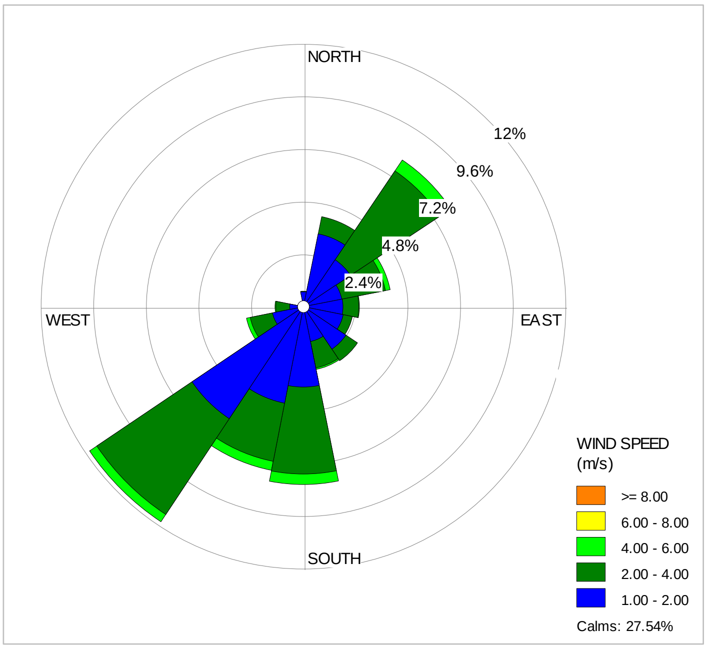
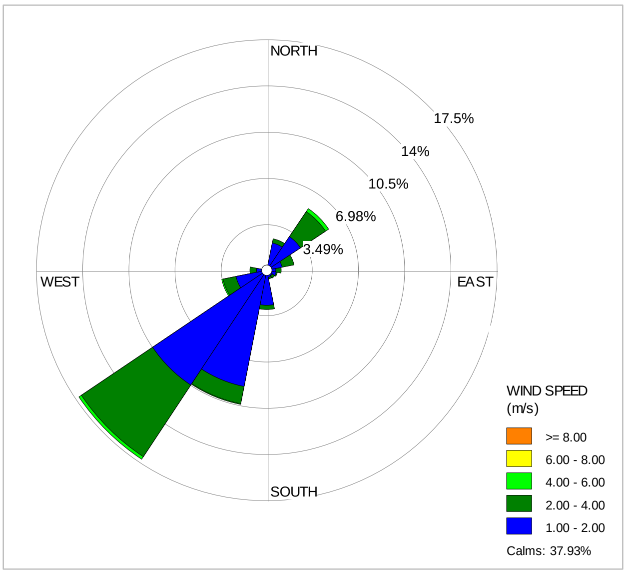
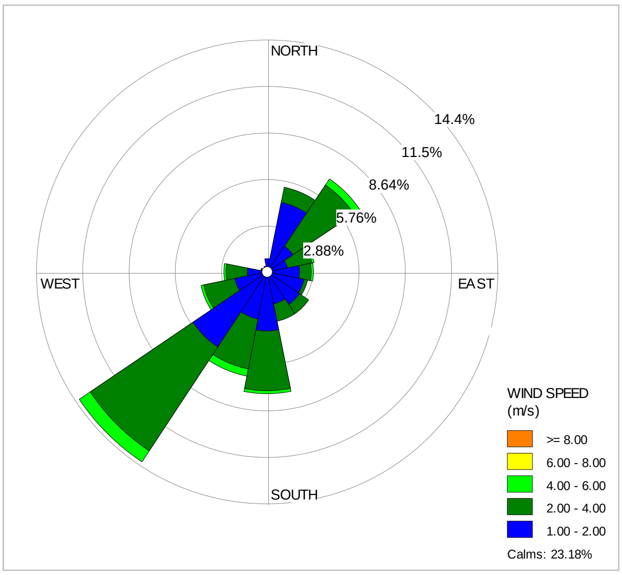


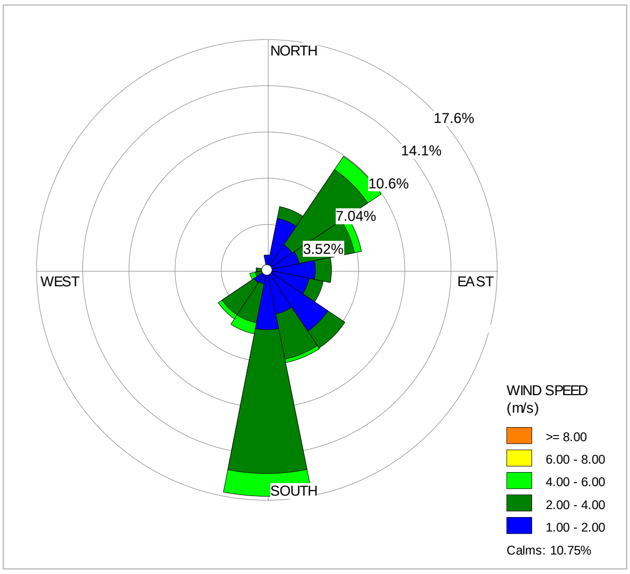
Figure 5-3: Mossel Bay period wind rose (2020)



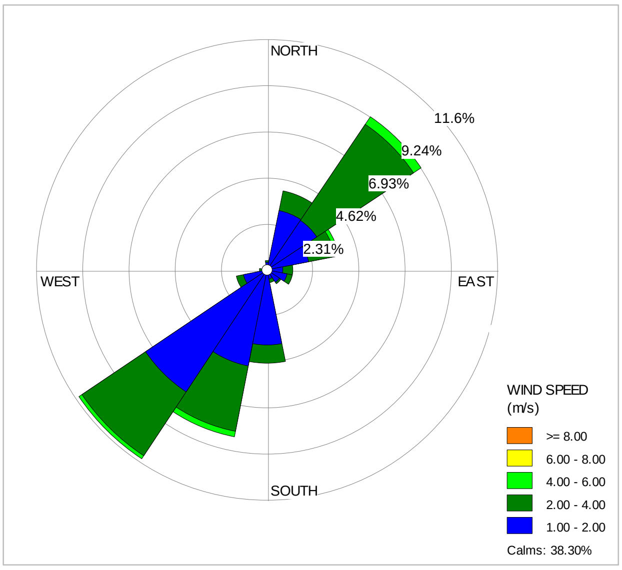
00:00 – 06:00



06:00 – 12:00

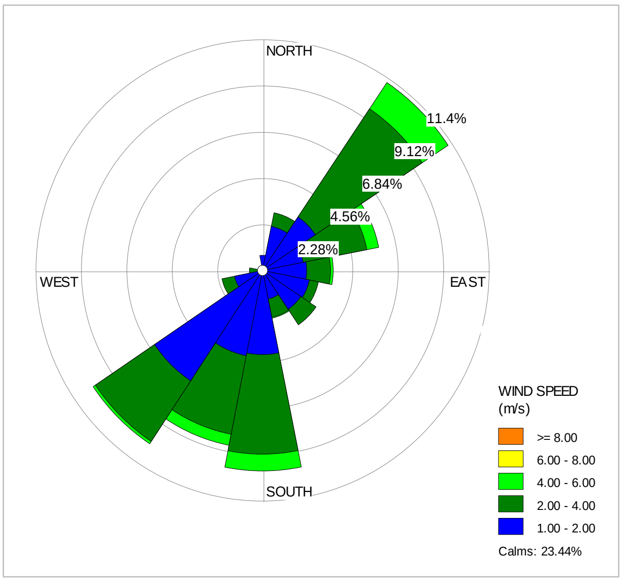


12:00 – 18:00

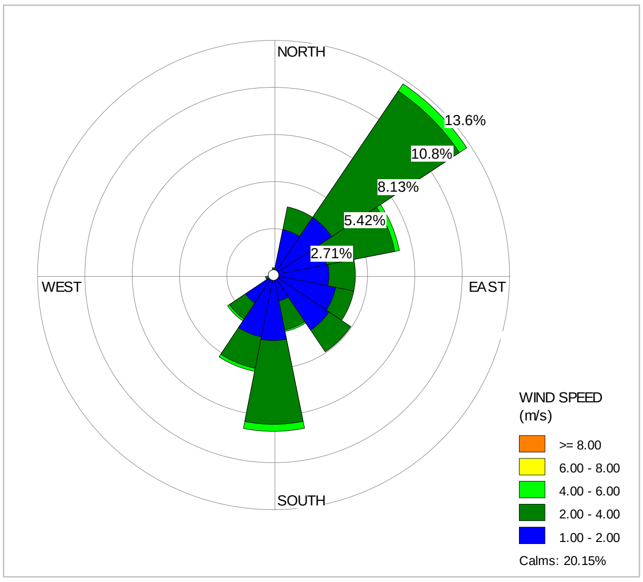


18:00 – 24:00

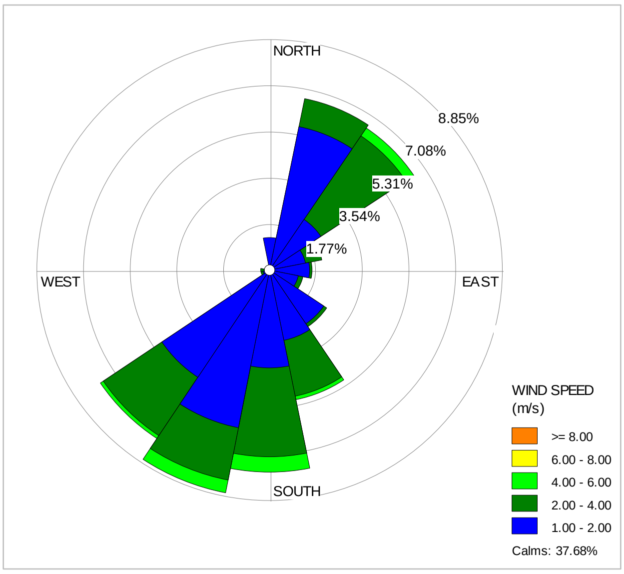
Figure 5-4: Mossel Bay diurnal wind roses (2020)



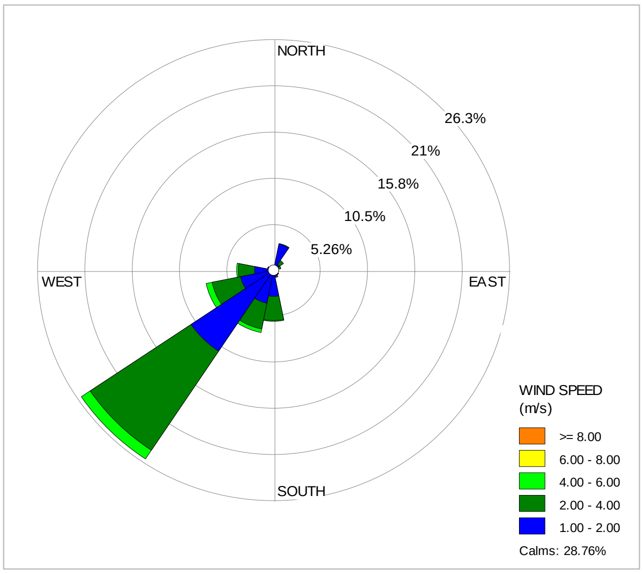
Spring



Summer



AUTUMN



WINTER

Figure 5-5: Mossel Bay seasonal wind roses (2020)

5.3 EXISTING AIR QUALITY SITUATION

5.3.1 EXISTING SOURCES OF EMISSIONS IN THE OPERATIONS AREA

Offshore, key contributors to ambient air pollutant concentrations include:

- Long-range transboundary transportation of pollutants through large scale weather systems. Key pollutants comprise CO, NO_x, PM, SO_2, and VOCs including Benzene (C_6H_6).
- Exhaust emissions from vessels in the area, with key pollutants comprising CO, NO_x, PM, SO_2, and VOCs including benzene.

- Offshore oil and gas exploration, extraction, and processing, with key emissions being CO, NO_x, PM, SO_2, and VOCs from flaring, vessels and drill rigs.
- Offshore combustion installations for operational maintenance and power generation with key pollutants comprising CO, NO_x, PM, SO_2, and VOCs including benzene.

Onshore, and within the ports and surrounding residential, and commercial areas there are several existing sources of atmospheric emissions. The main sources, based on land use types, are expected to be low-level mobile and stationary fugitive sources comprising:

- Storage and handling of fuel, mainly petroleum products, with the key pollutant being VOCs, including benzene.
- Railway yard operations emitting PM.
- Locomotive exhaust emissions comprising CO, NO_x, PM, SO_2, and VOCs including benzene.
- Offloading and loading of break-bulk, bulk, and other materials at the Port, emitting PM.
- Entrainment of fine materials by mobile equipment, with the key pollutant being PM.
- Entrainment of fine materials by vehicles along paved and unpaved roads, with the key pollutant being PM.
- Vehicle and other mobile equipment exhaust emissions emitting CO, NO_x, PM, SO_2, and VOCs.
- Ship (also referred to as vessels), vehicles and mobile equipment refuelling emitting VOCs, including benzene.
- Ship maintenance and repair including sandblasting or shotblasting, painting and hull repairs, emitting PM and VOCs, and possibly Lead (Pb).
- Ship hotelling resulting in generator exhaust emissions, with key pollutants being CO, NO_x, PM, SO_2, and VOCs.
- The erosion of unvegetated areas during incidents of high wind speeds, including coastal dunes, bare agricultural areas, construction areas, sports grounds, fine material stockpiles, unpaved roads, overgrazed areas. The key pollutant being PM.
- Residential fuel burning mostly in the lower income areas but also to a small extent in other residential areas and at isolated homesteads or farmsteads, with pollutants comprising CO, NO_x, PM and SO_2.
- Biomass burning, predominantly comprising agricultural burning and wildfires, with key pollutants being CO, NO_x, PM and SO_2.
- Agricultural activities including soil management, sewing, and harvesting, with key pollutants being PM, with smaller portions of HCs, SO_2, Nitrogen Monoxide (NO), Ammonia (NH_3), H_2S, and Ozone (O_3).

5.3.2 AMBIENT AIR QUALITY IN MOSSEL BAY

Although the shore base/logistics base will potentially be located at the ports of Mossel Bay, Gqeberha and/or Cape Town, the preferred and most likely port that support activities and equipment will operate from is Mossel Bay. Ambient data was available on the SAAQIS from the Eskom owned Gourikwa Station in Mossel Bay for the 2022 calendar year only (Department of Forestry, Fisheries and the Environment, 2023). This was the only data available for the Mossel Bay area near the port. The station information is provided in **Table 5-3** and the data availability and pollutant annual average concentrations are provided in **Table 5-4**. A minimum data recovery of

90% must be achieved to assess compliance as stipulated by SANAS (2012) in TR-03[1]. Data recovery for the monitoring periods was low (between 15.3% and 26.8%), well below this minimum requirement. Therefore, and despite being presented below, cannot be considered representative of air quality conditions in the Mossel Bay area.

Table 5-3: Station information

Station Name	Location	Longitude	Latitude	Target
Gourikwa	Corner of Marlin and Sampson Streets, GRDM offices	22.097439	-34.179158	Residential – low income

Table 5-4: Station data

Variable / Pollutant	PM_{10}	SO_2	NO_2
Availability	15.8%	26.8%	15.9%
Annual average concentration	40 µg/m³	5.07 µg/m³	1.68 µg/m³
NAAQS	40 µg/m³	50 µg/m³	40 µg/m³

[1] Supplementary Requirements for the Accreditation of Continuous Ambient Air Quality Monitoring Stations, Section 4.7

6 IMPACT OF EMISSIONS ON HUMAN HEALTH

The principal emissions emanating within Block 11B/12B, that can possibly reach the coast and at the Port(s) will be exhaust gas emissions produced by the combustion of fuel in vessel engines (including the drill unit), and helicopters. For exploration wells, flow testing may be undertaken to determine the economic potential of a discovery before the well is either abandoned or suspended. Flow testing will be required for each development well before connection to the subsea production system.

The onshore operations at the proposed laydown area are expected to make use of existing port infrastructure for any heating and power requirements. Based on available information, existing infrastructure does not comprise controlled emitters or listed activities as defined in NEM:AQA.

Although the PetroSA operated F-A Platform as an associated facility is not the focus of this assessment and will be subject to separate permitting processes, an indicative assessment of production related emissions from the F-A Platform is provided. The quantity of gas combusted for generators, heaters, and engines (referred to as gas auto consumption) at the PetroSA F-A Platform have been provided, as well as the amount of process gas routinely flared. Importantly, the F-A Platform activities do not form part of TEEPSA activities and are only associated with the production phase of the project.

6.1 EMISSIONS INVENTORY

An **emissions inventory** is a list of air pollution sources, including their physical and chemical parameters.

