

**APPENDIX V**

# Greenhouse Gas Assessment

**REPORT**

# Greenhouse Gas Emissions Assessment: Application for EA and WUL for the proposed Turfvlakte Open Pit Mining Project at Grootegeeluk Coal Mine near Lephalale, Limpopo Province

*Exxaro Resources Limited*

Submitted to:

**Exxaro Resources Limited**

The ConneXXion  
263B West Ave  
Centurion  
0163

Submitted by:

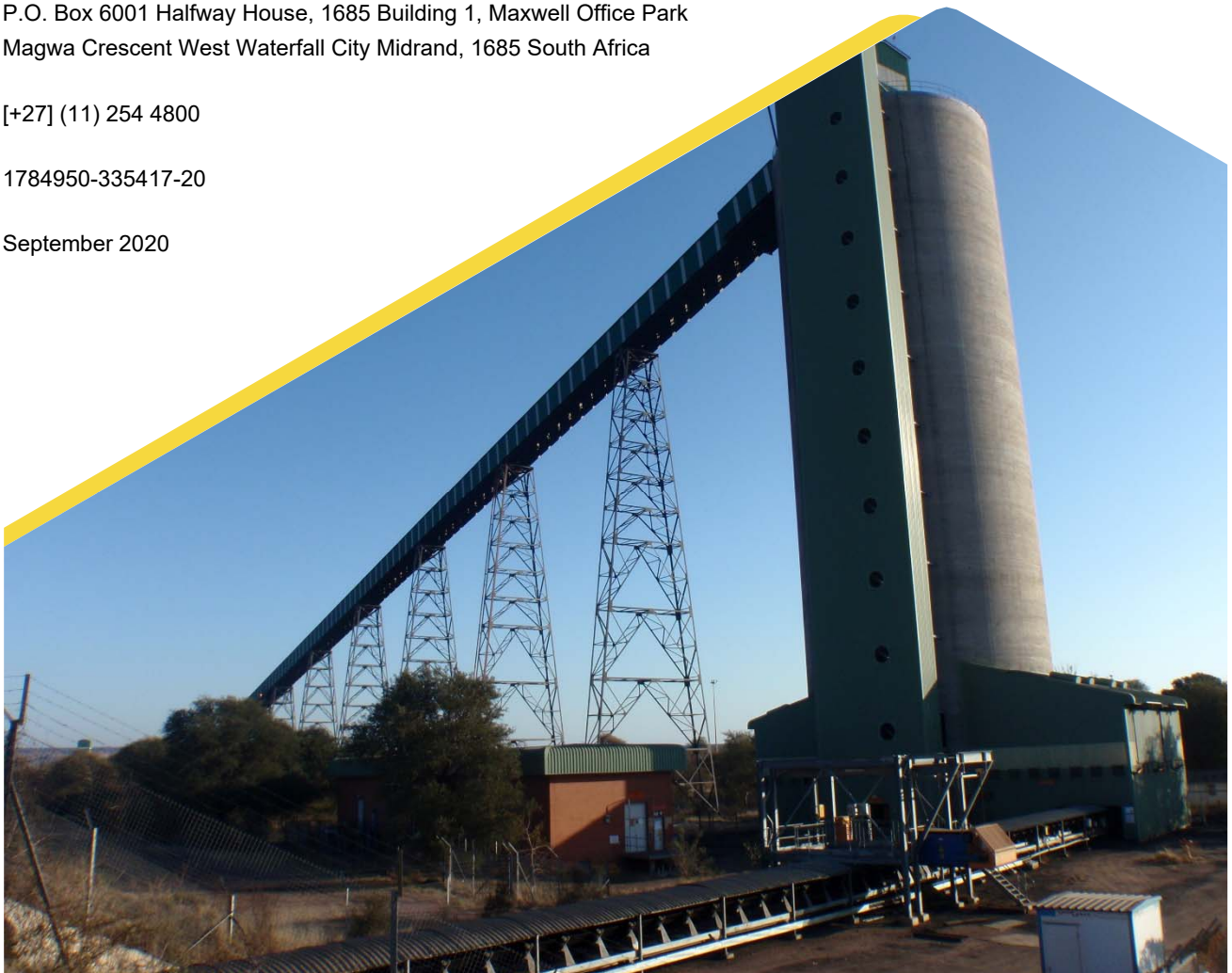
**Golder Associates Africa (Pty) Ltd.**

P.O. Box 6001 Halfway House, 1685 Building 1, Maxwell Office Park  
Magwa Crescent West Waterfall City Midrand, 1685 South Africa

[+27] (11) 254 4800

1784950-335417-20

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## Executive Summary

This greenhouse gas (“GHG”) emissions assessment was undertaken as part of the environmental impact assessment (“EIA”) process for the proposed Turfvlakte Open Pit Mining Project (“Turfvlakte Project” or the “Project”), located near the town of Lephalale, in the Limpopo Province.

The GHG emissions assessment was undertaken in accordance with the following local and international guidelines and standards:

- GHG Protocol Corporate Accounting and Reporting Standard
- DEFF’s Technical Guidelines for Monitoring, Reporting, Verification and Validation of Greenhouse Gas Emissions
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories

The following Scope 1 and 2 GHG emission were included in the assessment:

- Construction phase:
  - Diesel fuel
  - Land use change
- Operational phase:
  - Diesel fuel
  - Lubricants
  - Opencast coal mining
  - Purchased electricity
  - Land use change
- Closure phase:
  - Diesel fuel

Total GHG emissions during the construction phase are estimated to be 9 692.6 tCO<sub>2</sub>e. During the operational phase, total GHG emissions are estimated to be 270 280 tCO<sub>2</sub>e, with an average of 16 892.5 tCO<sub>2</sub>e per annum. Total GHG emissions during the closure phase are estimated to be 1 750.1 tCO<sub>2</sub>e.