Emission factors are used to estimate emissions where actual emission data is not available. In most cases, these factors are averages of available data of acceptable quality and are generally assumed to be representative of averages for all facilities in the source category. An emission factor is a value representing the relationship between an activity and the rate of emissions of a specified pollutant. Emission factors are always expressed as a function of the weight, volume, distance, or duration of the activity emitting the pollutant. The general equation used for the estimation of emissions is:

$$E = A \times EF \times \left(1 - \frac{ER}{100}\right)$$ **Equation 6-1**

where:

E = emission rate

A = activity rate

EF = emission factor

ER = overall emission reduction efficiency (%)

For the Project, there are several years that have multiple activity phases taking place simultaneously; these have been selected as key focusses for this assessment, in addition to years having a single activity phase mainly during the production phase and decommissioning. Nevertheless, the design of the scenarios, linked to certain years, are indicative only, with those activities potentially occurring in another year within the project lifecycle.

Except for exploration, assessed separately, the following years have been selected to assess the Project potential direct impacts on air quality and indirect impact on human health:

- Exploration activities comprising 1 exploration well as a standalone operation, which may occur in any year of the Project.
- Year 0 comprising construction activities (including 2 development wells).
- Year 1 comprising 1 development well and production support activities.
  - A second Year 1 scenario was also assessed, as described above, with the inclusion of F-A Platform associated facility emissions, which represents a cumulative scenario.
- Years 2 to 9 and 11 to 25 comprising production support activities.
  - A second Year 12, worst-case production year scenario was also assessed, as described above, with the inclusion of F-A Platform associated facility emissions, which represents a cumulative scenario.
- Year 10, comprising 2 development wells, marginal construction, production support activities.
  - A second Year 10 scenario was also assessed, as described above, with the inclusion of F-A Platform associated facility emissions, which represents a cumulative scenario.
- Year 26 comprising of decommissioning operations.
- A “worst-case” Year 10 scenario was also assessed, comprising 2 development wells, marginal construction, production support activities, and exploration activities (1 exploration well). The exploration operations can occur in any year and the “worst-case” direct impact on air quality would need to be considered in the study. Year 10 was selected as it is the operational year with the largest direct impact on air quality.
  - A second “worst case” Year 10 scenario was also assessed, as described above, with the inclusion of F-A Platform, which represents a cumulative scenario for the worst-case possible year within the project lifecycle.

Drill units and helicopters will only be operational during exploration, development drilling, and decommissioning. Various support and specialised vessels will be operational throughout the Project lifetime.

In addition to the operation of the vessel main and auxiliary engines in the port (excluding drill units and associated tugboats), generators will be operational to produce electricity and heating while the engines are not operating at full capacity/load.

During exploration well testing, flaring will occur, comprising substances of condensate, dry gas, and potentially trace amounts of oils used in the drilling process. During production well testing, flaring will occur, comprising of natural gas and associated gas.

The vessels (excluding drill units and tugboats) operating as support vessels for the Project would need to **return to port** where their operation will result in emissions contributing to existing baseline conditions in the vicinity. For vessel engine fuel use, the fuel use split and engine operating percentage discussed below was used to estimate emissions. During hotelling and manoeuvring the NPI suggest that for boilers / generators used during hotelling, if the fuel use is unknown, fuel consumption of 0.0125 tonnes/hour (t/h) should be used. In-port activities for which emissions were calculated include:

- Manoeuvring into port or into a position where they can be towed to port.
  - In the estimation of manoeuvring emissions, the widely used "Ship Emissions Inventory Mediterranean Sea Report for CONCAWE" indicates that 20% main engine power and 50% auxiliary engine power be applied.
  - Since the main engine and auxiliary engine details are unknown, it was assumed that the fuel usage is a split of 2/3 usage for the main engine and 1/3 for the auxiliary engines based on the engine power/fuel use ratio of various vessel with cargo carrying capabilities.
    - Based on this split an average operating fuel use percentage of 30% was applied.
  - Vessel's manoeuvring was assumed to be carried out for 1 hour.
- Hotelling, during which time the vessels use their auxiliary engines and boilers or generators to generate electric power for the ship:
  - The vessels residence period at port was provided as 2 to 3 days, to estimate worst-case, 3 days were used.
  - It was assumed 15 minutes for docking or undocking.

The emissions inventory was developed using available project information, emission (and reporting) factors developed by reputable international environmental bodies, publicly available information for similar operations, and technical (manufacturer) specifications for equipment. Emission factors were used to estimate both particulate and gaseous emissions. The emission estimation techniques and input variables used to quantify emissions from the Project and F-A Platform sources are presented in **Table 6-1**. Various sources of literature were consulted to identify the most appropriate emission factors.

The estimated emission rates are displayed in **Table 6-3** (offshore operations) and **Table 6-4** (port operations).

Table 6-1: Emissions calculation methods and input data

Source Group	Source Description	Emission Equation / Emission Factor	Parameters Used
Offshore and Port			
Vessels (including drill unit)	Combustion of marine fuel in main and auxiliary engines	The emission factors in kilograms per tonne (**kg/tonne**) of fuel from the EMEP/EEC air pollutant emission inventory guidebook 2019[(a)], Table 0-1 Tier 1 emission factors for ships using bunker fuel oil (1.A.3.d.i /1.A.3.d.ii): EF_{CO} = 3.67 EF_{NOx} = 69.1 $EF_{PM(10)}$ = 5.2 EF_{SO2} = 20*S(sulphur) EF_{VOCs} = 1.67 Assumed $EF_{benzene}$ = VOCs * benzene content of liquid fuel	▪ Marine fuel use provided by TEEPSA in tonnes per day (t/d) and the number of operational days (see Table 6-2). ▪ Sulphur content of 0.5% for marine fuel. TEEPSA will require contractors to use fuel of < 0.5%. ▪ Assumed benzene content of 0.1%, as a worst case, since MARPOL Annex I requires marine fuel to be <0.1% otherwise this must be listed on Safety Data Sheet (SDS). None of the SDSs publicly available for the South African suppliers of marine fuel / bunker oils provide benzene content. ▪ Vessel trips to port as per those provided for generators. **Note**: Survey vessel emissions were estimated but modelling was not conducted for these vessels.
Offshore			
Helicopters	Combustion of kerosene fuel in engines	The emission factors in **kg/tonne** of fuel from the EMEP/EEC air pollutant emission inventory guidebook 2019[(a)]: EF_{CO} = 9.7 EF_{NOx} = 66.4 EF_{SO2} = 1 EF_{VOCs} = 5.8 Assumed $EF_{benzene}$ = VOCs * benzene content of liquid fuel.	▪ Kerosene use provided by TEEPSA in t/d and the number of operational days (see Table 6-2). ▪ Assumed benzene content of 0.02% based on a report compiled by P P Egeghy, L Hauf-Cabalo, R Gibson, S M Rappaport titled "Benzene and naphthalene in air and breath as indicators of exposure to jet fuel" which considered kerosene benzene content for a variety of producers/suppliers. **Note**: Helicopter emissions were estimated but modelling was not conducted.

Source Group	Source Description	Emission Equation / Emission Factor	Parameters Used
Flaring	Gas flaring during Exploration well testing	The emission factors in **lb/MMBTU** from the 1983 Flare Efficiency Study[b]: EF_{CO} = 2.76E-01 EF_{NOx} = 1.38E-01 EF_{SO2} = 2*S(Sulphur) EF_{VOCs} = 1.40E-01 - Gas conversion factor for lb/MMBTU to pounds per standard cubic feet (lb/Scf) of 1,020 from the US EPA EETM[f]. - 1 lb = 454 g. Assumed $EF_{benzene}$ = VOCs * benzene portion of VOCs in gas composition, units in **lb/MMBtu**. The emission factors in grams per standard cubic metres (**g/Sm³**) from the Norwegian Oil and Gas Association's (Norsk Olje & Gas; NOROG)[c] guidance used for Norway's emissions reporting factor (referenced in the EMEP/EEC air pollutant emission inventory guidebook 2019[d]): $EF_{PM(10)}$ = 5.2	- Quantity of flared gas: 900 000 m³/day. - TEEPSA provided 1 event per year per well, with 3-4 days of flaring per event. Worst-case of 4 days of flaring per event was used to estimate the annual emissions for one. - Sulphur content based on 0.7 ppm H_2S, upper limit of H_2S content provided by TEEPSA (0.6-0.7 ppm). - Flared gas composition was not available. In the absence of the benzene content, the flared (process) gas composition provided by TEEPSA was used.
	Associated gas flaring during development well testing		- Quantity of flared gas per year provided by TEEPSA. - Assumed 2 events per year per well, with 5 days of flaring per event to determine the gas flared per day resulting in 1.915 million standard cubic metres per day (MMSm³/day) of associated gas. - Sulphur content based on 0.7 ppm H_2S, exploration block upper limit of H_2S content (0.6-0.7 ppm), as a conservative approach. - Flared associated gas composition was not available. In the absence of the benzene content, the flared (process) gas composition provided by TEEPSA was used.
	Natural gas flaring during development well testing	The emission factors in **lb/MMBTU** from the 1983 Flare Efficiency Study[b]: EF_{CO} = 2.76E-01 EF_{NOx} = 1.38E-01 EF_{SO2} = 2*S(Sulphur)	- Quantity of flared gas per year provided by TEEPSA. - Assumed 2 events per year per well, with 5 days of flaring per event to determine the gas flared per day resulting in 2.15 MMSm³/day of natural gas. - Flared (process) gas composition provided by TEEPSA, assumed the natural gas flared will be very similar.

Source Group	Source Description	Emission Equation / Emission Factor	Parameters Used
	Process Gas flaring at F-A Platform	▪ Gas conversion factor for lb/MMBTU to lb/Scf of 1,020 from the US EPA EETM(f). ▪ 1 lb = 454 g. The emission factors in **g/Sm³** from the Norwegian Oil and Gas Association's (Norsk Olje & Gas; NOROG)(c) guidance used for Norway's emissions reporting factor (referenced in the EMEP/EEC air pollutant emission inventory guidebook 2019(d)): $EF_{PM(10)}$ = 5.2 Adaptation of the emission equation from the Australian NPI EETM for Oil and Extraction and Production(e): $EF_{VOCs/benzene} = \frac{mass_{vocs/benzene}}{volume_{gas}} * \left(1 - \frac{DE}{100}\right)$ Where DE = destruction efficiency (%)	▪ Quantity of flared gas: 662 standard cubic metres per hour (Sm^3/h). ▪ Operational days per year provided by TEEPSA. Indicated as being routine flaring, occurring 24 hours per day. ▪ Sulphur content based on 0.7 ppm H_2S, exploration block upper limit of H_2S content (0.6-0.7 ppm), as a conservative approach. ▪ Flared (process) gas composition provided by TEEPSA.
Engines (gas auto consumption)	Combustion of gas in generators, turbines and / or heaters at F-A Platform	The emission factors in **lb/MMBTU** from the US EPA AP-42 Stationary Gas Turbines EETM(f): EF_{CO} = 8.2 E-02 EF_{NOx} = 3.10 E-01 EF_{PM} = 6.60 E-03 EF_{SO2} = 0.94*(S)ulphur EF_{VOCs} = 2.10E-03 $EF_{benzene}$ = 1.20E-05 ▪ Gas conversion factor for lb/MMBTU to lb/Scf of 1,020 from the US EPA EETM(f).	▪ Gas auto consumption in Sm³ per hour provided by TEEPSA. Varies per year. ▪ Operational days per year provided by TEEPSA. Indicated as being routine operations, occurring 24 hours per day. ▪ Sulphur content based on 0.7 ppm H_2S, exploration block upper limit of H_2S content (0.6-0.7 ppm), as a conservative approach.

Source Group	Source Description	Emission Equation / Emission Factor	Parameters Used
		▪ 1 lb = 454 g.	
Port			
Generators	Combustion of diesel in generators	The emission factors in **kilograms per kilolitre (kg/kl)** for "External combustion boilers - distillate oil residual" from the EMEP/EEU guidebook 2019 based on the US EPA AP-42 EETM[(g)]: EF_{CO} = 0.6 EF_{NOx} = 2.4 EF_{PM} = 0.24 EF_{SO2} = 0.1704 EF_{VOCs} = 0.06672 Assumed $EF_{benzene}$ = VOCs * benzene content of liquid fuel.	▪ NPI suggests 0.0125 tonnes/hour fuel consumption if unknown. ▪ Density of diesel of 0.845 kg/l from the South African technical guidelines for estimating greenhouse gases emissions. ▪ Assumed benzene content of 0.02%. ▪ Where there are two or more vessels of a specific type for an operational phase, e.g., 2 x supply vessels supporting well drilling, these are operating on a rotational basis and the two (or more) will never be operational simultaneously. ▪ Residence time in port = 2 to 3 days, conservatively used 3 days. ▪ Trips to port per vessel type and operational phase: • Well development (and exploration well drilling) - one trip per week for support vessels. • Construction vessels - one trip every four weeks. • Production support (maintenance and inspection) vessels - one trip every two weeks. • Decommissioning vessels - one trip per week.

Notes:

(a) European Monitoring and Evaluation Programme (EMEP)/European Environment Agency (EEA) Emission Factor Guidebook for "international maritime and inland navigation, national navigation, national fishing, recreational boats International maritime navigation, international inland navigation, national navigation (shipping), national fishing".
(b) McDaniel, M. (1983, July). Flare Efficiency Study, EPA-600 / 2-83-052. Engineering-Science, Inc. Austin: United States Environmental Protection Agency.
(c) OLF (2012): Veiledning til den Årlige Utslippsrapporteringen. Gjelder: Klifs TA 2718 "Retningslinjer for rapportering fra petroleumsvirksomhet til havs" & Statens strålevern "Retningslinjer for årlig rapportering av utslipp fra petroleumsvirksomhet. Stavanger, January 8th, 2012. (in Norwegian).
(d) EMEP/ EEA Emission Factor Guidebook for "1.B.2.c Venting and flaring", Table 3-3 Tier 2 emission factors for source category 1.B.2.c Venting and flaring, well testing (090206 flaring in gas and oil extraction).
(e) Department of Sustainability, Environment, Water, Population and Communities. (2013). National Pollutant Inventory (NPi): Emission estimation technique manual for Oil and Gas Extraction and Production Version 2.0. Cranberra: Australian Government.
(f) US EPA (2000). AP 42, Chapter 3: Stationary Internal Combustion Sources, 3.1 Stationary Gas Turbines.
(g) US EPA (2010). AP 42, Chapter 1: External Combustion Sources, 1.3 Fuel Oil Combustion.

Table 6-2: Marine fuel and kerosene consumption

Phase	Period of the project	Source	Quantity in t/d	Days	Consumption of marine fuel (tonnes)	Kerosene consumption (tonnes)
Exploration						
Well Drilling (EXPLO) - 1 Well	NA	1 x Drilling unit	88.5	120	10,620	-
		1 x Tugboat	28.3	120	3,398	-
		2 x Supply vessels*	15.9	120	1,912	-
		Helicopter (2 trips/day)	1.30	120	-	156
		Total			***15,930***	***156***
Surveys						
Survey	NA	1 x survey vessel	17.7	30	531	-
		Total			***531***	**-**
Development						
Well Drilling (DEV) - 5 wells	Year 0 (226 days) And Year 1 (113 days)	1 x Drilling unit	88.5	339	30,002	-
		1 x Tugboat	28.3	339	9,600	-
		2 x Supply vessels*	15.9	339	5,400	-
		Helicopter (2 trips/day)	1.30	339	-	441
	Year 10 (250 days)	1 x Drilling unit	88.5	250	22,125	-
		1 x Tugboat	35.4	250	8,850	-
		2 x Supply vessels*	17.7	250	4,425	-
		Helicopter (2 trips/day)	1.3	250	-	325
	Year 0, 1 and 10	***Total***			***80,402***	***766***
Construction	Year 0 And Year 10	3 x Large FSV (Y0)**	28.3	221	6,259	-
		2 x FSV (Y0)**	17.7	307	5,434	-
		2 x Large FSV (Y10)**	28.3	94	2,662	-
		1 x FSV (Y10)	17.7	30	531	-

Phase	Period of the project	Source	Quantity in t/d	Days	Consumption of marine fuel (tonnes)	Kerosene consumption (tonnes)
		Total			***14,886***	-
Production	Year 1 to 25***	1 x Supply vessel	8.85	9,131	80,809	-
		Total			***80,809***	-
Decommissioning	Year 26	1 x Drilling unit	88.5	100	8,850	-
		2 x Tugboat/Large FSV*	56.6	100	5,664	-
		2 x Supply vessels*	15.9	100	1,593	-
		Helicopter (1 trip/day)	0.65	100	-	65.0
		Total			***16,107***	***65.0***
Development	**Years 0 to 26**	**Total**			**192,204**	**831**

Notes:

Vessel fuel Conversion factor from m³ to tonnes = 0.885

* Consumption for 2 vessels

** Cumulative days in no. units

***A full year is 365 or 366 days (each 4 years)

Table 6-3: Emission rates for offshore operations

Source	Fuel use (t/yr) / gas combusted (scf/yr)	Emission Rate (t/yr)					
		CO	NO_x	PM	SO_2	VOC	Benzene
Offshore Surveys							
All survey vessels engines	531	1.95	36.7	2.76	5.31	0.887	8.87E-04
Total		**1.95**	**36.7**	**2.76**	**5.31**	**0.887**	**8.87E-04**
Exploration (1 well)							
All vessels engines (including drill unit)	15,930	58.5	1,101	82.8	159	26.6	0.03
Helicopter	156	1.51	10.4	-	0.156	0.905	1.81E-04
Flaring (well test)	134,125,325	17.1	8.56	0.213	0.006	8.69	0.036
Total		**77.1**	**1,119**	**83.0**	**160**	**36.2**	**0.063**
Year 0 (drilling 2 wells and Construction)							
All vessels engines (including drill unit)	41,694	153	2,881	217	417	69.6	0.070
Helicopter	294	2.85	19.5	-	0.29	1.70	3.41E-04
Flaring (well test)	1,352,292,961 (associated gas)	172	86.3	2.14	0.063	87.6	0.364
	1,518,533,168 (natural gas)	194	97.0	2.41	0.070	1.49	0.619
Total		***522***	***3,084***	***221***	***417***	***160***	***1.05***
Year 1 (drilling 1 well and TEEPSA operations only)							
All vessels engines (including drill unit)	18,231	66.9	1,260	94.8	182	30.4	0.030
Helicopter	147	1.42	9.75	-	0.147	0.852	1.70E-04
Flaring (well test)	676,146,481 (associated gas)	86.2	43.2	1.07	0.031	43.8	0.182
	759,266,584 (natural gas)	96.8	48.5	1.20	0.035	0.745	0.309
Total		***251***	***1,361***	***97.1***	***183***	***75.8***	***0.522***
Year 2 – 9 & 11 – 25 (TEEPSA operations only) – leap year worst case							
All vessels engines	3239	11.9	224	16.8	32.4	5.41	0.005
Total		***11.9***	***224***	***16.8***	***32.4***	***5.41***	***0.005***

Source	Fuel use (t/yr) / gas combusted (scf/yr)	Emission Rate (t/yr)					
		CO	NO_x	PM	SO_2	VOC	Benzene
Year 10 (construction, drilling 2 wells and TEEPSA operations only)							
All vessels engines (including drill unit)	41 823	153	2,890	217	418	69.8	0.070
Helicopter	325	3.15	21.6	-	0.325	1.89	3.77E-04
Flaring (well test)	1,352,292,961 (associated gas)	172	86.3	2.14	0.063	87.6	0.364
	1,518,533,168 (natural gas)	194	97.0	2.41	0.070	1.49	0.619
Total		***523***	***3,095***	***222***	***419***	***161***	***1.05***
Year 26							
All Vessels Engines	16,107	59.1	1,113	83.8	161	26.9	0.027
Helicopter	65.0	0.631	4.32	-	0.065	0.377	7.54E-05
Total		***59.7***	***1,117***	***83.8***	***161***	***27.3***	***0.027***
F-A Platform Year 1 (365 days)							
Process Flaring	204,794,327	26.1	13.1	0.325	0.009	57.4	23.8
Heaters and Engines	2,409,006,187	93.2	352	7.50	0.070	2.39	0.014
Total		**119**	**365**	**7.82**	**0.080**	**59.8**	**23.9**
F-A Platform Year 10 (365 days)							
Process Flaring	204,794,327	26.1	13.1	0.325	0.009	57.4	23.8
Heaters and Engines	2,445,507,218	94.6	358	7.61	0.071	2.42	0.014
Total		***121***	***371***	***7.94***	***0.081***	***59.8***	***23.9***
F-A Platform Year 12 (366 days)							
Process Flaring	205,355,407	26.2	13.1	0.326	0.010	57.6	23.9
Heaters and Engines	2,488,808,272	96.3	364	7.75	0.073	2.47	0.014
Total		***122***	***377***	***8.07***	***0.082***	***60.0***	***23.9***

Table 6-4: Emission rates for port operations

Source	Fuel Use at Port (t/yr)	Emission Rate (t/yr)					
		CO	NOx	PM	SO_2	VOCs	Benzene
Year 0							
Hotelling	46.0	0.033	0.131	0.013	0.009	0.004	7.27E-07
Manoeuvring	5.36	0.020	0.370	0.028	0.054	0.009	8.95E-06
Year 1							
Hotelling	38.0	0.027	0.108	0.011	0.008	0.003	6.00E-07
Manoeuvring	4.49	0.016	0.310	0.023	0.045	0.008	7.50E-06
Year 2 – 9 & 11 – 25							
Hotelling	23.5	0.017	0.067	0.007	0.005	0.002	3.71E-07
Manoeuvring	2.88	0.011	0.199	0.015	0.029	0.005	4.82E-06
Year 10							
Hotelling	59.6	0.042	0.169	0.017	0.012	0.005	9.41E-07
Manoeuvring	7.67	0.028	0.530	0.040	0.077	0.013	1.28E-05
Year 26							
Hotelling	25.7	0.018	0.073	0.007	0.005	0.002	4.06E-07
Manoeuvring	6.48	0.024	0.448	0.034	0.065	0.011	1.08E-05

6.2 MODELLING PREDICTIONS

6.2.1 OFFSHORE OPERATIONS

The following modelling predictions present the maximum concentration likely to occur at a certain distance from source and have been compared to the NAAQS limit concentrations. The model provides 1-hour maximum concentration predictions, and where 24-hour or 1-year averages are required for comparison against the NAAQS, factors have been applied to the predictions, as per the guidance of the dispersion modelling regulations. As noted previously, model predictions must be viewed recognising the distances activities occur offshore. These distances are:

- 160 km from the coast to the northern boundary of the development area (western block) (**Figure 6-1**).
- 85 km from the coast to the exploration area (eastern block) (**Figure 6-1**).
- 160 km from coast to the eastern side of the development area (western block) and western side of the exploration area (eastern block); where the activities associated with the "worst-case" Year 10 scenario could occur.
- 70 km from the coast to the PetroSA F-A Platform. F-A platform contributions to cumulative concentrations begins at 90 km from the Block 11B/12B sources i.e., F-A Platform 0 km concentrations are added to Block 11B/12B concentrations, 10 km F-A Platform concentrations to 100 km Block 11B/12B concentrations and so forth.

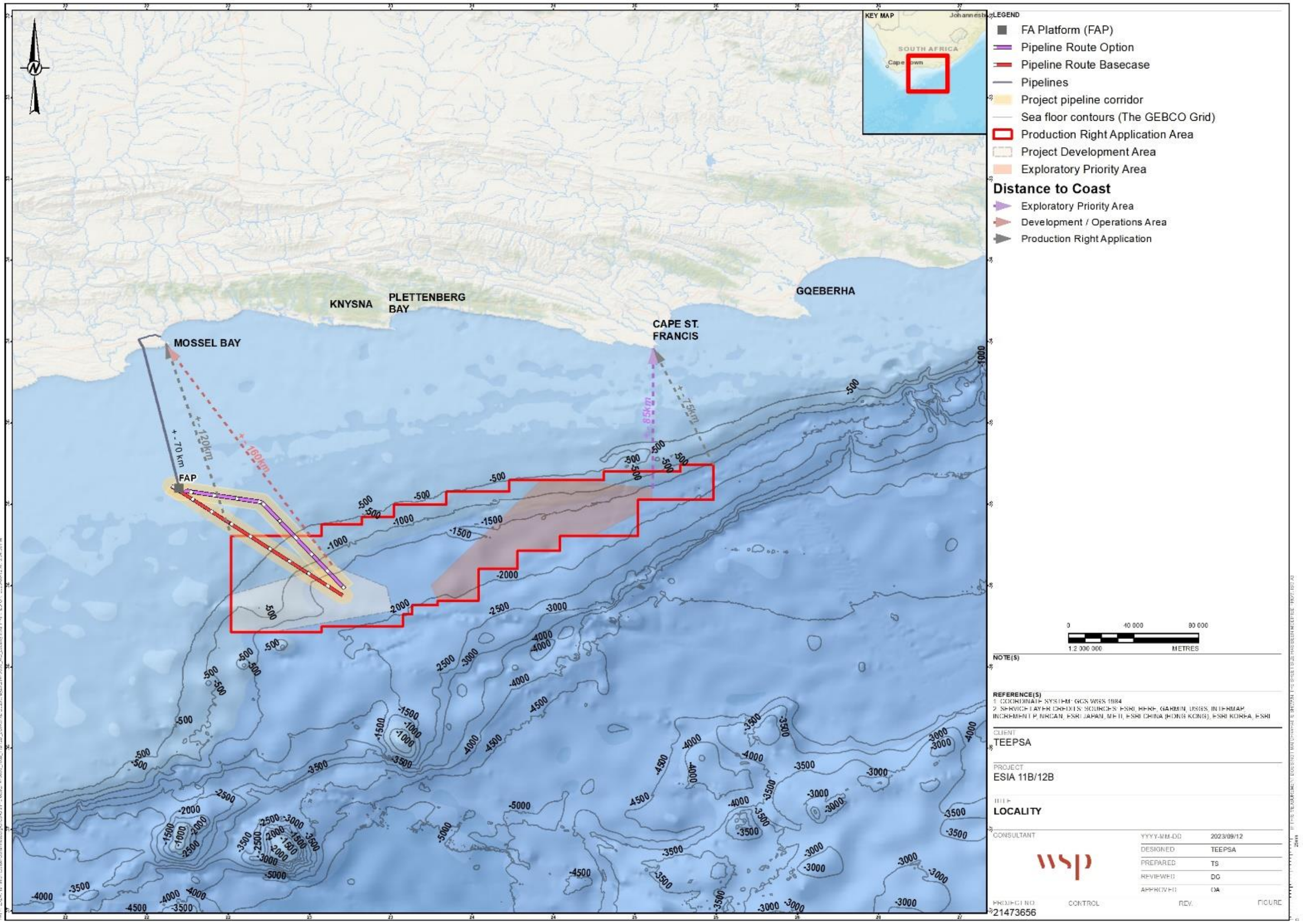


Figure 6-1: Project locality map

6.2.1.1 Carbon Monoxide Concentrations

Predicted 1-hour concentrations at select distances from a point of release are provided in **Table 6-5**. The NAAQS 1-hour limit concentration for CO is of 30,000 µg/m³. The NAAQS allows for 88 exceedances of the limit in a calendar year. The following key findings are highlighted:

Exploration:

- The closest edge of the exploration area is 85 km from shore.
- 1-hour concentrations are predicted to be well below the concentration limit (30,000 µg/m³) and no exceedance of the NAAQS is anticipated, inclusive of onshore and offshore locations.
- The maximum onshore concentration predicted is 15.5 µg/m³, remaining well below the NAAQS.

Year 0 (Construction including well development):

- The closest edge of the development area is 160 km from shore.
- All 1-hour concentrations are predicted to remain well below the NAAQS, inclusive of onshore and offshore locations.
- The maximum onshore concentration predicted is 1.19 µg/m³, remaining well below the NAAQS.

Year 1 (Well development and production support vessels i.e., TEEPSA only):

- The closest edge of the development area is 160 km from shore.
- All 1-hour concentrations are predicted to remain well below the NAAQS, inclusive of onshore and offshore locations.
- The maximum onshore concentration predicted is 0.447 µg/m³, remaining well below the NAAQS.

Year 2 to 9 and 11 to 25 (Project operations i.e., TEEPSA only):

- The closest edge of the development area is 160 km from shore.
- All 1-hour concentrations are predicted to remain well below the NAAQS, inclusive of onshore and offshore locations.
- The onshore concentration predicted is 0.017 µg/m³, remaining well below the NAAQS.

Year 10 (Well development, limited construction, production support vessels i.e., TEEPSA only)

- The closest edge of the development area is 160 km from shore.
- All onshore 1-hour concentrations remain well below the NAAQS (30,000 µg/m³), with a maximum concentration of 1.23 µg/m³ predicted.

Year 26 (Decommissioning).

- The closest edge of the development area is 160 km from shore.
- All 1-hour concentrations are predicted to remain well below the NAAQS, inclusive of onshore and offshore locations.
- The onshore concentration predicted is 0.262 µg/m³, remaining well below the NAAQS.

Year 10 with exploration (Well development, limited construction, production support vessels, and exploration i.e., TEEPSA only)

- The distance where the development area and exploration area are closest is 160 km from shore.
- All onshore 1-hour concentrations remain well below the NAAQS (30,000 µg/m³), with a maximum onshore concentration of 1.68 µg/m³ predicted.

Table 6-5: Onshore 1-Hour peak CO concentrations due to offshore operations (µg/m^3)

Distance from Source (km)	Exploration	Year 0	Year 1[(a)]	Year 2 – 9 & 11-25[(a)]	Year 10[(a)]	Year 26	Year 10[(a)] with exploration
85	15.5	n/a	n/a	n/a	n/a	n/a	n/a
160	0.458	1.19	0.447	0.017	1.23	0.262	1.68

Notes:
Concentrations presented in µg/m^3.
Comparison made against the 1-hour NAAQS for CO of 30,000µg/m^3.
(a) Project operations only i.e., TEEPSA only, and excludes associated assets e.g., F-A Platform production.

6.2.1.2 Nitrogen Dioxide Concentrations

Predicted 1-hour and annual average NO_2 concentrations at select distances from a point of release are provided in **Table 6-6**. The NAAQS 1-hour limit concentration for NO_2 is 200 µg/m^3. The NAAQS allows for 88 exceedances of the limit in a calendar year. The NAAQS annual average concentration for NO_2 is 40 µg/m^3. The following key findings are highlighted:

Exploration:

- The closest exploration could occur to the shore is 85 km. All 1-hour onshore concentrations are predicted to remain well below the NAAQS.
- The predicted maximum onshore (85 km) 1-hour concentration is 26.6 µg/m^3, with an annual average concentration of 2.12 µg/m^3.
- 1-Hour offshore concentrations are predicted to exceed the NO_2 NAAQS concentration limit (200 µg/m^3) to an extent of approximately 5 km from the point of release, while annual average concentrations are predicted to exceed the NAAQS (40 µg/m^3) to approximately 1 km from the point of release.
- Importantly, the NAAQS are designed for human health impacts, and specifically relates to residents' exposure to certain pollutants on a long-term, consistent basis. This will not be the case 85km offshore, with individuals exposed comprising those working at the offshore operations, in which case the Occupational Exposure Limits (OELs) of the Occupational Health and Safety Act, (Act 85 of 1993), as amended will apply, or those traversing the operational area, in which case exposure will be very short-lived and comparison against the NAAQS is inappropriate.

Year 0 (Construction including well development):

- All 1-hour onshore concentrations are predicted to remain well below the NAAQS.
- Predicted maximum onshore (160 km) 1-hour concentration is 5.65 µg/m^3, with an annual average concentration of 0.452 µg/m^3.
- 1-Hour offshore concentrations are predicted to exceed the NO_2 NAAQS concentration limit (200 µg/m^3) to an extent of approximately 30 km from the point of release, while annual average concentrations are predicted to exceed NAAQS (40 µg/m^3) to approximately 5 km from the point of release.
- Importantly, as noted previously, the application of the NAAQS 160 km offshore is not appropriate for a human health assessment since there are no permanent residents offshore, and any

exposure would either be very short-lived, or managed under the Occupational Health and Safety Act, (Act 85 of 1993), as amended.

Year 1 (Well development and production support vessels i.e., TEEPSA only):

- All 1-hour onshore concentrations are predicted to remain well below the NAAQS.
- The predicted maximum onshore (160 km) 1-hour concentration is 4.54 µg/m³, with an annual average concentration of 0.364 µg/m³.
- 1-Hour offshore concentrations are predicted to exceed the NO_2 NAAQS concentration limit (200 µg/m³) to an extent of approximately 20 km from the point of release, while annual average concentrations are predicted to exceed the NAAQS (40 µg/m³) to approximately 5 km from the point of release.
- Importantly, as noted previously, the application of the NAAQS 160 km offshore is not appropriate for a human health assessment since there are no permanent residents offshore, and any exposure would either be very short-lived, or managed under the Occupational Health and Safety Act, (Act 85 of 1993), as amended.

Year 2 to 9 and 11 to 25 (Project operations i.e., TEEPSA only):

- All 1-hour concentrations are predicted to remain well below the NAAQS, inclusive of onshore and offshore locations.
- The predicted maximum onshore (160 km) 1-hour concentration is 0.263 µg/m³, with an annual average concentration of 0.021 µg/m³.

Year 10 (Well development, limited construction, production support vessels i.e., TEEPSA only):

- All 1-hour onshore concentrations are predicted to remain well below the NAAQS.
- The predicted maximum onshore (160 km) 1-hour concentration is 6.18 µg/m³, with an annual average concentration of 0.494 µg/m³.
- 1-Hour offshore concentrations are predicted to exceed the NO_2 NAAQS concentration limit (200 µg/m³) to an extent of approximately 30 km from the point of release, while annual average concentrations are predicted to exceed the NAAQS (40 µg/m³) to approximately 10 km from the point of release.
- Importantly, as noted previously, the application of the NAAQS 160 km offshore is not appropriate for a human health assessment since there are no permanent residents offshore, and any exposure would either be very short-lived, or managed under the Occupational Health and Safety Act, (Act 85 of 1993), as amended.

Year 26 (Decommissioning):

- All 1-hour concentrations are predicted to remain well below the NAAQS, inclusive of onshore and offshore locations.
- Predicted maximum onshore (160 km) 1-hour concentration is 3.95 µg/m³, with an annual average concentration of 0.316 µg/m³.