The potential impact of the GHG emissions from Turfvlakte Projects was assessed in terms of the following three benchmarks (Table E.1):

**Table E.1: Summary of the potential impacts from Turfvlakte’s GHG emissions**

Potential impact	Significance
Contribution to South Africa’s national GHG emissions	Low
Product unit intensity	Low
Pre-defined thresholds	Low

Potential impact	Significance
Overall	Low

From a GHG emissions perspective and with the implementation of the mitigation measures listed below, the Turfvlakte Project is not deemed to present significant risk or impact:

- Install telemetry in all construction and fleet vehicles and monitor driver behaviour in terms of speeding, excessive braking, idling and so on. Investigate incidents of excessive consumption
- Investigate feasibility of using biofuel blend (up to 20% blend) in mining and fleet vehicles. Implement if found to be feasible and does not void warranty of vehicles (confirm with suppliers)
- Investigate feasibility of using diesel additives in mining and fleet vehicles. Implement if found to be feasible and does not void warranty of vehicles (confirm with suppliers)
- Develop and implement an energy management system based on ISO 50001 methodology at the processing plant to reduce energy consumption (and GHG emissions) from diesel and grid electricity consumption
- Investigate feasibility of installing wind turbines and/or a solar photovoltaic system onsite to reduce the usage of grid electricity which is relatively carbon intensive
- Investigate feasibility of purchasing renewable energy from an independent power producer through a wheeling agreement
- Where possible, undertake concurrent rehabilitation of disturbed areas to reinstate biomass (aboveground and below-ground) carbon stocks onsite

No offsets were considered in this assessment as no information regarding specific offsetting mechanisms was provided by Exxaro at the time that the report was being prepared.

## Abbreviations

Abbreviation	Description
AFOLU	Agriculture, forestry, and land use
CH <sub>4</sub>	Methane
CO <sub>2</sub>	Carbon dioxide
DEFF	Department of Environment, Forestry and Fisheries
DEFRA	Department for Environment, Food & Rural Affairs
EBRD	European Bank of Reconstruction and Development
Exxaro	Exxaro Resources Limited
EIA	Environmental impact assessment
F-gases	Fluorinated gases
FOLU	Forestry and other land use
GHG	Greenhouse gas
GHG Protocol	GHG Protocol Corporate Accounting and Reporting Standard
Golder	Golder Associates Africa (Pty) Ltd.
HFCs	Hydrofluorocarbons
INDC	Intended Nationally Determined Contribution
IPPU	Industrial processes and product use
LUCF	Land use change and forestry
Mtpa	Million tonnes per annum
MtCO <sub>2</sub> e	Million tonnes carbon dioxide equivalent
N <sub>2</sub> O	Nitrous oxide

Abbreviation	Description
NDC	Nationally Determined Contribution
NDP	National Development Plan
PFCs	Perfluorocarbons
Project site	Turfvlakte 463 LQ
ROM	Run-of-mine
SA-LEDS	South Africa's Low Emission Development Strategy 2050
SARS	South African Revenue Services
SF <sub>6</sub>	Sulphur hexafluoride
tCO <sub>2</sub> e	Tonnes of carbon dioxide equivalent
Turfvlakte Project	Turfvlakte Open Pit Mining Project
UNFCCC	United Nations Framework Convention on Climate Change
WTT	Well-to-tank

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## APPENDICES

### APPENDIX A

#### Document Limitations

## 1.0 INTRODUCTION

Golder Associates Africa (Pty) Ltd. (“Golder”) were appointed by Exxaro Resources Limited (“Exxaro”) to undertake a greenhouse gas (“GHG”) emissions assessment as part of the environmental impact assessment (“EIA”) process for the proposed Turfvlakte Open Pit Mining Project (“Turfvlakte Project” or the “Project”), located near the town of Lephalale, in the province of Limpopo.

The scope of work of this assessment was as follows:

- Identify and quantify significant sources of Scope 1 and Scope 2 emissions in the construction, operational, and closure phases
- Assess the impact of the Project's GHG emissions in terms of three benchmarks:
  - Contribution of the Project's GHG emissions to South Africa's annual GHG emissions
  - Emissions intensity of the Project against emitters in the same sector
  - Annual emissions of the Project against established thresholds
- Provide high level recommendations for reducing the Project's GHG emissions

## 2.0 BACKGROUND

### 2.1 Project Location

The Turfvlakte Project is located within the Lephalale Local Municipality, which falls within the boundaries of the Waterberg District Municipality, in the Limpopo Province.

More specifically, the Turfvlakte Project is located on the farm Turfvlakte 463 LQ (“Project site”) directly south of and within the existing Mining Right of Grootegeluk Coal Mine (Figure 1).

The Eskom Medupi Power Station is located to the south and privately-owned land to the east and southeast of the Project site. The Matimba Power Station is located approximately 3 km to the east of the Project site, Marapong approximately 5 km to the northeast, and Lephalale approximately 30 km southeast.