Year 10 with exploration (Well development, limited construction, production support vessels, and exploration i.e., TEEPSA only):

- All 1-hour onshore concentrations are predicted to remain well below the NAAQS.
- Predicted maximum onshore (160 km) 1-hour concentration is 10.2 µg/m³, with an annual average concentration of 0.816 µg/m³.

- 1-Hour offshore concentrations are predicted to exceed the NO_2 NAAQS concentration limit (200 µg/m³) to an extent of approximately 30 km from the point of release, while annual average concentrations are predicted to exceed NAAQS (40 µg/m³) to approximately 10 km from the point of release.
- Importantly, as noted previously, the application of the NAAQS 160 km offshore is not appropriate for a human health assessment since there are no permanent residents offshore, and any exposure would either be very short-lived, or managed under the Occupational Health and Safety Act, (Act 85 of 1993), as amended.

Table 6-6: Onshore 1-Hour and annual average NO_2 concentrations due to offshore operations (µg/m³)

Distance from Source (km)	Exploration	Year 0	Year 1[(a)]	Year 2-9 & 11-25[(a)]	Year 10[(a)]	Year 26	Year 10[(a)] with exploration
1-Hour Concentrations							
85	26.6	n/a	n/a	n/a	n/a	n/a	n/a
160	4.02	5.65	4.54	0.263	6.18	3.95	10.2
Annual Average Concentrations							
85	2.12	n/a	n/a	n/a	n/a	n/a	n/a
160	0.322	0.452	0.364	0.021	0.494	0.316	0.816

Notes:
Concentrations presented in µg/m³.
Comparison made against the 1-hour NAAQS of 200µg/m³ and annual NAAQS of 40µg/m³ for NO_2.
(a) Project operations only i.e., TEEPSA only, and excludes associated assets e.g., F-A Platform production.

6.2.1.3 Fine Particulate Matter (PM_{10} and $PM_{2.5}$)

Predicted 24-hour and annual average PM concentrations at select distances from a point of release are provided in **Table 6-7**.

As noted previously, it is assumed PM_{10} and $PM_{2.5}$ is equivalent to PM emissions due to limited availability of particle size information, therefore the following section compares predicted PM concentrations with the most stringent PM NAAQS, which is $PM_{2.5}$.

The NAAQS 24-hour limit concentration for PM_{10} and $PM_{2.5}$ is 75 µg/m³ and 40 µg/m³, respectively. The NAAQS allows for 4 exceedances of the limit in a calendar year. The NAAQS annual average concentration for PM_{10} and $PM_{2.5}$ is 40 µg/m³ and 25 µg/m³, respectively. The following key findings are highlighted:

Exploration:

- Noting 85km is the closest exploration will occur to the shore, all onshore and offshore 24-hour and annual average concentrations remain below their respective NAAQS (PM_{10} and $PM_{2.5}$ NAAQS), with a maximum onshore 24-hour concentration of 0.867 µg/m³, and an onshore annual average concentration of 0.171 µg/m³ predicted.

Year 0 (Construction including well development):

- Predicted onshore (160km) 24-hour (0.204 µg/m³) and annual average (0.041 µg/m³) concentrations remain well below their respective NAAQS.
- 24-Hour offshore concentrations are predicted to exceed the most stringent $PM_{2.5}$ NAAQS to an extent of approximately 1km from the point of release, while annual average concentrations are predicted remain below the NAAQS offshore.
- Importantly, as noted previously, the application of the NAAQS 160 km offshore is not appropriate for a human health assessment since there are no permanent residents offshore, and any exposure would either be very short-lived, or managed under the Occupational Health and Safety Act, (Act 85 of 1993), as amended.

Year 1 (Well development and production support vessels i.e., TEEPSA only):

- Predicted onshore (160km) 24-hour (0.163 µg/m³) and annual average (0.033µg/m³) concentrations remain well below their respective NAAQS.
- 24-Hour offshore concentrations are predicted to exceed the most stringent $PM_{2.5}$ NAAQS to an extent of approximately 1km from the point of release, while annual average concentrations are predicted to remain below the NAAQS offshore.
- Importantly, as noted previously, the application of the NAAQS 160km offshore is not appropriate for a human health assessment since there are no permanent residents offshore, and any exposure would either be very short-lived, or managed under the Occupational Health and Safety Act, (Act 85 of 1993), as amended.

Year 2 to 9 and 11 to 25 (Project operations i.e., TEEPSA only):

- Predicted onshore (160km) 24-hour (0.01µg/m³) and annual average (0.002µg/m³) concentrations remain well below their respective NAAQS.
- All 24-hour and annual average concentrations are predicted to remain well below their respective NAAQS, inclusive of offshore concentrations.

Year 10 (Well development, limited construction, production support vessels i.e., TEEPSA only):

- Predicted onshore (160km) 24-hour (0.224 µg/m³) and annual average (0.045 µg/m³) concentrations remain well below their respective NAAQS.
- 24-Hour offshore concentrations are predicted to exceed the most stringent $PM_{2.5}$ NAAQS to an extent of approximately 1km from the point of release, while annual average concentrations are predicted remain below the NAAQS offshore.
- Importantly, as noted previously, the application of the NAAQS 160km offshore is not appropriate for a human health assessment since there are no permanent residents offshore, and any exposure would either be very short-lived, or managed under the Occupational Health and Safety Act, (Act 85 of 1993), as amended.

Year 26 (Decommissioning):

- Predicted onshore (160km) 24-hour (0.148µg/m³) and annual average (0.030µg/m³) concentrations remain well below their respective NAAQS.
- All 24-hour and annual average concentrations are predicted to remain well below their respective NAAQS, inclusive of offshore concentrations.

Year 10 (Well development, limited construction, production support vessels and exploration i.e., TEEPSA only):

- Presents the worst-case scenario, combining Year 10 activities with exploration, occurring approximately 160km offshore.
- Predicted onshore (160km) 24-hour (0.373 µg/m^3) and annual average (0.075 µg/m^3) concentrations remain well below their respective NAAQS.
- 24-Hour offshore concentrations are predicted to exceed the most stringent $PM_{2.5}$ NAAQS to an extent of approximately 2 km from the point of release.
  - This concentration is only possible if exploration activities occur on the western side of the eastern exploration block, in which case there is potential for cumulative impacts with western block emissions. Should exploration not occur on the western edge of the eastern block, cumulative impacts are unlikely, resulting in low concentrations associated with Year 10.
- Importantly, as noted previously, the application of the NAAQS 160km offshore is not appropriate for a human health assessment since there are no permanent residents offshore, and any exposure would either be very short-lived, or managed under the Occupational Health and Safety Act, (Act 85 of 1993), as amended.

Table 6-7: Onshore 24-Hour and annual average PM concentrations due to offshore operations (µg/m^3)

Distance from Source (km)	Exploration	Year 0	Year 1	Year 2-9 & 11-25[(a)]	Year 10[(a)]	Year 26	Year 10[(a)] with exploration
24-Hour Concentrations							
85	0.857	n/a	n/a	n/a	n/a	n/a	n/a
160	0.149	0.204	0.163	0.010	0.224	0.148	0.373
Annual Average Concentrations							
85	0.171	n/a	n/a	n/a	n/a	n/a	n/a
160	0.030	0.041	0.033	0.002	0.045	0.030	0.075

Notes:
Concentrations presented in µg/m^3.
Comparison made against the 24-hour NAAQS of 75µg/m^3 and annual NAAQS of 40µg/m^3 for PM_{10}.
Comparison made against the 24-hour NAAQS of 40µg/m^3 and annual NAAQS of 20µg/m^3 for $PM_{2.5}$.
(a) Project operations only i.e., TEEPSA only, and excludes associated assets e.g., F-A Platform production.

6.2.1.4 Sulphur Dioxide Concentrations

Predicted 1-hour, 24-hour and annual average SO_2 concentrations at select distances from a point of release are provided in **Table 6-8**. The NAAQS 1-hour limit concentration for SO_2 is 350 µg/m^3. The NAAQS allows for 88 exceedances of the limit in a calendar year. The NAAQS 24-hour limit concentration for SO_2 is 125 µg/m^3. The NAAQS allows for 4 exceedances of the limit in a calendar year. The NAAQS annual average concentration limit for SO_2 is 50 µg/m^3. The following key findings are highlighted:

Exploration:

- Should exploration occur at the location nearest shore (85km), it is predicted 1-hour (3.79µg/m³), 24-hour (1.52µg/m³) and annual average (0.303µg/m³) concentrations are likely not to exceed the respective NAAQS, inclusive of onshore and offshore.
- Vessel operations were the main activity contributing to these concentrations, occurring during well testing, with high contributions to both the annual emissions and hourly concentrations (almost 100%).

Year 0 (Construction including well development):

- Predicted onshore (160km) 1-hour (0.962µg/m³), 24-hour (0.385µg/m³) and annual average (0.077µg/m³) concentrations remain well below their respective NAAQS.
- All 1-hour, 24-hour and annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Year 1 (Well development and production support vessels i.e., TEEPSA only):

- Predicted onshore (160km) 1-hour (0.305 µg/m³), 24-hour (0.122µg/m³) and annual average (0.024µg/m³) concentrations remain well below their respective NAAQS.
- All 1-hour, 24-hour and annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Year 2 to 9 and 11 to 25 (Project operations i.e., TEEPSA only):

- Predicted onshore (160km) 1-hour (0.048µg/m³), 24-hour (0.019µg/m³) and annual average (0.004µg/m³) concentrations remain well below their respective NAAQS.
- All 1-hour, 24-hour and annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Year 10 (Well development, limited construction, production support vessels i.e., TEEPSA only):

- Predicted onshore (160km) 1-hour (1.06µg/m³), 24-hour (0.423µg/m³) and annual average (0.085µg/m³) concentrations remain well below their respective NAAQS.
- All 1-hour, 24-hour and annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Year 26 (Decommissioning):

- Predicted onshore (160km) 1-hour (0.714µg/m³), 24-hour (0.286µg/m³) and annual average (0.057µg/m³) concentrations remain well below their respective NAAQS.
- All 1-hour, 24-hour and annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Year 10 (Well development, limited construction, production support vessels and exploration i.e., TEEPSA only):

- Presents the worst-case scenario, combining Year 10 activities with exploration, occurring approximately 160km offshore.
- Predicted onshore (160km) 1-hour (1.77µg/m³), 24-hour (0.708µg/m³) and annual average (0.142µg/m³) concentrations remain well below their respective NAAQS.
- All 1-hour, 24-hour and annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Table 6-8: Onshore 1-Hour, 24-hour and annual average SO_2 concentrations due to offshore operations (µg/m³)

Distance from Source (km)	Exploration	Year 0	Year 1	Year 2-9 & 11-25[(a)]	Year 10[(a)]	Year 26	Year 10[(a)] with exploration
1-Hour Concentrations							
85	3.79	n/a	n/a	n/a	n/a	n/a	n/a
160	0.714	0.962	0.305	0.048	1.06	0.714	1.77
24-Hour Concentrations							
85	1.52	n/a	n/a	n/a	n/a	n/a	n/a
160	0.286	0.385	0.122	0.019	0.423	0.286	0.708
Annual Average Concentrations							
85	0.303	n/a	n/a	n/a	n/a	n/a	n/a
160	0.057	0.077	0.024	0.004	0.085	0.057	0.142

Notes:
Concentrations presented in µg/m³.
Comparison made against the 1-hour (350µg/m³), 24-hour (125µg/m³), and annual (50µg/m³) NAAQS for SO_2.
Highlighted red concentrations indicate predicted exceedances of the NAAQS.
(a) Project operations only i.e., TEEPSA only, and excludes associated assets e.g., F-A Platform production.

6.2.1.5 Benzene concentrations

Predicted annual average concentrations at select distances from a point of release are provided in **Table 6-9**. The NAAQS annual average concentration limit for benzene is 5 µg/m³. The following key findings are highlighted:

Exploration:

- Should exploration occur at the location nearest shore (85km), it is predicted annual average concentrations will not exceed the NAAQS, with a maximum concentration of 0.003µg/m³ predicted.
- The annual average concentrations are predicted to remain below the NAAQS offshore.

Year 0 (Construction including well development):

- Predicted onshore (160km) annual average (<0.001µg/m³) concentrations remain well below the NAAQS.
- All annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Year 1 (Well development and production support vessels i.e., TEEPSA only):

- Predicted onshore (160km) annual average (<0.001µg/m³) concentrations remain well below the NAAQS.
- All annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Year 2 to 9 and 11 to 25 (Project operations i.e., TEEPSA only):

- Predicted onshore (160km) annual average (<0.001µg/m³) concentrations remain well below the NAAQS.
- All annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Year 10 (Well development, limited construction, production support vessels i.e., TEEPSA only):

- Predicted onshore (160km) annual average (<0.001µg/m³) concentrations remain well below the NAAQS.
- All annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Year 26 (Decommissioning):

- Predicted onshore (160km) annual average (<0.001µg/m³) concentrations remain well below the NAAQS.
- All annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Year 10 (Well development, limited construction, production support vessels and exploration i.e., TEEPSA only):

- This presents the worst-case scenario, combining Year 10 activities with exploration, occurring approximately 160km offshore.
- Predicted onshore (160km) annual average (<0.001µg/m³) concentrations remain well below the NAAQS.
- All annual average concentrations are predicted to remain below the NAAQS, inclusive of offshore concentrations.

Table 6-9: Onshore Annual average benzene concentrations due to offshore operations (µg/m³)

Distance from Source (km)	Exploration	Year 0	Year 1	Year 2 – 9 & 11-25[(a)]	Year 10[(a)]	Year 26	Year 10[(a)] with exploration
85	0.003	n/a	n/a	n/a	n/a	n/a	n/a
160	5.50E-05	1.93E-04	1.90E-04	6.36E-07	1.94E-04	9.54E-06	2.49E-04

Notes:
Concentrations presented in µg/m³.
Comparison made against the annual NAAQS for benzene of 5 µg/m³.
(a) Project operations only i.e., TEEPSA only, and excludes associated assets e.g., F-A Platform production.

6.2.2 OFFSHORE CUMULATIVE OPERATIONS

6.2.2.1 Carbon Monoxide Concentrations

Table 6-10 presents offshore cumulative operations, representing the combination of offshore TEEPSA operations and associated facilities (i.e., F-A Platform).

Cumulative onshore concentrations, as a result of offshore activities, remain extremely low, well below the NAAQS during the production years including the worst-case scenario of Year 10 and exploration operations taking place simultaneously.

Table 6-10: Onshore cumulative CO concentrations during production years

Scenario	1-Hour Concentration (µg/m³)
Project Operations Only (for production years) – 160 km from Project	
Year 1	0.0447
Year 2-9 & 11-25	0.017
Year 10	1.23
Year 10 with Exploration	1.68
Cumulative Offshore Operations (Project + PetroSA Platform) – 160 km from Project, 70 km from F-A Platform	
Year 1	0.665
Year 12	1.40
Year 10	1.77
Year 10 with Exploration	2.23

Notes:
Comparison made against the 1-hour NAAQS for CO of 30,000µg/m³.

6.2.2.2 Nitrogen Dioxide Concentrations

Table 6-11 presents offshore cumulative operations, representing the combination of offshore TEEPSA operations and associated facilities (i.e., F-A Platform). Cumulative onshore concentrations, as a result of offshore activities, remain low, well below the NAAQS during the production years including the worst-case scenario of Year 10 and exploration operations taking place simultaneously.

Table 6-11: Onshore cumulative NO_2 concentrations during production years

Scenario	1-hour Concentration (µg/m³)	1-year Concentration (µg/m³)
Project Operations Only (for production years) – 160 km from Project		
Year 1	4.54	0.364
Year 2-9 & 11-25	0.263	0.021
Year 10	6.18	0.494
Year 10 with exploration	10.2	0.816
Cumulative Offshore Operations (Project + PetroSA Platform) – 160 km from Project, 70 km from F-A Platform		
Year 1	7.45	0.596
Year 12	2.52	0.202
Year 10	9.49	0.759
Year 10 with exploration	13.52	1.08

Notes:
Comparison made against the 1-hour NAAQS of 200µg/m³ and annual NAAQS of 40µg/m³ for NO_2.

6.2.2.3 Fine Particulate Matter (PM_{10} and $PM_{2.5}$)

Table 6-12 presents offshore cumulative operations, representing the combination of offshore TEEPSA operations and associated facilities (i.e., F-A Platform). Cumulative onshore concentrations, as a result of offshore activities, remain extremely low, well below the NAAQS during the production years including the worst-case scenario of Year 10 and exploration operations taking place simultaneously.

Table 6-12: Onshore cumulative PM concentrations during production years

Scenario	24-hour Concentration (µg/m³)	1-year Concentration (µg/m³)
Project Operations Only (for production years) – 160 km from Project		
Year 1	0.163	0.033
Year 2-9 & 11-25	0.010	0.002
Year 10	0.224	0.045
Year 10 with exploration	0.373	0.075
Cumulative Offshore Operations (Project + PetroSA Platform) – 160 km from Project, 70 km from F-A Platform		
Year 1	0.178	0.033

Scenario	24-hour Concentration (µg/m³)	1-year Concentration (µg/m³)
Year 12	0.029	0.002
Year 10	0.239	0.045
Year 10 with exploration	0.389	0.075

Notes:
Comparison made against the 24-hour NAAQS of 75µg/m³ and annual NAAQS of 40µg/m³ for PM_{10}.
Comparison made against the 24-hour NAAQS of 40µg/m³ and annual NAAQS of 20µg/m³ for $PM_{2.5}$.

6.2.2.4 Sulphur Dioxide Concentrations

Table 6-13 presents offshore cumulative operations, representing the combination of offshore TEEPSA operations and associated facilities (i.e., F-A Platform). Cumulative onshore concentrations, as a result of offshore activities, remain extremely low, well below the NAAQS during the production years including the worst-case scenario of Year 10 and exploration operations taking place simultaneously.

Table 6-13: Onshore cumulative SO_2 concentrations during production years

Scenario	1-hour Concentration (µg/m³)	24-hour Concentration (µg/m³)	1-year Concentration (µg/m³)
Project Operations Only (for production years) – 160 km from Project			
Year 1	0.305	0.122	0.024
Year 2-9 & 11-25	0.048	0.019	0.004
Year 10	1.06	0.423	0.085
Year 10 with exploration	1.77	0.708	0.142
Cumulative Offshore Operations (Project + PetroSA Platform) – 160 km from Project, 70 km from F-A Platform			
Year 1	0.305	0.122	0.024
Year 12	0.048	0.019	0.004
Year 10	1.06	0.423	0.085
Year 10 with exploration	1.34	0.708	0.142

Notes:
Comparison made against the 1-hour (350µg/m³), 24-hour (125µg/m³), and annual (50µg/m³) NAAQS for SO_2.

6.2.2.5 Benzene concentrations

Table 6-14 presents offshore cumulative operations, representing the combination of offshore TEEPSA operations and associated facilities (i.e., F-A Platform). Cumulative onshore concentrations, as a result of offshore activities, remain extremely low, well below the NAAQS during the production years including the worst-case scenario of Year 10 and exploration operations taking place simultaneously.

Table 6-14: Onshore cumulative benzene concentrations during production years

Scenario	Annual Concentration (µg/m³)
Project Operations Only (for production years) – 160 km from Project	
Year 1	1.90E-04
Year 2-9 & 11-25	6.36E-07
Year 10	1.94E-04
Year 10 with exploration	2.49E-04
Cumulative Offshore Operations (Project + PetroSA Platform) – 160 km from Project, 70 km from F-A Platform	
Year 1	0.003
Year 12	0.007
Year 10	0.007
Year 10 with exploration	0.007

Notes:
Comparison made against the annual NAAQS for benzene of 5µg/m³.

6.2.3 PORT OPERATIONS

Operations in the port area for which emissions were estimated included both vessels manoeuvring and hotelling. Hotelling is the key activity undertaken by vessels while in the port, resulting in the most frequent and prolonged emissions associated with vessels in/near-port activities. Given that NAAQS are applicable to persistent, long-term exposure, only hotelling is assessed in the dispersion model.

Only the support vessels have been considered as it is anticipated that the drill unit and tugboat(s) will remain offshore. When refuelling is required, this will be done offshore by transporting fuel to the drill unit and tugboat(s). The crew will be shuttled between the offshore site and the port using crew vessels.

Highest ground -level concentrations for all pollutants are predicted to occur approximately 950 m from the port but remain well below the associated NAAQS. The peak occurs at this distance as it takes 950 m for the bulk of the plume to reach the ground. The meteorological conditions selected in the Screen3 model were “worst-case” based on full meteorology, this is where Screen 3 selects the meteorological conditions that would result in the worst-case concentration for each discrete distance dependant on the potential exit gas momentum and / or buoyancy at that distance. Based on the Screen3 simulations the highest concentrations could occur at 950 m downwind of the vessels during very unstable (turbulent atmosphere) conditions and low horizontal wind speed of 1 m/s (at a height of 10 m above ground).

6.2.3.1 Carbon Monoxide Concentrations

Predicted 1-hour concentrations at select distances from the port are provided in **Table 6-15**, while the following key findings are highlighted:

- Predicted 1-hour CO concentrations remain well below the CO NAAQS at all distances downwind from the point of release, with no exceedances predicted at neighbouring sensitive receptors.
- The highest CO concentrations over the Project lifecycle will occur in Year 26.

Table 6-15: 1-Hour peak CO concentrations during hotelling (µg/m^3)

Distance from Source (m)	Exploration	Year 0	Year 1	Year 2 – 9 & 11-25	Year 10	Year 26	Year 10 with Exploration
150	5.54E-06	1.66E-05	1.11E-05	5.54E-06	2.21E-05	4.43E-05	2.77E-05
300	1.28E-04	3.84E-04	2.56E-04	1.28E-04	5.12E-04	1.02E-03	6.40E-04
350	6.60E-04	1.98E-03	1.32E-03	6.60E-04	2.64E-03	5.28E-03	3.30E-03
1,000	7.38E-03	2.21E-02	1.48E-02	7.38E-03	2.95E-02	5.91E-02	3.69E-02

Notes:
Concentrations presented in µg/m^3.
Comparison made against the 1-hour NAAQS for CO of 30,000µg/m^3.

6.2.3.2 Nitrogen Dioxide Concentrations

Predicted 1-hour and annual average concentrations at select distances from the port are provided in **Table 6-16** for the various scenarios. The following key findings are highlighted:

- Predicted 1-hour and annual average concentrations remain well below the NAAQS at all distances downwind from the port, with no exceedances predicted at neighbouring sensitive receptors.
- The highest concentrations over the Project lifecycle will occur in Year 26.

Table 6-16: 1-Hour and annual average NO_2 concentrations during hotelling (µg/m^3)

Distance from Source (m)	Exploration	Year 0	Year 1	Year 2 – 9 & 11-25	Year 10	Year 26	Year 10 with Exploration
1-Hour Concentrations							
150	1.77E-05	5.31E-05	3.54E-05	1.77E-05	7.08E-05	8.86E-06	8.86E-05
300	4.10E-04	0.001	0.001	4.10E-04	0.002	2.05E-04	0.002
350	0.002	0.006	0.004	0.002	0.008	0.001	0.011
1,000	0.024	0.071	0.047	0.024	0.094	0.012	0.118

Distance from Source (m)	Exploration	Year 0	Year 1	Year 2 – 9 & 11-25	Year 10	Year 26	Year 10 with Exploration
Annual Average Concentrations							
150	1.42E-06	4.25E-06	2.83E-06	1.42E-06	5.67E-06	7.08E-07	7.08E-06
300	3.28E-05	9.84E-05	6.56E-05	3.28E-05	1.31E-04	1.64E-05	1.64E-04
350	1.69E-04	5.07E-04	3.38E-04	1.69E-04	6.75E-04	8.44E-05	8.44E-04
1,000	1.89E-03	5.67E-03	3.78E-03	1.89E-03	7.56E-03	9.45E-04	9.45E-03

Notes:
Concentrations presented in µg/m3.
Comparison made against the 1-hour NAAQS of 200µg/m³ and annual NAAQS of 40µg/m³ for NO_2.

6.2.3.3 Fine Particulate Matter (PM_{10} and $PM_{2.5}$)

Predicted 24-hour and annual average concentrations at select distances from the port are provided in **Table 6-17** for the various scenarios. The following key findings are highlighted:

- Predicted 24-hour and annual average concentrations remain well below the NAAQS at all distances downwind from the port, with no exceedances predicted at neighbouring sensitive receptors.
- The highest concentrations over the Project lifecycle will occur in Year 26.

Table 6-17: 24-Hour and annual average PM concentrations during hotelling (µg/m³)

Distance from Source (m)	Exploration	Year 0	Year 1	Year 2-9 & 11-25	Year 10	Year 26	Year 10 with Exploration
24-Hour Concentrations							
150	8.86E-07	2.66E-06	1.77E-06	8.86E-07	3.54E-06	1.77E-06	4.43E-06
300	2.05E-05	6.15E-05	4.10E-05	2.05E-05	8.20E-05	4.10E-05	1.02E-04
350	1.06E-04	3.17E-04	2.11E-04	1.06E-04	4.22E-04	2.11E-04	0.001
1,000	0.001	0.004	0.002	0.001	0.005	0.002	0.006
Annual Average Concentrations							
150	1.77E-07	5.31E-07	3.54E-07	1.77E-07	7.08E-07	3.54E-07	8.86E-07
300	4.10E-06	1.23E-05	8.20E-06	4.10E-06	1.64E-05	8.20E-06	2.05E-05
350	2.11E-05	6.33E-05	4.22E-05	2.11E-05	8.44E-05	4.22E-05	1.06E-04
1,000	2.36E-04	0.001	4.72E-04	2.36E-04	0.001	4.72E-04	0.001

Notes:
Concentrations presented in µg/m³.
Comparison made against the 24-hour NAAQS of 75µg/m³ and annual NAAQS of 40µg/m³ for PM_{10}.
Comparison made against the 24-hour NAAQS of 40µg/m³ and annual NAAQS of 20µg/m³ for $PM_{2.5}$.

6.2.3.4 Sulphur Dioxide Concentrations

Predicted 24-hour concentrations at select distances from the port are provided in **Table 6-18** for the various scenarios. The following key findings are highlighted:

- Predicted 1-hour, 24-hour and annual average concentrations remain well below the NAAQS at all distances downwind from the port, with no exceedances predicted at neighbouring sensitive receptors.
- The highest concentrations over the Project lifecycle will occur in Year 26.

Table 6-18: 1-Hour, 24-hour and annual average SO_2 concentrations during hotelling (µg/m³)

Distance from Source (m)	Exploration	Year 0	Year 1	Year 2-9 & 11-25	Year 10	Year 26	Year 10 with Exploration
1-Hour Concentrations							
150	1.57E-06	0.003	3.14E-06	1.57E-06	6.29E-06	3.14E-06	7.86E-06
300	3.64E-05	0.069	7.28E-05	3.64E-05	1.46E-04	7.28E-05	1.82E-04
350	1.87E-04	0.357	3.75E-04	1.87E-04	7.49E-04	3.75E-04	9.37E-04
1,000	0.002	3.993	0.004	0.002	0.008	0.004	0.010
24-Hour Concentrations							
150	6.29E-07	0.001	1.26E-06	6.29E-07	2.52E-06	1.26E-06	3.14E-06
300	1.46E-05	0.028	2.91E-05	1.46E-05	5.82E-05	2.91E-05	7.28E-05
350	7.49E-05	0.143	1.50E-04	7.49E-05	3.00E-04	1.50E-04	3.75E-04
1,000	0.001	1.597	0.002	0.001	0.003	0.002	0.004
Annual Average Concentrations							
150	1.26E-07	2.40E-04	2.52E-07	1.26E-07	5.03E-07	2.52E-07	6.29E-07
300	2.91E-06	0.006	5.82E-06	2.91E-06	1.16E-05	5.82E-06	1.46E-05
350	1.50E-05	0.029	3.00E-05	1.50E-05	5.99E-05	3.00E-05	7.49E-05
1,000	1.68E-04	0.319	3.35E-04	1.68E-04	6.71E-04	3.35E-04	0.001

Notes:
Concentrations presented in µg/m³.
Comparison made against the 1-hour (350µg/m³), 24-hour (125µg/m³), and annual (50µg/m³) NAAQS for SO_2.

6.2.3.5 Benzene concentrations

Predicted annual average concentrations at select distances from the port are provided in **Table 6-19** for the various scenarios. The following key findings are highlighted:

- Predicted annual concentrations remain well below the NAAQS at all distances downwind from the port, with no exceedances predicted at neighbouring sensitive receptors.
- The highest concentrations over the Project lifecycle will occur in Year 26.

Table 6-19: Annual average benzene concentrations during hotelling (µg/m³)

Distance from Source (m)	Exploration	Year 0	Year 1	Year 2 – 9 & 11-25	Year 10	Year 26	Year 10 with Exploration
150	9.85E-12	4.29E-10	1.97E-11	9.85E-12	3.94E-11	1.97E-11	4.92E-11
300	2.28E-10	9.93E-09	4.56E-10	2.28E-10	9.12E-10	4.56E-10	1.14E-09
350	1.17E-09	5.11E-08	2.35E-09	1.17E-09	4.69E-09	2.35E-09	5.87E-09
1,000	1.31E-08	5.72E-07	2.63E-08	1.31E-08	5.25E-08	2.63E-08	6.57E-08

Notes:
Concentrations presented in µg/m³.
Comparison made against the annual NAAQS for benzene of 5µg/m³.

6.3 UNPLANNED EVENTS

It is expected that should any unplanned events occur; these will be over short periods resulting in short-term impacts. The resultant emissions, concentrations and potential impacts vary depending on the type of event. Given the short duration of emissions / impacts and very low probability of occurrence; emissions from these events have not been estimated and impacts quantitatively assessed. The events that could result in the most substantial impact magnitude has been qualitatively assessed in Section 8.4 using the ESIA impact significance methodology. Where the anticipated emissions and resultant onshore concentrations are minimal, these events have been screened out of the assessment.

Sources of emissions associated with unplanned events are described in **Table 6-20**. Should any of these events occur resulting in impacts to air quality, TEEPSA should undertake an investigation, comprising, at a minimum:

- Date of incident.
- Nature of Incident.
- Cause of Incident.
- Actions to Minimise Impact.
- Actions to Reduce Likelihood of Reoccurrence.

In addition, if the incident had or has the potential to impact communities or other I&APs, it is recommended that TEEPSA notify the relevant I&APs / communities of the incident and is required to take measures to mitigate impacts. Project controls, over and above TEEPSA's oil spill contingency plan, that will be implemented to prevent or limit impacts from the unplanned events are provided in **Table 6-20**.

Table 6-20: Emissions and project controls associated with unplanned events

Activity	Potential Sources	Expected Pollutants	Project Controls	Screened out?
Offshore Surveys Development Exploration	Fuel spills from fuel tanks on vessels	VOCs	Ensure an emergency response procedure in line with TotalEnergies Oil Spill Response Plan (TEPSA_2_MAN_HSE_07.02) is in place; all personal are trained, with regular refreshers. Ensure equipment is well maintained and repaired as required.	Yes -evaporative losses due to fuel spilt offshore would be minimal and unlikely that resultant concentrations will be significant onshore.
	Fuel leaks from rig and vessel fuel tanks	VOCs	Ensure an emergency response procedure in line with TotalEnergies Oil Spill Response Plan (TEPSA_2_MAN_HSE_07.02) is in place; all personnel are trained, with regular refreshers. Ensure equipment is well maintained and repaired as required.	Yes - a small amount of fuel from fuel tank leaks is likely to reach the surface and evaporative losses would be minimal, with negligible concentrations reaching onshore
Development	Gas leaks from subsea system including pipeline	VOCs / HCs	Ensure an emergency response procedure is in place; all personal are trained, with regular refreshers. Ensure equipment is well maintained and repaired as required – this is the purpose of the supply vessels during years 1 to 25.	Yes - gas reaching the surface is likely to be negligible as there is expected to be mixing within the water and that emergency response plans will be implemented prior to any major losses. Therefore, the resultant concentrations are likely insignificant onshore.
Development and exploration – Well Drilling; Construction; and Production	Loss of well control / well blow-out	VOCs / HCs	Ensure an emergency response procedure in line with TotalEnergies Blow Out Contingency Plan (TEPSA_2_MAN_OPS_07.09_5) is in place; all personal are trained, with regular refreshers. Ensure equipment is well maintained and repaired as required.	No – although correct implementation of controls and backup measures can limit emissions after the initial event; should a

Activity	Potential Sources	Expected Pollutants	Project Controls	Screened out?
				blow-out occur, resultant concentrations are likely to be high, but short-lived due to the implementation of project controls.
Development Exploration	Fire on vessels, drill unit or ignition of the highly combustible gas and condensate (from loss of well control and accidental fugitive leaks).	CO, NO_x, PM (including secondary particulate formation), SO_2, VOCs / HCs, dioxins and furans (PCDD/Fs), and heavy metals.	Ensure an emergency response procedure is in place; all personal are trained, with regular refreshers. Ensure equipment is well maintained and repaired as required. TotalEnergies Oil Spill Response Plan (TEPSA_2_MAN_HSE_07.02) and Blow Out Contingency Plan (TEPSA_2_MAN_OPS_07.09_5) cover some fire situations and in the applicable cases, the response procedures should be undertaken in line with these guidelines.	No - large amounts of pollutant emissions will result from fires and will continue to occur during smouldering.

6.4 CUMULATIVE IMPACTS

6.4.1 BLOCK 11B/12B AND OTHER OFFSHORE ACTIVITIES

Although marine (ship) traffic can be anticipated in the vicinity of Block 11B/12B and is expected to pass through the Block, the residence time of this traffic is limited and anticipated to have little impact on ambient concentrations within the block.

Model predictions show 1-hour and annual NO_2 levels are elevated offshore as well as 24-hour PM levels, especially within Block 11B/12B, for three of the 27 Project years (Year 0, Year 1, and Year 10). In these years, the resultant cumulative ambient NO_2 and PM levels are expected to be elevated within the Block 11B/12B. The remaining pollutant levels for these years are expected to be low offshore and contribute a small amount to cumulative offshore pollutant levels.