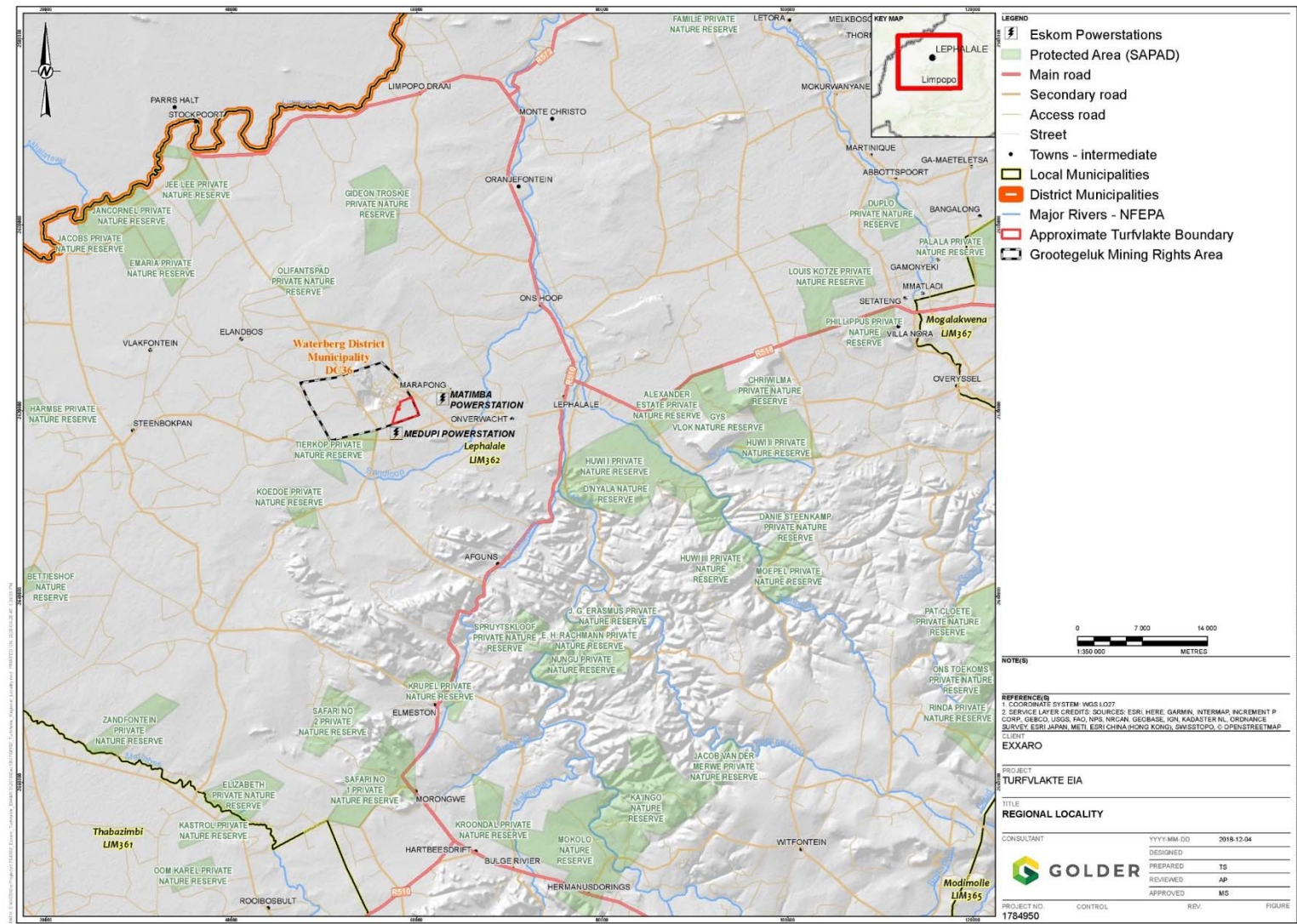


Figure 1: Regional locality of the Turfvlakte Project

## 2.2 Project Description

Exxaro is proposing to develop the Turfvlakte Project in order to augment the current production from Grootegeluk Coal Mine during periods when the main pit production is under pressure.

### Products

The Turfvlakte Project will mainly produce thermal coal for the local market.

### Mining Method

The topsoil from the open pit areas will be stripped prior to mining and will be stored on a dedicated topsoil stockpile located in the north western section of the Project site. The overburden (material that lies above the coal, such as the hards and softs) generated during the creation of the box cuts (first cut into the overburden to access the coal and interburden) will be stockpiled on the existing Dump 6 at the Grootegeluk Coal Mine. The interburden (material that separates the coal seams within strata) will be transported with the coal to the existing beneficiation plants at the Grootegeluk Coal Mine for further beneficiation.

Removal of topsoil, overburden, interburden, and coal will be done by means of draglines, bucket wheel excavators or bowl scrapers.

### Production Rates and Mining Schedule

The preferred option is to mine Pit 1 and then Pit 2 to produce 1.5 million tonnes per annum (“Mtpa”) run of mine (“ROM”) coal over a period of 16 years. Pit 1 will be mined from year 1 to 11, while Pit 2 will be mined from year 12 to 16. Mining operations will be undertaken 24 hours a day, six (6) days a week.

The alternative option is to mine the two pits concurrently, with Pit 1 being mined from year 1 to 4 and Pit 2 from year 1 to 7, to produce 3 mtpa ROM coal over a period of 7 years. This option was not considered further in this assessment as the mining schedule does not materially affect the GHG emissions. This is because it is the quantity of coal and not necessarily the rate at which it is mined that determines the emissions.

### Main Infrastructure:

Table 1 presents a brief description of the main infrastructure at the Turfvlakte Project. The proposed layout of the Project is shown in Figure 2. For contextual purposes, the location of the associated infrastructure at Grootegeluk Coal Mine is shown in Figure 3.

**Table 1: Main infrastructure at the Turfvlakte Project**

Infrastructure	Description
Open pits	The opencast operations will consist of two pits, namely Pit 1 and Pit 2. Pit 1 will be 158 ha in extent and will be 88 m deep, while Pit 2 will be 64 ha in extent and 109 m deep.
Roads	The Project site will be accessed via the existing tarred access roads to the Grootegeluk Coal Mine. New haul roads will be constructed at the Project site to tie into the existing haul roads at the Grootegeluk Coal Mine. The haul roads will be gravel surfaced and connect Pit 1, Pit 2, the infrastructure laydown area (also referred to as the ‘servitude for infrastructure’), and topsoil stockpile at the Project site with Dump 6 and the rest of the operational areas at the Grootegeluk Coal Mine.
Servitude for infrastructure	The servitude for infrastructure will be 18 ha in extent and will serve as an area for safe parking, offices, and equipment storage.

Infrastructure	Description
Storm water management	Cut-off berms and earth canals will be located upstream of the infrastructure areas to divert the clean water run-off around the dirty infrastructure areas. The contaminated run-off will be collected in concrete-lined channels that will connect with the existing storm water management system at the Grootegeeluk Coal Mine via the pit pumping system. Pit water will then be pumped to the relevant water storage facilities for reuse at the Grootegeeluk Coal Mine.
Water supply	Potable water will be pumped from the existing potable water system at the Grootegeeluk Coal Mine.
Sewage treatment	Sewage effluent will be transferred to the existing the existing sewage treatment facilities at the Grootegeeluk Coal Mine for treatment.
Electricity supply	Electricity will be supplied directly from the main Eskom 132/33 kV substation, as well as the proposed GG1/GG2 33 kV switching station at the Grootegeeluk Coal Mine.

## 2.3 Project Timeframes

The construction phase will likely commence in 2022 and last for approximately one year. The operational phase will be initiated after the completion of construction and will last approximately sixteen years (2023-2038) – see Figure 4. The closure phase will last approximately one year (2039).



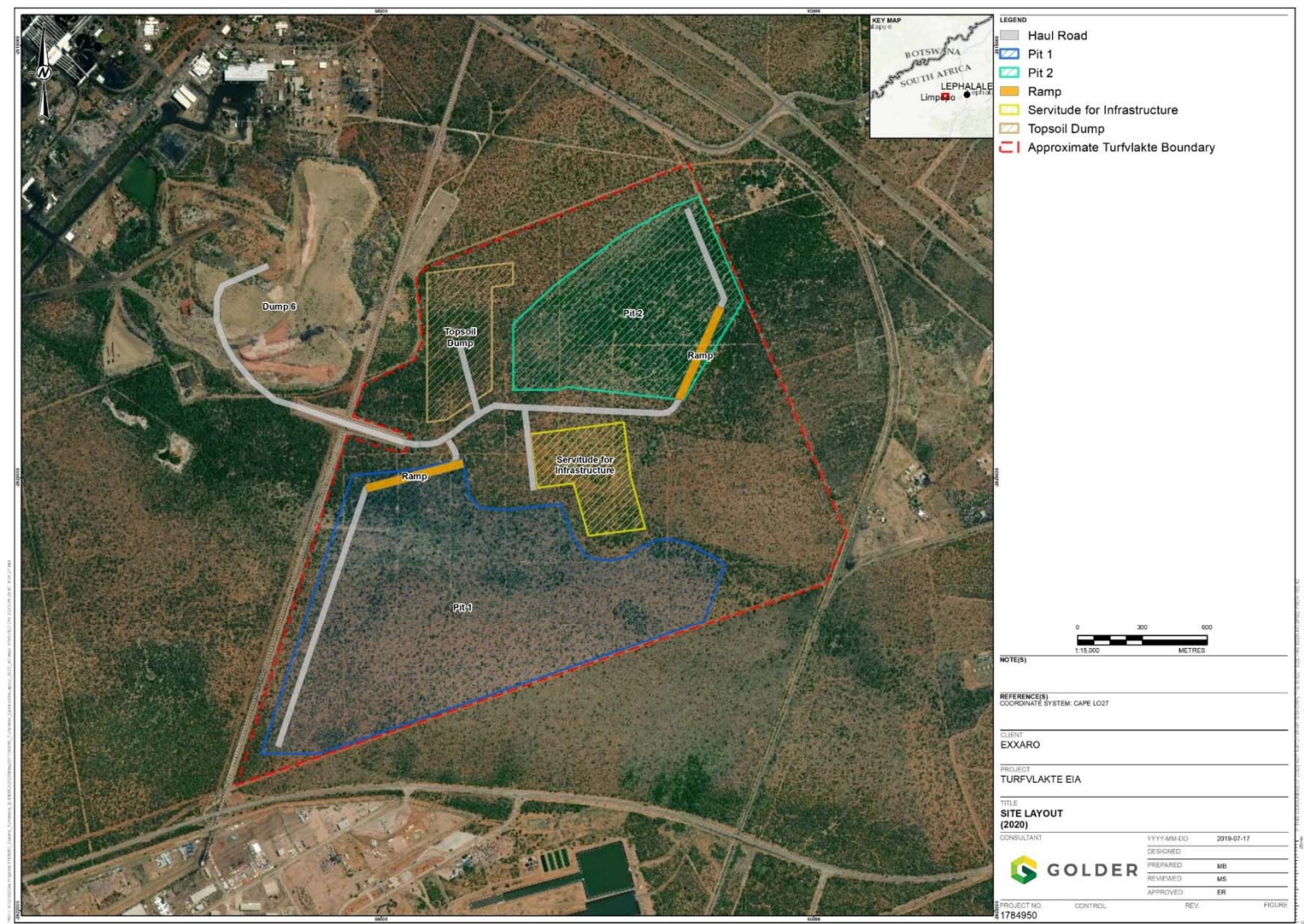


Figure 2: Proposed layout of the Turfvlakte Project



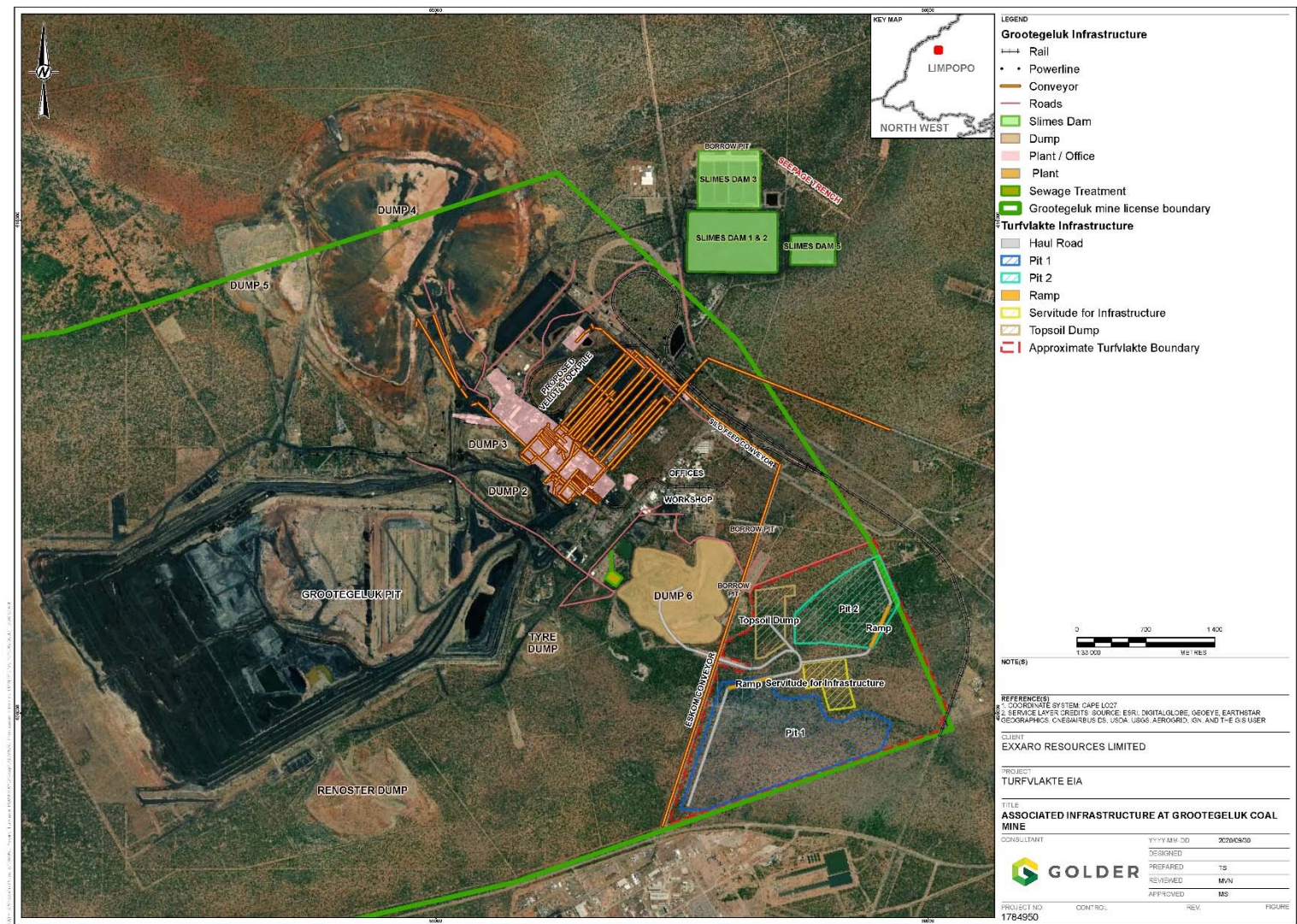