During production years, taking place for most of the Project lifecycle, offshore and onshore pollutant concentrations are low and will result in little noticeable change in air quality.

6.4.2 PORTS

Most of South Africa’s ports have very limited air quality information, nor are ports, inclusive of vessel activities, required to report emissions to South African reporting systems. This is recognised as a concerning gap in emissions estimation for South Africa. Further, in addition to port related emissions, areas surrounding ports generally comprise industrial, transport, and residential activities such as domestic fuel burning, all contributing to degraded air quality within the port area.

Despite the above, and lack of representative monitoring data, contributions from the Project to the existing air quality situation at the port are likely to be low. As shown by the modelling predictions, port activities related to the Project will contribute negligible concentrations, remaining well below the NAAQS. Further, contributions from offshore activities generally remain low.

6.4.3 COASTAL TOWNS AND INDIVIDUAL RECEPTORS

Coastal towns and individual sensitive receptor pollutant levels are mostly attributed to existing, nearby heavy industry (where applicable), national and regional transport operations and residential activities such as personal and public transport operations, and residential fuel burning. The simulation results show that the pollutant levels for the Project activities would likely be below the NAAQS in these areas, with very low contributions to existing air quality in the area.

7 PROJECT ALTERNATIVES

Alternatives are defined in terms of the NEMA, as "different means of meeting the general purpose and requirements of the activity, which may include alternatives to –

(a) the property on which or location where it is proposed to undertake the activity.
(b) the type of activity to be undertaken.
(c) the design or layout of the activity.
(d) the technology to be used in the activity.
(e) the operational aspects of the activity."

This section briefly discusses what should be considered in terms of the selected alternatives.

7.1 ACTIVITY DESIGN AND LAYOUT ALTERNATIVES

7.1.1 WELL LOCATIONS

The exact location of each well will be determined by on site investigative work, including sonar scans to check the bathymetry and sea floor sampling to check sediment and, prior to drilling commencing, a seabed survey using a ROV to document the condition of the seabed around each planned well centre.

The lowest possible impacts on receptors along the coastline due to exploration and development operations, would result from increasing the distance of the wells from the shore. However, the selection of well locations is resource location dependant and there is no opportunity for locating wells more than a kilometre from the determined well location. A few kilometres will not make a significant difference to onshore impacts and there is no alternative in terms of the selection of well locations that will make a noteworthy difference in the onshore impacts.

7.1.2 SUBSEA SYSTEM DESIGN

Where viable, the subsea system should be designed in a manner that reduces the time, number of vessels and size of vessels required to construct the system while ensuring that the integrity of the system and safety of vessels are not compromised to prevent unplanned / upset incidents occurring. The reduction in vessel operations and sizes would ensure less fuel is used and that fuel combustion emissions are reduced as well as emissions associated with support operations, e.g., fuel transport, handling and storage, vessel repair and maintenance.

7.1.3 PIPELINE CORRIDOR

Two pipeline alignments have been identified:

- The (base case) pipeline alignment corridor is a direct route of approximately 109 km from the anticipated well location to the F-A platform.
- The (alternative) pipeline alignment corridor is approximately 115 km, routing slightly northeast from the base case with a bend to reach the F-A Platform.

Where viable, the pipeline should be designed to reduce the time, number of vessels and size of vessels required to construct the pipeline while ensuring that the integrity of the pipeline and safety of vessels are not compromised to prevent unplanned / upset incidents occurring. The reduction in vessel operations and sizes would ensure less fuel is used and that fuel combustion emissions are reduced as well as emissions associated with support operations, e.g., fuel transport, handling and storage, vessel repair and maintenance. The base case option would be preferred given the shorter distance, however since this distance is not substantially shorter than the alternative, either option could be selected, with both options likely having similar impacts on air quality.

7.2 LOGISTICS BASE LOCATION

Port selection will not reduce impacts from emissions although Mossel Bay receptors are located much closer to the Port than the those at Cape Town and Gqeberha. It is anticipated that the larger ports could have poorer air quality and the addition of the operations associated with the project could possibly result in similar cumulative pollutant concentrations at the nearest receptors. The logistics base impacts could be best reduced by mitigation such as regular housekeeping (by sweeping of the laydown area, bagging / containment, and correct disposal of the swept up loose materials); and reducing trips / equipment movement to and at the logistics base. Cape Town and Gqeberha are further from the offshore operational areas; therefore, locating the logistics base at either of these ports, would require the support vessels to travel further, consuming more fuel and increasing trips / operational days resulting in an increase in emissions related to vessel operations offshore and at the port.

7.3 SUPPORT OPERATIONS

Contractors will be responsible for obtaining operational permits and licences to ensure compliance with safety and environmental standards, as well as the use of BAT and facility / equipment maintenance. A noteworthy measure that (vessel) contractors could implement to ensure negligible emissions is the use of onshore power supply during vessel hotelling rather than using onboard generators / boilers, where feasible, and available.

7.4 PETROSA F-A PLATFORM ASSOCIATED FACILITY

No alternatives to operational aspects are considered for the F-A Platform. PetroSA will be responsible for obtaining operational permits and licences to ensure compliance with safety and environmental standards.

To ensure the lowest possible cumulative impacts on receptors along the coastline as a result of flaring, diesel generator and gas turbines, boiler and /or heater operations at the PetroSA F-A Platform, equipment must be maintained, and operated to supplier specifications. Further, a comprehensive air quality assessment should be undertaken to verify emissions associated with platform activities, and the impact of these on the coastal areas.

8 ASSESSMENT OF IMPACTS

The impact significance methodology included in ESIA has been used to assess the impacts significance on sensitive receptors located along the coast and coastal towns.

8.1 POTENTIAL IMPACT DESCRIPTION

The release of pollutants considered in this study, principally CO, NO_x, SO_2, fine particulate matter (PM_{10}/$PM_{2.5}$) and VOCs (including benzene), impact air quality at sensitive receptor locations which is considered **direct negative** impact. The **direct negative** impacts in turn could have effects on human health (e.g., respiratory effects), referred to as an **indirect negative** impact. Only the effects on human health (**indirect negative** impacts) have been assessed in this study and considered in determining the significance of the Project impacts.

Emissions from the offshore activities would result in the most significant **direct negative** impacts within the Block, and along the routes taken by the vessels from Mossel Bay, Cape Town or Gqeberha and the helicopters from George to the Block.

Emissions from port activities associated with the Project would take place at the port of Mossel Bay, and potentially a limited amount at Cape Town or Gqeberha with the **direct negative** impact at the Ports and nearby receptors within Mossel Bay, Cape Town, Gqeberha being possible but not at individual sensitive receptors beyond these towns and other towns.

The impact of emissions on air quality from marine surveys has been screened out and not included in the assessment, since the emission contributions from the surveys are extremely low and will occur over short periods of time.

The impact of emissions on air quality from helicopter operations were screened out, given these are generally low emissions, infrequent, and covering a large area.

8.2 SENSITIVITY OF RECEPTORS

The Block 11B/12B Exploratory Priority Area is located more than 80 km offshore and the production site in Block 11B12B 160 km or farther from the coast (namely from Mossel Bay and Plettenburg Bay and the coastline between these two areas) and is far removed from any sensitive receptors (e.g., residential areas). It is anticipated that occupational exposure limits would be more applicable offshore than the NAAQS, as noted previously; especially given the fact that NAAQS are applicable for lifetime, permanent exposure and were developed to protect the most sensitive members of the population.

The Project activities will occur for up to 27 years; far below the South African and Global life expectancy[2] of 65.25 years and 72.27 years, respectively. The offshore operation emissions could still have an **indirect negative** effect on sensitive receptors and other offshore activities, without the project controls in place. This said, the sensitivity of receptors in the offshore area to increases in

2 datacatalog.worldbank.org

pollutant concentrations is still considered **low** given the non-permanent nature of the receptors.

At the port(s); vessel operations can be anticipated as well as light to medium industry operations such as bulk cargo, break-bulk cargo, and petroleum / organic liquids storage and handling, petroleum product blending and associated support operations such as road and rail operations. Further from the port; usually outside the Towns, there would be heavy industries. The baseline air quality in the port area and nearby residential areas is expected to be poor with elevated pollutant concentrations (Bacalja, Krčum, & Slišković, 2020; Browning & Bailey, 2006; California Air Resources Board, 2011; Hussain, et al., 2022; Toscano & Murena, 2019). In addition to industry and transport operations there are emissions from residential activities such as personal and public transport operations, and residential fuel burning. The nearby receptors sensitivity to increases in pollutant concentrations is considered **high** as the increase in already elevated concentrations could have a significant cumulative detrimental impact on human health even if the operations occur for 27 years.

8.3 NORMAL OPERATIONS

8.3.1 IMPACT MAGNITUDE (OR CONSEQUENCE)

As mentioned above, it is anticipated that occupational exposure limits would be more applicable offshore rather than the NAAQS. The simulation results for the operations with the implementation of Project controls show that the NO_2 and $PM_{2.5}$ NAAQS are exceeded offshore, for three of the 27 development years (Year 0, Year 1, and Year 10). During the production years, taking place for most of the Project period of 25 years, no exceedances of the NAAQS are predicted; neither offshore nor onshore. Given that the NAAQS are applicable for continuous and lifetime exposure the **indirect negative** impact of reduction of human health is unlikely to occur from offshore operations. The year(s) in which exploration will be undertaken is unknown. Exploration **indirect negative** impacts are anticipated to be insignificant offshore within Block 11B/12B and onshore with the Project controls. Pollutant concentrations from the Project vessel operations were the main contributor but were simulated to be below the NAAQS for all years with Project controls.

8.3.1.1 Normal Operations with Development and/or Exploration Well Test Flaring - Offshore Operations and Port Operations

Table 8-1 presents the impact significance associated with offshore exploration activities (1 well), Year 0, Year 1, and Year 10, and considers all pollutants. As noted previously, NO_2 and fine PM concentrations are predicted to be elevated near to the source of offshore release with Project controls, extending for various distances from the point of release; however, are well below the NAAQS onshore. The flaring that takes place during these years is non-routine; only occurring during well tests, between 4 days (exploration) and 10 to 20 days (development) per year.

Based on these residual impact results, the pre-mitigation impact offshore could potentially be of **low intensity** as the change is expected to possibly result in a nuisance which is easily tolerated and/or reversible in the short term (within Block 11B/12B). The impact of the estimated emissions from the Project offshore activities is **regional** as although it is confined to within the project concession and its surroundings; the distance from the sources / concession that elevated pollutant levels can be experienced are substantial, not nearby as per the definition of local, especially for fine PM and Benzene. The impact is of intermittent **short-term** duration as although these activities occur for 3-4 years of the Project lifecycle it would be experienced by receptors (if any) on a non-permanent basis. Thus, the impact **magnitude** (or consequence) is **very low** (**Table 8-1**). Although the 3-4 years of normal operations includes non-routine flaring associated with well testing, non-routine flaring will only occur approximately 54-days of this 3-4 year period, occurring in years 0, 1, 10, and exploration.

The pre-mitigation impact onshore at sensitive receptors from activities within Block 11B/12B i.e., offshore and the associated port operations would be of **low intensity** (slight change which may affect a small proportion of receptors), is **local** and of intermittent **medium-term** duration (occurring for 3-4 years of the Project lifecycle, noting non-routine flaring will not occur throughout these years, as noted previously). Thus, the impact **magnitude** (or consequence) is **very low** (**Table 8-1**).

The onshore and offshore impacts of the production years offshore cumulative operations (see **6.2.2**) comprising of TEEPSA operations and F-A Platform associated activities, are anticipated to be of the same ***intensity, extent**, **duration***, and resultant **magnitude** (or consequence) as the TEEPSA Year 1, and Year 10 activities (refer to **Table 8-1**). Note that only the two known years with non-routine well test flaring is mentioned here; however, exploration activities could occur in any of the production years.

8.3.1.2 Normal Operations without Development and/or Exploration Well Test Flaring – Offshore and Port Operations

The pre-mitigation impact offshore is expected to be of **very low intensity** (negligible change which may have minimal effect on receptors). The Project offshore activities are **regional** and of intermittent **short-term** duration as although the impact will occur for 5-25 years and cease after operations conclude it would be experienced by receptors (if any) on a non-permanent basis. Thus, the impact **magnitude** (or consequence) is **very low** (**Table 8-2**).

The impact onshore at sensitive receptors would be from activities within Block 11B/12B i.e., offshore and at the associated port operations would be of **very low intensity** (negligible change which may affect a tiny proportion of receptors), is **local** and of intermittent **long-term** duration (duration of the impact will be 5-25 years and cease after operations conclude). Thus, the impact **magnitude** (or consequence) is **very low** (**Table 8-2**).

The onshore and offshore impacts of the production years offshore cumulative operations (see **6.2.2**) comprising of TEEPSA operations and F-A Platform associated activities, are anticipated to be of the same ***intensity, extent**, **duration***, and resultant **magnitude** (or consequence) as the TEEPSA production support activities (refer to **Table 8-2**).

8.3.2 IMPACT SIGNIFICANCE

8.3.2.1 Normal Operations with Development and/or Exploration Well Test Flaring - Offshore Operations and Port Operations

Based on the **low sensitivity** of the receptors offshore and the **very low magnitude**, the potential impact of concentrations offshore is considered of ***NEGLIGIBLE*** **significance** without mitigation (**Table 8-1)**. Based on the **high sensitivity** of receptors onshore and the **very low magnitude**, the potential impact of concentrations surrounding the port is of ***LOW*** **significance** without mitigation (**Table 8-1**).

The onshore and offshore impacts of the production years offshore cumulative operations (see **6.2.2**) comprising of TEEPSA operations and F-A Platform associated activities, are anticipated to be of the same **significance** as the TEEPSA Year 1, and Year 10 activities (refer to **Table 8-1**). Note that only the two known years with non-routine well test flaring is mentioned here; however, exploration activities could occur in any of the production years.

8.3.2.2 Normal Operations without Development and/or Exploration Well Test Flaring – Offshore and Port Operations

Based on the **low sensitivity** of the receptors offshore and the **very low magnitude**, the potential impact of concentrations offshore is considered of ***NEGLIGIBLE*** **significance** without mitigation (**Table 8-2)**. Based on the **high sensitivity** of receptors onshore and the **very low magnitude**, the potential impact of concentrations surrounding the port is of ***LOW*** **significance** without mitigation (**Table 8-2**).

The onshore and offshore impacts of the production years offshore cumulative operations (see **6.2.2**) comprising of TEEPSA operations and F-A Platform associated activities, are anticipated to be of the same **significance** as the TEEPSA production support activities (refer to **Table 8-2**).

8.3.3 RESIDUAL IMPACT ASSESSMENT

The potential impact cannot be eliminated as the Project activities will generate emissions regardless of the extent of the mitigation applied. The mitigation measures applied would impact the intensity (and possibly magnitude) of the **direct negative impacts** from Project emissions and **indirect negative** impacts which will affect sensitive receptors.

The pre-mitigated F-A Platform activities have been considered in the **8.3.1** and **8.3.2** discussions; and the exact measures that will be implemented at the F-A Platform is unknown. The production years offshore cumulative operations (see **6.2.2**) comprising of TEEPSA operations and F-A Platform associated activities, are anticipated to be of the same ***intensity, extent, duration*****, magnitude** (or consequence) and **significance** as the TEEPSA activities residual impact.

8.3.3.1 Normal Operations with Development and/or Exploration Well Test Flaring - Offshore Operations and Port Operations

With the implementation of the Project controls and recommended mitigation measures, the ***intensity*** of the air quality impact during years with drilling (and associated non-routine flaring) offshore and onshore reduce to **very low** but the ***magnitude*** remains **very low**. Thus, the residual impact offshore remains **NEGLIGIBLE significance** (**Table 8-1**).

With the implementation of the design / planned mitigation measures, the ***intensity*** and ***magnitude*** of the air quality impact onshore remains **low** and **very low**, respectively. The residual impact onshore remains of **LOW significance** (**Table 8-1**).

The pre-mitigated F-A Platform activities have been considered in the **8.3.1** and **8.3.2** discussions; and the exact measures that will be implemented at the F-A Platform is unknown. The production years offshore cumulative operations (see **6.2.2**) comprising of TEEPSA operations and F-A Platform associated activities, are anticipated to be of the same ***intensity, extent, duration*****, magnitude** (or consequence) and **significance** as the TEEPSA activities residual impact.

8.3.3.2 Normal Operations without Development and/or Exploration Well Test Flaring - Offshore Operations and Port Operations

With the implementation of the Project controls and recommended mitigation measures, the ***intensity*** and ***magnitude*** of the air quality impact during normal operation years without drilling, offshore and onshore remain **very low**; however, the ***extent*** encompasses the footprint of the activity and is the rating reduced to **site**. The residual impact offshore and onshore remains **NEGLIGIBLE** and **LOW significance**, respectively (**Table 8-2**).

8.3.4 ADDITIONAL ASSESSMENT CRITERIA

The additional assessment criteria are summarised in **Table 8-1** and **Table 8-2**, assessing impact significance associated with CO, NO_2, PM_{10}, $PM_{2.5}$, SO_2, and benzene emissions during normal operations for all Project phases (and years), considering offshore and onshore activities separately. Elevated residual concentrations are only predicted to occur during Year 0, Year 1, Year 10 offshore and not onshore.

The offshore impact has a high probability of occurring i.e., a **highly likely probability**; while there is a reasonable probability that the onshore impact could occur i.e., the impact is **possible**. The degree of confidence for ***residual*** impacts offshore is **high** and onshore (namely at the port) is **medium** given the Project specific fuel use or vessel engines data was not used. The ***pre-mitigation*** impacts degree of confidence both offshore and onshore is **medium** as the direct and indirect impacts were not determined quantitatively in this study and potential impacts were based on literature review.

Due to the implementation of the project controls, the mitigation potential is **medium,** and the loss of resource is **low**. The **direct negative** impact is **fully reversible**; however, the **indirect negative** impact for most sensitive receptors onshore will be **partially reversible**. The **indirect negative** impact offshore will be **fully reversible**.

There is the potential for accumulation (including the F-A Platform associated facility contributions in Years 0 to 25) and the ***potential of cumulative impacts*** arising is **possible** offshore and **likely** onshore.

The probability of the pre-mitigation impacts of the production years offshore cumulative operations (see **6.2.2**) comprising of TEEPSA operations and F-A Platform associated activities, are anticipated to be **highly likely** offshore and **possible** onshore. The pre-mitigation offshore cumulative operations impact degree of confidence both offshore and onshore is **medium** as the direct and indirect TEEPSA related impacts were not determined quantitatively in this study nor were all the source data for the F-A Platform provided, with potential impacts were based on literature review. The residual offshore cumulative operations impact degree of confidence both offshore and onshore is **medium** as the direct and indirect were not determined using only the source data for the F-A Platform provided. The mitigation potential is **medium**, the loss of resource is **low**. The **indirect negative** impact of the production years offshore cumulative operations (see **6.2.2**) offshore and onshore is **fully reversible** and **partially reversible**, respectively. The ***potential of cumulative impacts*** incorporated into **Table 8-1** and **Table 8-2** already consider F-A Platform.

Table 8-1: Impact significance of the project offshore operations with development and / or exploration well test flaring

Project Phase:	**Offshore and Onshore Normal Operations with Well Test Flaring**			
Impacted Area	**Offshore**		**Onshore**	
Type of Impact	**Direct and Indirect (indirect assessed)**			
Nature of Impact	**Negative**			
Sensitivity of Receptor	**LOW**		**HIGH**	
	Pre-Mitigation Impact	**Residual Impact**	**Pre-Mitigation Impact**	**Residual Impact**
Magnitude (Consequence)	VERY LOW	VERY LOW	VERY LOW	VERY LOW
Intensity	LOW	VERY LOW	LOW	LOW
Extent	REGIONAL	REGIONAL	LOCAL	LOCAL
Duration	SHORT-TERM	SHORT-TERM	MEDIUM TERM	MEDIUM TERM
Significance	NEGLIGIBLE	NEGLIGIBLE	LOW	LOW
Probability	HIGHLY LIKELY	HIGHLY LIKELY	POSSIBLE	POSSIBLE
Confidence	MEDIUM	HIGH	MEDIUM	MEDIUM
Reversibility	FULLY REVERSIBLE	FULLY REVERSIBLE	PARTIALLY REVERSIBLE	PARTIALLY REVERSIBLE
Loss of Resources	LOW	LOW	LOW	LOW
Mitigation Potential	-	MEDIUM	-	MEDIUM
Cumulative potential	POSSIBLE	POSSIBLE	LIKELY	LIKELY

Table 8-2: Impact significance of the project offshore operations without development and / or exploration well test flaring

Project Phase:	Offshore and Onshore Normal Operations without Well Test Flaring			
Impacted Area	Offshore		Onshore	
Type of Impact	Direct and Indirect (indirect assessed)			
Nature of Impact	Negative			
Sensitivity of Receptor	LOW		HIGH	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Magnitude (Consequence)	VERY LOW	VERY LOW	VERY LOW	VERY LOW
Intensity	VERY LOW	VERY LOW	VERY LOW	VERY LOW
Extent	REGIONAL	SITE	LOCAL	SITE
Duration	SHORT-TERM	SHORT-TERM	LONG-TERM	LONG-TERM
Significance	NEGLIGIBLE	NEGLIGIBLE	LOW	LOW
Probability	HIGHLY LIKELY	HIGHLY LIKELY	POSSIBLE	POSSIBLE
Confidence	MEDIUM	HIGH	MEDIUM	MEDIUM
Reversibility	FULLY REVERSIBLE	FULLY REVERSIBLE	PARTIALLY REVERSIBLE	PARTIALLY REVERSIBLE
Loss of Resources	LOW	LOW	LOW	LOW
Mitigation Potential	-	MEDIUM	-	MEDIUM
Cumulative potential	POSSIBLE	POSSIBLE	LIKELY	LIKELY

8.4 UNPLANNED EVENTS

8.4.1 IMPACT MAGNITUDE (OR CONSEQUENCE)

As mentioned above, it is anticipated that occupational exposure limits would be more applicable offshore rather than the NAAQS; however, in the case of a major unplanned event such as a well blow-out and / or fire the expectant emissions would potentially exceed the NAAQS onshore. Both the **direct and indirect negative** impacts are anticipated to be significant.

The impact would likely be **regional** (possibly even transboundary dependant on the volume of emissions and meteorological conditions), considered **medium intensity** (reversible over the medium term, and may affect a moderate proportion of receptors), and of **medium-term** duration (occurring when an unplanned event happens). Thus, the impact **magnitude** (or consequence) is **medium** (**Table 8-3**).

8.4.2 IMPACT SIGNIFICANCE

Based on the **low sensitivity** of the receptors offshore and the **medium magnitude**, the potential impact of emission to the atmosphere is of ***LOW*** **significance** without mitigation (**Table 8-3**).

Based on the **high sensitivity** of receptors onshore and the **medium magnitude**, the potential impact of concentrations in the port is of ***MEDIUM*** **significance** without mitigation (**Table 8-3**).

8.4.3 RESIDUAL IMPACT ASSESSMENT

This potential impact cannot be eliminated as the Project activities will generate emissions resulting in **direct** and **indirect negative** impacts which will affect sensitive receptors if an unplanned event occurs. With the implementation of the design / planned mitigation measures, the ***intensity*** and ***magnitude*** of the air quality impact could be reduced to **low**. Thus, the residual impact offshore and onshore is **VERY LOW significance** and **LOW significance**, respectively (**Table 8-3**).

8.4.4 ADDITIONAL ASSESSMENT CRITERIA

The additional assessment criteria are summarised in **Table** 8-3. Although there is the potential for accumulation, the **direct negative** impact is **fully reversible**; however, the **indirect negative** impact may be **partially reversible**. Due to the project controls that will be in place for significant spills, mitigation potential is **medium**.

Table 8-3: Impact significance of the project unplanned events

Project Phase:	**Unplanned Events – Well Blowout / Loss of Well Control and Fires**			
Impacted Area	**Offshore**		**Onshore**	
Type of Impact	**Direct and Indirect**			
Nature of Impact	**Negative**			
Sensitivity of Receptor	**LOW**		**HIGH**	
	Pre-Mitigation Impact	**Residual Impact**	**Pre-Mitigation Impact**	**Residual Impact**
Magnitude (Consequence)	MEDIUM	LOW	MEDIUM	LOW
Intensity	MEDIUM	LOW	MEDIUM	LOW
Extent	REGIONAL	REGIONAL	REGIONAL	REGIONAL
Duration	MEDIUM TERM	MEDIUM TERM	MEDIUM TERM	MEDIUM TERM
Significance	LOW	VERY LOW	MEDIUM	LOW
Probability	UNLIKELY	UNLIKELY	UNLIKELY	UNLIKELY
Confidence	MEDIUM	MEDIUM	MEDIUM	MEDIUM

Project Phase:	Unplanned Events – Well Blowout / Loss of Well Control and Fires			
Impacted Area	Offshore		Onshore	
Type of Impact	Direct and Indirect			
Nature of Impact	Negative			
Sensitivity of Receptor	LOW		HIGH	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Reversibility	PARTIALLY REVERSIBLE	PARTIALLY REVERSIBLE	PARTIALLY REVERSIBLE	PARTIALLY REVERSIBLE
Loss of Resources	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Mitigation Potential	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Cumulative potential	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE

9 EMISSIONS MANAGEMENT PLAN

9.1 MANAGEMENT MEASURES INCLUDING COMPLIANCE AND CORRECTIVE ACTIONS

The Project must have a complaint register at the logistics base as well formulate an alternative complaint logging procedure e.g., online system. All complaints should be responded to and where necessary investigations undertaken and reporting of findings to Authorities.

As discussed in **Section 6** should any unplanned events / incidents occur, TEEPSA should investigate the incident and report to the Local Authorities.

If some Project controls cannot be implemented or be adequately implemented, or complaints and unplanned event investigations indicate that there could be a notable increase in NO_x, PM, SO_x, VOCs emissions, additional measures must be implemented with an applicable management requirement being undertaking of dispersion studies. These studies should be undertaken on a case-by-case basis to assess the potential impact on air quality; one of these cases being the non-implementation of Project controls as specified below.

Once final design is completed, should there be increases to the amount of gas flared or changes in the proposed vessel fleet, as well as diesel use in generators and gas for turbines, boilers and / or heaters the changes should be screened in terms of the potential to negatively impact air quality and if required, an updated dispersion modelling exercise be undertaken. The level of assessment should be determined based on the updated emission calculations.

9.2 PROJECT CONTROLS

The following Project controls will be in place:

- TEEPSA will comply with the requirements set out in MARPOL Annex VI Regulation 18 - Fuel Quality. Project vessels will be supplied with marine gasoil (MGO) or heavy fuel oil (HFO) with less than 0.5% sulphur (mass).
- Project vessels will be operated and maintained to ensure the efficient consumption of fuel in completion of the required activities.
- Ensure that contractors make use of efficient flare tips, as appropriate.
- Optimise well test programme to reduce non-routine flaring as much as possible during the test.
- Commence with well testing during daylight hours where feasible due to poor dispersion potential during night-time hours.
- Use a high-efficiency burner for flaring to maximise combustion of the hydrocarbons to minimise emissions and hydrocarbon 'drop-out' during well testing.
- Flare inspections and maintenance, as well as performance monitoring, to ensure reduced malfunctions and interruptions.
- Burning emissions from well testing or purging shall be minimised by optimising the burning system design and the testing procedures.

9.3 RECOMMENDED MITIGATION MEASURES

The recommended mitigation measures are provided in **Table 9-1**.

Table 9-1: Recommended mitigation measures

Mitigation measure	Classification
▪ Optimise rig movement and the logistics (number of trips required to and from the onshore logistics base) to reduce fuel consumption. ▪ Maintain a record of fuel consumption for monthly submission to TEEPSA for reporting purposes. ▪ Use of onshore power supply during vessel hotelling rather than using onboard generators/boilers, when available. ▪ TEEPSA will continue to engage with PetroSA regarding the use of best available technology, good international industry practice in the operation and maintenance of the F-A Platform and compliance with permits.	Avoid / reduce at source
▪ Ensure no incineration of waste occurs within the port limits, subject to obtaining an atmospheric emissions licence.	Avoid

9.4 RECOMMENDED MONITORING

According to TotalEnergies standards, air quality monitoring should be undertaken in specific sensitive areas, and / or where measurement stations and / or detectors/monitors may be required to ensure a permanent monitoring/control of air quality. Cape St Francis Bay and Mossel Bay have been identified as areas most likely to be affected the most by the Project and sampling rather than monitoring can be undertaken. As the impact significance is estimated low, this sampling needs be conducted only if there are project controls that cannot be adequately implemented or if complaints are received by TEEPSA following the initiation of operations, especially in years were well drilling is taking place.

10 KEY FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

10.1 MAIN FINDINGS

10.1.1 BASELINE ASSESSMENT

The closest north-eastern point of the PR application area is about 75 km offshore from Cape St Francis, whereas the closest north-western point is about 120 km offshore from Mossel Bay. The source areas closest distance to the coast / towns[3] are:

- From the development area - 160 km.
- From the exploration area – 85 km.
- From the PetroSA Platform – 70 km.

Offshore meteorological conditions in Block 11B/12B are characterised by:

- Air temperature ranges from 8°C to 26.9°C and averages 19°C.
- The moisture content in the air (humidity) varies from 31% to 100%, with a mean of 77%.
- Westerly winds are predominant in winter and spring, with southerly winds in summer.
- Gale force winds (>60 km/hr) are common during winter whilst calm conditions are characteristic of autumn.

Meteorological conditions at Mossel Bay are characterised by:

- Air temperature ranges from 8°C (9°C lowest daily average) to 34°C (25°C highest daily average), with daily averages in the mid-teens to mid-twenties.
- The predominant winds are those from the southwest, northeast, and south. Spring and autumn winds are mainly from the north-east, south-west and south. Summer winds mainly originate from the north-easterly sector, while south-westerly winds are dominant during winter.
- Calm conditions (wind speeds < 1.0 m/s) occurred for more than a quarter of the year, with the majority occurring in Autumn. Summer had the lowest frequency of calm conditions.

Offshore, the main contributors to existing air pollutant concentrations include:

- Long-range transboundary transportation.
- Exhaust emissions from sea vessels.
- Offshore oil and gas exploration, extraction, processing, and combustion installations.

Within the ports and surrounding residential and commercial areas existing sources of emissions include:

- Light and medium industrial operations at the port.
- Land transport operations at and near the port including road and rail.
- Vessel manoeuvring, hotelling, refuelling, loading and offloading of cargo at the port.

3 Including Mossel Bay, Buffels Bay, Brenton-on-Sea, Knysna, and Plettenberg Bay.

- Vessel repair and maintenance operations at the port.
- Residential activities such as personal and public transport operations, residential fuel combustion, and informal refuse burning.
- Heavy industries usually operate outside of towns but often still impact air quality within nearby towns.

In addition to onshore sources, coastal maritime traffic can also add to onshore pollutant levels.

Although the logistics base will potentially be located at the ports of Mossel Bay, Gqeberha and/or Cape Town; the preferred and most likely port that support activities and equipment will operate from is Mossel Bay. Data was available on the SAAQIS for the 2022 calendar year from the Eskom owned Gourikwa Station in Mossel Bay (Department of Forestry, Fisheries and the Environment, 2023). Data recovery for the monitoring period was low, well below the minimum SANAS requirement of 90% and therefore compliance with the NAAQS cannot be accurately assessed.

10.1.2 IMPACT ASSESSMENT

The main findings for normal operations are as follows:

- Dispersion model results:
  - Although some scenarios have offshore concentrations above the NAAQS, it is important to note that the NAAQS are designed for human health impacts, and specifically relates to residents' exposure to certain pollutants on a long-term, consistent basis. This will not be the case offshore, with individuals exposed comprising those working at the offshore operations, in which case the OELs of the Occupational Health and Safety Act, (Act 85 of 1993), as amended will apply, or those traversing the operational area, in which case exposure will be very short-lived and comparison against the NAAQS is inappropriate.
  - As a result of offshore development activities, the simulated and calculated pollutant concentrations do not exceed the NAAQS at the coast.
  - Although subject to separate studies, the PetroSA F-A Platform operations were considered to estimate partial cumulative offshore activities scenarios. The emissions estimation and simulations were undertaken for all production years including Year 10 with multiple development activities. The calculated pollutant concentrations were below the NAAQS at the coast.
  - As a result of the support vessel activities at the port, the simulated and calculated pollutant concentrations do not exceed the NAAQS.
- The significance of offshore impacts is **negligible** and the onshore impacts **low**. The onshore impact significance is for all project operations and not only the support vessel operations at the port.
- Cumulative impacts offshore in the block are expected to be minimal; however, at the port, and near the coast (offshore and onshore) the cumulative ambient air pollutant concentrations could be elevated with baseline sources contributing the most to the cumulative pollutant concentrations.

10.2 RECOMMENDATIONS

In addition to implementation of the Project controls the following project-specific mitigation measures have been recommended for implementation:

- Optimise rig movement and the logistics (number of trips required to and from the onshore logistics base) to reduce fuel consumption.
- Maintain a record of fuel consumption for monthly submission to TEEPSA for reporting purposes.
- Use of onshore power supply during vessel hotelling rather than using onboard generators/boilers, when available.
- TEEPSA will continue to engage with PetroSA regarding the use of good international industry practice in the operation and maintenance of the F-A Platform.
- Ensure no incineration of waste occurs within the port limits, subject to obtaining an Atmospheric Emissions Licence.

In the case of direct emissions to atmosphere from unplanned events TEEPSA and / or the operator should ensure that there are adequate controls and backup measures in place and that these are correctly implemented.

TEEPSA and / or operator as well as service providers must provide initial and refresher training for operational, environmental, and emergency response plans.

Should any unplanned events occur, TEEPSA should investigate the incident and report it to the Local Authorities. If it affects I&APs or surrounding communities those affected should be notified of the possible impacts. A complaints register should be setup for the Project.