Figure 3: Location of associated infrastructure at the Grootegeluk Coal Mine



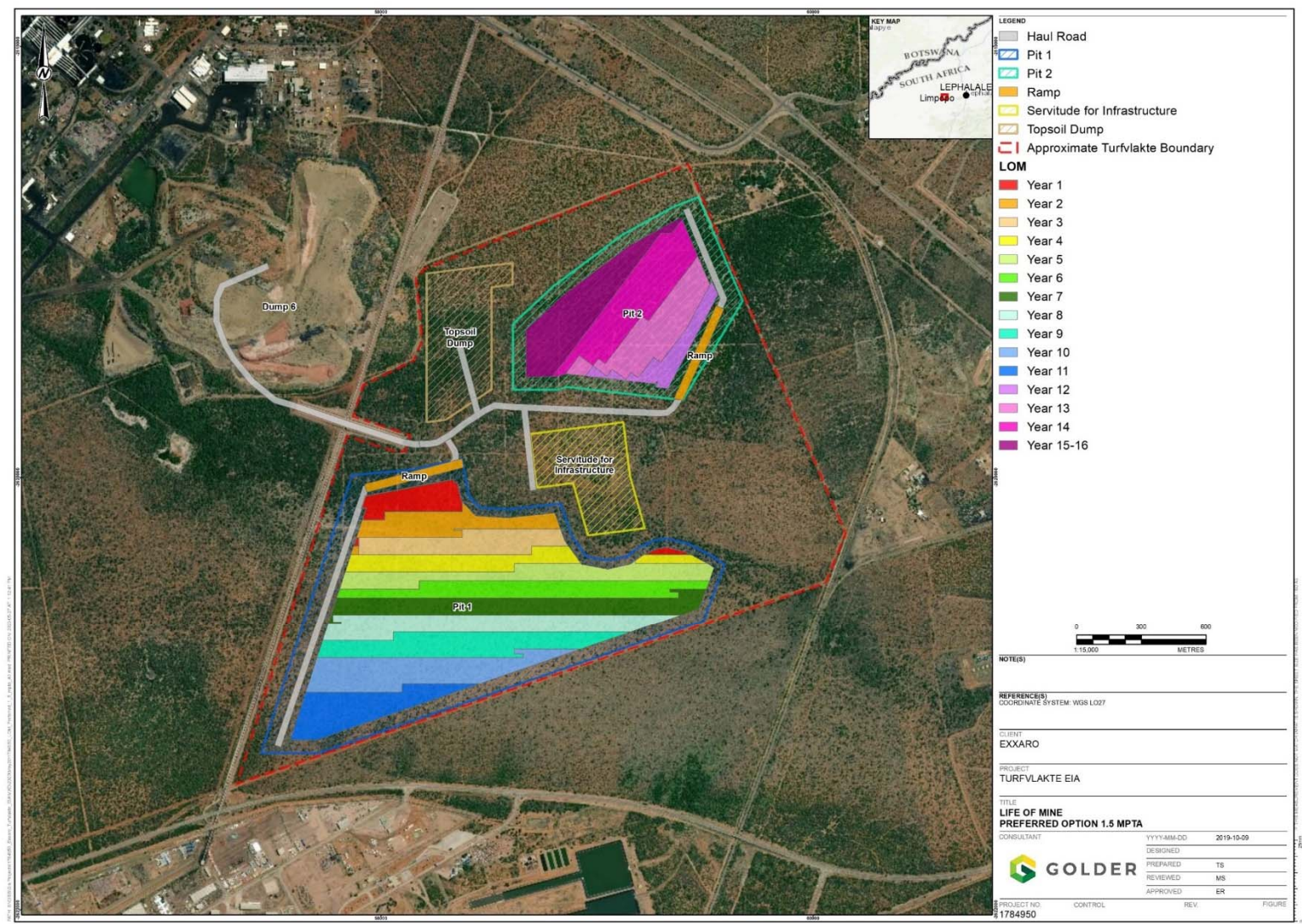


Figure 4: Proposed mining schedule of the Turfvlakte Project

## 3.0 LEGISLATIVE FRAMEWORK

This following section presents a broad overview of framework regulating greenhouse gas emissions globally and in South Africa. It is not intended to be a comprehensive review of all legislation, policies, and guidelines, but only those which are most applicable to the Turfvlakte Project.