Once final design is completed, should there be increases to the amount of gas flared or changes in the proposed vessel fleet, as well as diesel use in generators and gas for turbines, boilers and / or heaters the changes should be screened in terms of the potential to negatively impact air quality and if required, an updated dispersion modelling exercise be undertaken. The level of assessment should be determined based on the updated emission calculations.

10.3 CONCLUSION

Based on the above key findings, WSP is of the opinion that the Project be authorised if the final Project design does not deviate from the considered controls. Recommended mitigation measures should be implemented to ensure emissions are controlled and impacts on the receiving environment reduced.

11 REFERENCES

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Appendix A

SPECIALIST CURRICULUM VITAE

Natasha Anne Shackleton

Earth & Environment – Air Quality, Principal Consultant

CAREER SUMMARY

Natasha is a registered Professional Natural Scientist (Pr. Nat. Sci.) with the South African Council for Natural Scientific Professions (SACNASP) currently employed as Principal Consultant at WSP Group Africa (Pty) Ltd. Natasha has over 12 years of experience in air quality studies and the development of air quality management plans including monitoring and sampling data analysis, emissions quantification, simulations using a range of dispersion models, impacts assessment and health risk screening assessments.

Countries of work experience include South Africa, Botswana, Burkina Faso, Gabon, Guinea, Lesotho, Madagascar, Mozambique, Namibia, Tanzania, Zambia, Zimbabwe, and Suriname.

EDUCATION

BSc Hons., Meteorology, University of Pretoria - Research project title: Retrieval of Relative Humidity and Cloud Thickness from CSIR-NLC Mobile LIDAR Backscatter Measurements - Research project supervisor: Dr S Venkataraman.	2011
BSc, University of Pretoria	2010

PROFESSIONAL HISTORY

WSP Group Africa (Pty) Ltd	May 2022 – present
Airshed Planning Professionals (Pty) Ltd	2011 – 2022

PROFESSIONAL MEMBERSHIPS

NACA - National Association for Clean Air	2020 – present
AMS – American Meteorological Society	2017 and 2018
SASAS – South African Society for Atmospheric Sciences	2016 – present
SACNASP - Certified Professional Natural Scientist with the South African Council for Natural Scientific Professions – Member No. 116335	2018 - present

PROFESSIONAL EXPERIENCE

National Ministry of Environment, UPL Cornubia Warehouse Fire, Durban, Kwa-Zulu Natal Province, South Africa

2022
Assisting Air Quality Specialist

Atmospheric Dispersion Modelling for the Air Quality Specialist Study used as input for a fire incident at a chemical storage facility.

Transnet Port Terminals, Transnet Port Terminals Multipurpose Terminal Expansion, Saldanha Bay, Western Cape Province, South Africa
2021 - 2022
Project Manager and Air Quality Specialist

Air Quality Specialist Study for Environmental Authorisation application process as well as the Atmospheric Impact Report as part of the Atmospheric Emission Licence application process for additional manganese storage at TPT multipurpose terminal operations at the Port of Saldanha. Study including the TPT bulk storage terminal operations at the Port of Saldanha. Study also included the surrounding industries and port operations.

SLR Consulting (Pty) Ltd, Cape Ocean Terminals Fuel Storage Facility, Saldanha Bay, Western Cape Province, South Africa 2021 - 2022
Project Manager and Air Quality Specialist

Air Quality Specialist Study for Environmental Authorisation amendment application process as well as the Atmospheric Impact Report as part of the Atmospheric Emission Licence application process for petroleum products storage and distribution facility.

Environmental Impact Management Services (Pty) Ltd, Acacia Peaking Power Station, Cape Town, Western Cape Province, South Africa 2019 - 2020
Project Manager and Air Quality Specialist

Atmospheric Impact Report with dispersion modelling was required as part of the Acacia Peaking Power Station Minimum Emission Standards Compliance Postponement Application.

SLR Consulting (Pty) Ltd, Green Oil and Lubricants Plant, Saldanha Bay, Western Cape Province, South Africa 2016
Project Manager and Air Quality Specialist

Air Quality Specialist Study for Environmental Authorisation application process as well as the Atmospheric Impact Report as part of the Atmospheric Emission Licence application process for used oil recycling and petroleum products storage.

SLR Consulting (Pty) Ltd, Phakisa Project, Saldanha Bay, Western Cape Province, South Africa 2015
Air Quality Specialist

Air Quality Specialist Study for Environmental Authorisation application process for an offshore vessel maintenance facility and petroleum products storage and distribution facility (inland).

SRK Consulting (South Africa) (Pty) Ltd, Tronox Namakwa Sands Mineral Separation Plant LNG Project, Lutzville / Vredendal, Western Cape Province, South Africa 2015
Project Manager and Air Quality Specialist

Air Quality Specialist Study for Environmental Authorisation application process as well as the Atmospheric Impact Report as part of the Atmospheric Emission Licence application process for heavy mineral sand processing operations with on-site LNG decompression facility for natural gas use as fuel for the dryers.

SLR Consulting (Pty) Ltd, Ibhubesi Gas Project, Saldanha Bay, Western Cape Province, South Africa 2015
Air Quality Specialist

Air Quality Specialist Study for Environmental Authorisation application process for gas pipeline.

SRK Consulting (South Africa) (Pty) Ltd, Transnet Port Terminals Bulk Terminal Tippler 3, Saldanha Bay, Western Cape Province, South Africa 2012
Air Quality Specialist

Air Quality Specialist Study for Environmental Authorisation application process as well as the Atmospheric Emission Licence application process for the handling of iron ore at TPT bulk terminal operations at the Port of Saldanha. Study including the surrounding industries and port operations.

Bradley Keiser

Earth & Environment, Director, Air Quality and Climate Change

CAREER SUMMARY

Brad is currently employed as a Director at WSP Group Africa, Earth & Environment. Brad has a BSc Honours degree in Geography and Environmental Management from the University of KwaZulu-Natal. Since completing his studies, Brad has worked as an Air Quality Specialist for seventeen years. Brad's key areas of expertise include ambient air quality monitoring, emissions inventories, dispersion modelling (AERMOD and CALPUFF) and licensing, having completed numerous Air Quality Impact Assessments, Atmospheric Impact Reports, Air Quality Management Plans and Atmospheric Emission License applications. Sectors in which Brad has substantial experience include mining, oil and gas, power and industrial.

Countries of work experience include South Africa, Botswana, Mozambique, Swaziland, Tanzania, Saudi Arabi and Australia.

13 years with WSP

Area of expertise

Ambient Air Quality Monitoring

Emission Inventories and Dispersion Modelling

Air Quality Impact Assessments, Atmospheric Impact Reports, and Air Quality Management Plans

Licensing

17 years of experience

Language

English - Fluent

EDUCATION

Bachelor of Science (Honours), Environmental Management, University of KwaZulu-Natal, Pietermaritzburg, South Africa — 2006

Bachelor of Science, Geography, University of KwaZulu-Natal, Pietermaritzburg, South Africa — 2005

ADDITIONAL TRAINING

Hazard Identification & Risk Assessment — 2016

Snake Awareness and First Aid for Snakebite and Scorpion Sting, African Snakebite — 2016

Legal Liability — 2016

Project Management, Graduate School of Business UCT — 2013

PROFESSIONAL MEMBERSHIPS

National Association for Clean Air — 2007 - Current

PROFESSIONAL HISTORY

WSP Group Africa (Pty) Ltd — July 2011 - present

Gondwana Environmental Solutions (Pty) Ltd — January 2007 – June 2011

PROFESSIONAL EXPERIENCE –

Oil & Gas

Vopak Durban Terminal, Environmental Advisory Role, South Africa 2022 – 2023
Project Director and Lead Consultant

Provision of guidance and support to Vopak focusing on areas of key non-compliance and developing plans of actions to address this until compliance is reached, inclusive of air quality and general environmental compliance with authorisations.

Vopak Durban Terminal, AEL Compliance Support, South Africa 2020 – 2023
Project Manager and Lead Consultant

Provision of AEL compliance support inclusive of fenceline monitoring, leak detection and repair, annual emissions inventory compilations with the use of emission factors and the US EPA TANKs model, AEL auditing, and annual reporting to NAEIS and eThekwini Metropolitan Municipality.

FFS Refiners, Atmospheric Impact Report for proposed expansions at the Maydon Wharf Tank Terminal South Africa 2023
Project Director

Compilation of an Atmospheric Impact Report, inclusive of an emissions inventory, AERMOD dispersion model, and recommendations to manage fugitive emissions due to the proposed expansions.

Bidvest Tank Terminals, Annual Emissions Inventory and NAEIS Reporting, South Africa 2021 – 2023
Project Director

Compilation of an annual emissions inventory for the Richards Bay, Isando and Durban Island View tank farms using emission factors and the US EPA TANKs model for reporting to NAEIS.

FFS Refiners, Atmospheric Screening Assessment for proposed product changes at the Cape Town Harbour Tank Farm, South Africa 2022
Project Manager and Lead Consultant

WSP undertook a screening assessment of the proposed changes in products to be stored when compared to a previous assessment to determine any substantial changes in emissions and impacts on the receiving environment.

NATREF, Passive Diffusive Monitoring at the NATREF Refinery, Free State, South Africa 2017 – 2023
Project Director

Radiello passive diffusive sampling was undertaken for BTEX, determining fenceline concentrations for compliance purposes and onsite concentrations for management purposes.

NATREF, Passive Diffusive Monitoring at NATCOS, KwaZulu-Natal, South Africa 2017 – 2023
Project Director

Radiello passive diffusive sampling was undertaken for BTEX, determining fenceline concentrations for compliance purposes and onsite concentrations for management purposes.

Total SA, Leak Detection and Repair, National, South Africa 2017
Project Manager

A leak detection and repair program was implemented at nine Total SA fuel depots with all flanges, valves and connections etc. being tested to identify leaks requiring maintenance.

Transnet Pipelines, Compliance Monitoring, National, South Africa 2014 – 2015
Project Manager

Radiello passive diffusive sampling for BTEX and leak detection and repair programs were undertaken at various depots across the country, inclusive of a number of air quality management reports to ensure compliance with AEL conditions.

FFS Refiners Evander, Passive Monitoring, Mpumalanga, South Africa 2012
Project Manager
Radiello passive diffusive monitoring was undertaken for BTEX as required within the facility AEL.

PROFESSIONAL EXPERIENCE –

Roads, Rail & Port

Airports Company South Africa, O.R. Tambo International Airport, Ambient Air Quality Monitoring, Somaliland 2021 - Current
Project Director

The monitoring includes monthly dust fallout monitoring at five fenceline locations at the ORTIA, active CO monitoring and passive monitoring for NO_2, SO_2 (Radiello) and BTEX (US EPA) conducted quarterly at twelve sites in and around the ORTIA.

DP World Berbera, Air Quality Impact Assessment for the Phase 2 Multipurpose Terminal Expansion, South Africa 2021 - 2022
Project Director

WSP was appointed to undertake a detailed Air Quality Impact Assessment for the Port of Berbera Multipurpose Terminal Phase 2 Expansion project, in Somaliland. The assessment included a baseline assessment, emissions inventory and dispersion modelling. Additionally, WSP also provided guidance in implementation of the Port's Masterplan from an air quality perspective.

Transnet Port Terminals, Ambient Monitoring, South Africa 2018-2019, 2022 – 2023
Project Director

The monthly maintenance and management of continuous particulate monitors and dust fallout samplers at the Maydon Wharf Terminal.

Transnet Port Terminals, Ambient Monitoring, South Africa 2018-2019, 2023
Project Director

The monthly maintenance and management of continuous particulate monitors and dust fallout samplers at the Richards Bay Terminal.

Transnet Port Terminals, Ambient Monitoring, South Africa 2018 – 2023
Project Director

Maintenance and management, including monthly reporting, of the meteorological stations located at various ports throughout South Africa.

Transnet Port Terminals, Air Quality Impact Assessment, South Africa 2018
Project Director

An AQIA was undertaken in support of an Atmospheric Emission License Application due to the proposed increase in throughputs at the Multi-Purpose Terminal at Saldanha Bay.

Transnet Port Terminals, Cape Town Harbour Terminal, Ambient Monitoring, Western Cape, South Africa 2017
Project Manager

Continuous particulates monitoring (PM_{10} and $PM_{2.5}$) and dust fallout monitoring at the Cape Town Harbour Terminal, with compliance assessment reports submitted on a monthly basis.

Transnet Port Terminals Saldanha Bay Terminal, Ambient Monitoring, Western Cape, South Africa 2016 – 2017
Project Manager

Dust fallout and dust flux monitoring at the Saldanha Terminal, including compilation of monthly compliance reports, inclusive of analysis of continuous stack monitoring data, particulate concentrations and meteorological conditions.

Transnet Port Terminals Saldanha Bay Terminal, Particulates Monitoring, Western Cape, South Africa 2015
Project Manager

Supply, installation and management of one continuous particulates monitor, including compilation of monthly compliance reports.

Transnet Port Terminals Saldanha Bay Terminal, Air Quality Impact Assessment, Western Cape, South Africa 2014
Project Manager

An AQIA was undertaken to investigate the relationship between iron ore emissions originating from the Saldanha Bay Terminal and staining in the nearby residential areas using the CALPUFF dispersion modelling platform.

Appendix B

LITERATURE REVIEWED

Information from the following publications, international guidance documents, and offshore oil and gas projects were consulted in undertaking the study:

- Gas Engineering Volume 2: Composition and Processing of Gas Streams (Speight, 2022).
- Offshore Oil and Gas Development and Production (Braxton, Stephens, & Stephens, 1977).
- US EPA Flare Efficiency Study (McDaniel, 1983).
- Emissions Estimation Protocol for Petroleum Refineries (RTI International, 2011).
- Flaring and Venting guidance (North Sea Transition Authority, 2021).
- Research studies on oil and gas exploration and production:
  - Estimation of Thermal Energy Release Rates from Gas Flare (A Case Study in Niger Delta Region) (Alagoa, Abovie, & Bunonyo, 2022).
  - Natural Gas Flaring - Alternative Solutions (Aregbe, 2016).
  - A Fifteen Year Record of Global Natural Gas Flaring Derived from Satellite Data (Elvidge, et al., 2009).
  - An Air Quality Emissions Inventory of Offshore Operations for the Exploration and Production of Petroleum by the Mexican Oil Industry (Villasenor, et al., 2003).
  - Technical Guideline for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry. A Companion to the South African National GHG Emissions Reporting Regulations (Department of Environmental Affairs, 2017).
- Oil and gas exploration and production environmental impact studies and management plans/programmes:
  - The Environmental and Social Impact Assessment for additional exploration drilling and associated activities in Block 11B/12B off the south coast of South Africa undertaken by SLR Consulting (Pty) Ltd) (SLR) (SLR, 2020; SLR, 2021).
  - The PetroSA Block 9 F-A Platform EMPr (Lwandle Technologies (Pty) Ltd & PetroSA, 2013).
  - The Proposed Development of the F-O Gas Field in Petroleum Licence Block 9 EIA undertaken by CCA Environmental[4] (CCA, 2011).
  - The Environmental Management Programme, F-O Production Area (CCA, 2011a).
  - Environmental Impact Report for an EIA for Prospecting Right Application for Offshore Sea Concessions 13C, 15C, Q6C, 17C & 18C, West Coast (SLR, 2021a).
  - Exploration Drilling within Block ER236, of the East Coast of South Africa (Eni, 2018)
- Research studies on marine traffic and port emissions:
  - A line Ship Emissions while Manoeuvring and Hotelling - A Case Study of Port Split (Bacalja, Krčum, & Slišković, 2020).
  - Current Methodologies and Best Practices for Preparing Port Emissions Inventories (Browning & Bailey, 2006).
  - Emissions Estimation Methodology for Ocean-Going Vessels (California Air Resources Board, 2011).

[4] CCA Environmental was acquired by SLR Consulting in 2014.

- Estimation of Shipping Emissions in a Developing Country; A Case Study of Mohammad Bin Qasim Port, Pakistan (Hussain, et al., 2022).
- Emissions estimate methodology for maritime navigation (Trozzi, 2010).
- Atmospheric ship emissions in ports: A correlation with data of ship traffic (Toscano & Murena, 2019).
- Fact #621: May 3, 2010, Gross Vehicle Weight vs. Empty Vehicle Weight (Vehicle Technologies Office, 2010).

The following were consulted for the emissions inventory:

- The United States Environmental Protection Agency (US EPA) Fifth Edition Compilation of Air Pollutant Emissions Factors (AP-42), Volume 1: Stationary Point and Area Sources:
  - Chapter 1, Section 3: Fuel oil combustion (United States Environmental Protection Agency (US EPA), 2010).
  - Chapter 3, Section 1: Stationary Gas Turbines (United Stated Environmental Protection Agency (US EPA), 2000a).
  - Chapter 3, Section 3: Natural Gas Processing (United States Environmental Protection Agency (US EPA), 1995).
  - Chapter 5, Section 1: Petroleum Refining (United States Environmental Protection Agency (US EPA), 2015).
  - Chapter 7: Liquid Storage Tanks (United States Environmental Protection Agency (US EPA), 2000b).
  - Chapter 13, Section 2: Paved Roads (United States Environmental Protection Agency (US EPA), 2011).
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