### 3.1 Local Legislative Framework

#### 3.1.1 South-Africa's Low-Emission Development Strategy, 2020

South Africa's Low Emission Development Strategy 2050 ("SA-LEDS") sets out the country's long-term low GHG emission development strategies (DEFF, 2020). It has been developed in response to the requirements of the Paris Agreement (Section 3.2.4) and builds on South Africa's existing climate change policy framework.

The vision of the SA-LEDS is as follows:

*"South Africa follows a low-carbon growth trajectory while making a fair contribution to the global effort to limit the average temperature increase, while ensuring a just transition and building of the country's resilience to climate change"*

In the absence of an agreed quantitative articulation of the SA-LEDS vision, the peak, plateau, decline emissions trajectory range, as reflected in the National Climate Change Response White Paper and National Development Plan ("NDP") will be used.

The SA-LEDS centres on four key sectors of the economy, namely energy, industry, waste, and agriculture, forestry, and land use ("AFOLU"). The SA-LEDS also includes several cross-sectoral measures, such the carbon tax (Section 3.1.2), sectoral emissions targets, carbon budgets, and the phasing out of inefficient fossil fuel subsidies/incentives.

Within the energy sector, the SA-LEDS focuses on measures to decarbonise South Africa's energy supply. This includes the following measures:

- **Integrated Energy Plan:** Project the country's future energy requirements under a variety of different scenarios, including those with emissions limits and carbon prices
- **Integrated Resource Plan:** Diversification of the country's electricity generation mix and promoting the use of renewable energy and other low-carbon technologies
- **Biofuels opportunities:** Increase the volumes of biofuel that could be produced, without competing with food products for feedstocks

The SA-LEDS is to be implemented in the following three stages:

- **Starting Right (to be completed prior to end of 2021 financial year):** This stage will focus on developing long term plans for each sector, to avoid lock-in to emissions intensive infrastructure and establish the basis for transformation at scale. This stage will also focus on identifying the institutional, legislative, finance, and other changes required to achieve transformation, as well as developing an understanding of the relevant government decisions which need to be taken to achieve the long-term plans. A monitoring plan will also be developed during this stage
- **Turning the Corner (to begin in parallel with the Starting Right stage and continue to 2025):** This stage will be implemented in parallel with the "Starting Right" stage and focus on developing and beginning to implement detailed transformation plans for each sector. This stage will also focus on developing investment pathways to support the transformation, implementing foundational changes to

drive down the national trajectory, and implementing the institutional changes to accelerate the rate of transformation and remove barriers

- **Massive Rollout (2025 to 2050):** This stage will focus on rolling-out the implementation plans for each sector along with measures to support changes until they become the new reality, as well as refining strategies as required, to account for changes in technologies, society and market

### 3.1.2 Carbon Tax Act, 2019

The Carbon Tax Act, 2019 (Act No. 15 of 2019) was signed into law on 23 May 2019 and came into effect on 1 June 2019. Hereafter referred to as the Carbon Tax Act. The Carbon Tax Act is enacted through the Customs and Excise Amendment Act (Act No. 13 of 2019), which was signed into law on the same day.

The Carbon Tax Act gives effect to the ‘polluter pays principle’ where the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.

The Carbon Tax Act is aimed at reducing GHG emissions in a sustainable, cost effective, and affordable manner. By imposing a tax on GHG emissions and concomitant measures, such as providing tax incentives for rewarding the efficient use of energy, it is believed that the Carbon Tax Act will provide appropriate price signals to steer the economy towards a more sustainable growth path.

The Carbon Tax Act is administered by the South African Revenue Services (“SARS”). Carbon taxes are assessed, collected, and enforced as an environmental levy by the SARS in terms of Section 54A of the Customs and Excise Act (Act No. 91 of 1964). Companies liable for carbon taxes are required to submit yearly environmental levy accounts and payments as prescribed by rule in terms of the Customs and Excise Act, 1964, for every tax period.

In terms of the Carbon Tax Act, any company that conducts an activity which emits GHG emissions above the thresholds listed in Schedule 2 of the Act, is liable to pay carbon tax equivalent of those GHG emissions. The GHG emissions resulting from onsite fuel combustion, selected industrial processes and fugitive emissions must be calculated and reported according to the methodology approved by the Department of Environment, Forestry and Fisheries (“DEFF”).

According to Schedule 2 of the Act, there is currently no minimum threshold for fugitive emissions from coal mining and handling (IPCC Code 1B1a), which includes both underground mines (IPCC Code 1B1ai) and surface mines (IPCC Code 1B1aai).

### 3.1.3 Climate Change Bill, 2018

The objectives of the Climate Change Bill, 2018 are to (DEA, 2018):

- Provide for the coordinated and integrated response to climate change and its impacts by all spheres of government in accordance with the principles of cooperative governance
- Provide for the effective management of inevitable climate change impacts through enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to building social, economic, and environmental resilience and an adequate national adaptation response in the context of the global climate change response
- Make a fair contribution to the global effort to stabilise GHG concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe and in a manner that enables economic, employment, social and environmental development to proceed in a sustainable manner



In terms of GHG emissions and removals, the Minister must:

- Determine a national GHG emissions trajectory for South Africa which is binding on all organs of state in all spheres of government, and all persons to the extent applicable
- Determine sector emissions targets for GHG emitting sectors and sub-sectors. This includes the preparation of a sector emissions reduction plan which sets out how the relevant sector and sub-sector will meet the sector emissions targets within five years of the publication of the said targets
- Determine a GHG emissions threshold for the purposes of determining persons that will be allocated a carbon budget. A person to whom a carbon budget has been allocated is obliged to:
  - Comply with the carbon budget
  - Develop and implement an approved GHG mitigation plan
- Develop and implement a plan to phase down or phase out the use of synthetic GHGs

### 3.1.4 National Climate Change Response White Paper, 2012

The National Climate Change Response White Paper, 2012 presents South Africa's "*vision for an effective climate change response and the long-term, just transition to a climate-resilient and lower-carbon economy and society*" (DEA, 2012).

The main objectives of the White Paper are to:

- 1) Effectively manage inevitable climate change impacts through interventions that build and sustain South Africa's social, economic, and environmental resilience and emergency response capacity
- 2) Make a fair contribution to the global effort to stabilise GHG concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe that enables economic, social, and environmental development to proceed in a sustainable manner

The White Paper acknowledges that South Africa has relatively high emissions per capita or by GHG intensity (emissions per unit gross domestic product). This energy intensity is largely due to coal-intensive electricity generation, and mining, industry, and transport sectors.

The White Paper recognises that South Africa's GHG emissions could grow rapidly, by as much as four-fold, by 2050 if left unchecked. In contrast to other developing countries, South Africa has limited opportunities to reduce emissions by reducing deforestation as land use change only accounts for 5% of country's total GHG emissions. The White Paper focuses on electricity generation, mining, industry, and transport sectors as this is where the largest emission reduction potential exists. The main opportunities for mitigation include energy efficiency, demand management, and transition to a less emissions-intensive energy mix.

The White Paper supports policy decisions on new infrastructure investments which consider climate change impacts to avoid being locked into emissions intensive technologies in the future. However, given the current economic lifecycle of existing infrastructure, the most viable short-term mitigation options are energy efficiency and demand side management, coupled with increasing investment in a renewable energy programme. The White Paper also recognises that there are sectors of economy which are emissions-intensive and/or trade-exposed that are vulnerable impacts of climate change regulation, the application of trade barriers, a shift in consumer preferences, and a shift in investor priorities. This includes sectors, such as iron and steel, non-ferrous metals, chemicals and petrochemicals, mining and quarrying, machinery, and manufacturing.

### 3.1.5 National Development Plan 2030

The NDA aims to eliminate poverty and reduce inequality by 2030 (NPC, 2012).

In terms of GHG emissions, the NDA recognises that South Africa needs to reduce its GHG emissions and to improve energy efficiency. This will be achieved by meeting the following selected objectives:

- Achieve the peak, plateau, and decline trajectory for GHG emissions, with the peak being reached around 2025
- By 2030, an economy-wide carbon price should be entrenched
- Zero emission building standards by 2030
- Absolute reductions in the total volume of waste disposed to landfill each year
- At least 20 000 MW of renewable energy should be contracted by 2030

In order to meet these objectives, the following selected actions are required:

- An independent climate change centre, in partnership with academic and other appropriate institutions, is established by government to support the actions of government, business, and civil society
- Carbon price, building standards, vehicle emission standards and municipal regulations to achieve scale in stimulating renewable energy, waste recycling and in retrofitting buildings
- Carbon-pricing mechanisms supported by a wider suite of mitigation policy instruments to drive energy efficiency
- All new buildings to meet the energy efficiency criteria set out in South African National Standard 204: 2011.

The NDA recognises that power generation plants contribute about half of South Africa's current greenhouse gas emissions. Furthermore, if the energy sector follows the proposed carbon emissions scenario of peak, plateau and decline, the balance of new capacity will need to come from gas, wind, solar, imported hydroelectricity and possibly a nuclear programme from about 2023. Programmes to curb demand will also be necessary.

The NDA also recognises that the mining sector is a relatively minor contributor to South Africa's GHG emissions, accounting for 13.5% of the country's emissions, of which 9.9% consists of indirect emissions (Scope 2) and the remaining 3.6% from direct emissions (Scope 1).

### 3.1.6 National Greenhouse Gas Emission Reporting Regulations, 2017

The National Greenhouse Gas Emission Reporting Regulations, 2017 were published under General Notice 275 in Government Gazette 40762 of 3 April 2017 (RSA, 2017a). Hereafter referred to as the "National GHG Emissions Reporting Regulations".

The purpose of the National GHG Emissions Reporting Regulations is to introduce a single national reporting system for the transparent reporting of GHG emissions, which will be used to:

- Update and maintain South Africa's GHG inventory
- Meet South Africa's reporting obligations under the United Framework Convention on Climate Change ("UFCCC")
- Inform the formulation and implementation of legislation and policy

The National GHG Emissions Reporting Regulations apply to a holding company, corporation, or legal entity registered in South Africa who are in control of or conduct any activity above the threshold in listed Annexure 1 of the Regulations.

### 3.1.7 Declaration of Greenhouse Gases as Priority Pollutants, 2017

The Declaration of Greenhouse Gases as Priority Pollutants, 2017 was published under Government Notice 710 in Government Gazette 40996 of 21 July 2017 (RSA, 2017b).

In terms of this notice, the following GHGs are declared priority air pollutants:

- 1) Carbon dioxide (CO<sub>2</sub>)
- 2) Methane (CH<sub>4</sub>)
- 3) Nitrous oxide (N<sub>2</sub>O)
- 4) Hydrofluorocarbons (HFCs)
- 5) Perfluorocarbons (PFCs)
- 6) Sulphur hexafluoride (SF<sub>6</sub>)

In accordance with this notice, any holding company, corporation, or legal entity registered in South Africa conducting a production process set out in Annexure A of the notice which involves the emission of GHG in excess of 100 000 tonnes carbon dioxide equivalent (tCO<sub>2</sub>eq)), is required to submit a Pollution Prevention Plan to the DEFF for approval.

### 3.1.8 National Pollution Prevention Plans Regulations, 2017

The National Pollution Prevention Plans Regulations, 2017 were published under Government Notice 712 in Government Gazette 40996 of 21 July 2017 (RSA, 2017c). Hereafter referred to as the “National Pollution Prevention Plans Regulations”.

The purpose of the National Pollution Prevention Plans Regulations is to prescribe the requirements of pollution prevention plans which are prepared specifically for the mitigation of greenhouse gases declared as priority air pollutants in terms of the National Environmental Management: Air Quality Act (Act No. 39 of 2004), as amended.

## 3.2 International Legislative Framework

South Africa is a signatory to several climate change agreements which are discussed in more detail in the sections to follow.

### 3.2.1 United Nations Framework Convention on Climate Change, 1994

The UNFCCC came into force on 21 March 1994 (UNFCCC, 2020a). Currently, there are 197 parties to the UNFCCC. South Africa ratified the convention on 29 August 1997.

The aim of the UNFCCC is to stabilise greenhouse gas concentrations at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.

The UNFCCC recognises that economic development is critical to developing countries, and that economic progress will be difficult to achieve even without complications associated with climate change. As such, the UNFCCC accepts that the share of GHG emissions produced by developing countries will increase in the future. For UNFCCC to achieve its aim, support will need to be provided to developing countries so that they are able limit emissions in ways that will not hinder their economic progress.

### 3.2.2 Kyoto Protocol, 2005

The Kyoto Protocol came into force on 16 February 2005 (UNFCCC, 2020b). Currently, there are 192 Parties to the Kyoto Protocol. South Africa ratified the Kyoto Protocol on 31 July 2002.

The purpose of the Kyoto protocol is to operationalise the UNFCCC by committing industrialised countries to limit and reduce GHG emissions in accordance with agreed individual targets. The Kyoto Protocol only binds developed countries, and places a heavier burden on them, because it recognises that they are largely responsible for the current high levels of GHG concentrations in the atmosphere.

The Kyoto Protocol comprises of the following annexes:

- **Annex 1:** Developed countries and countries with economies in transition have binding emission reduction targets. These targets add up to an average 5% emission reduction compared to 1990 levels over the five-year period 2008–2012 (the first commitment period)
- **Annex II:** Developed countries which are required to provide financial resources to enable developing countries to undertake emissions reduction activities
- **Non-Annex 1:** Developing countries with no binding emission reduction targets. South Africa is listed as Non-Annex 1 country

One of the most important elements of the Kyoto Protocol was the establishment of flexible market mechanisms, to allow countries that are unable to meet their targets through national measures, to meet the targets by way of three market-based mechanisms. This includes:

- International Emissions Trading (between Annex 1 and 2 country)
- Joint implementation (between Annex 1 and 2 country)
- Clean Development Mechanism (between Annex 1 or 2 country and Non-Annex 1 country)

These mechanisms are meant to encourage GHG abatement where it is most cost-effective, such as in developing countries. The premise is that it does not matter where emissions are reduced, so long as they are removed from the atmosphere. The added benefit of these mechanisms is that they encourage the private sector to cut and hold steady GHG emissions at a safe level, to stimulate green investment in developing countries, and make leap-frogging (skipping the use of older, dirtier technology for newer, cleaner infrastructure and systems) more economical.

### 3.2.3 Copenhagen Accord, 2009

The Copenhagen Accord came out of COP15 (2009), which was held in Copenhagen, Denmark. This non-binding agreement was signed by 141 countries, including South Africa. One of the main elements of the Accord was requirement for countries to pledge to non-binding emission reduction targets. In accordance with this requirement, South Africa pledged, subject to receiving international support, to (DEA, 2010):

- Reduce GHG emissions by 34% by 2020 compared to business-as-usual
- Reduce emissions by 42% by 2025 compared to business-as-usual

### 3.2.4 Paris Agreement, 2016

The Paris Agreement came into force on 4 November 2016 (UNFCCC, 2020c). Currently, there are 125 Parties to the Agreement. South Africa signed the Agreement on 22 April 2016.



The purpose of the Agreement is to strengthen the global response to the threat of climate change, reaffirming the goal of limiting global temperature increase to well below 2°C, while pursuing efforts to limit the increase to 1.5°C. The agreement also aims to:

- Reach global peaking of GHGs as soon as possible, recognising that peaking will take longer for developing countries
- Conserve and enhance, as appropriate, sinks and reservoirs of GHGs
- Recognise possibility of voluntary cooperation/market- and non-market-based approaches
- Establish a global goal on adaptation to enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change
- Enhance understanding, action, and support on a cooperative and facilitative basis with respect to loss and damage associated with the adverse effects of climate change
- Reaffirm the obligation of developed countries to support the efforts of developing countries, while also other countries to make voluntary contributions
- Enhance climate change education, training, public awareness, public participation, and public access to information
- To undertake a “global stocktake” in 2023 and every 5 years thereafter, to assess collective progress toward achieving the purpose of the Agreement

In addition, the Agreement also requires all Parties to submit their Intended Nationally Determined Contributions (“INDCs”), which outline a country’s proposed mitigation and adaptation measures for the period post-2020. Upon ratification, an INDC becomes a Nationally Determined Contributions (“NDC”). Parties are also required to communicate their NDCs every 5 years and provide information necessary for clarity and transparency.

### 3.2.5 Nationally Determined Contribution

In accordance with the requirements of the Paris Agreement, to which South Africa is a signatory, the DEFF submitted South Africa’s first NDC to the UNFCCC secretariat (RSA, 2015). The NDC contains the steps that South Africa intends to take to reduce its GHG emissions and to adapt to climate change impacts, as well as the international support that is needed.

According to the NDC, South Africa has pledged to maintaining its national GHG emissions in the range of 398 to 614 million tonnes carbon dioxide equivalent (MtCO<sub>2e</sub>) over the period 2025 to 2030 (415 to 631 MtCO<sub>2e</sub> excluding land use change and forestry (“LUCF”). These levels are between 17% and 78% above 1990 levels (excluding LUCF).

The NDC recognises that South Africa faces significant rigidity in its economy and any policy-driven transition to a low carbon and climate resilient society must take into account and emphasise its overriding priority to address poverty and inequality.

## 3.3 Corporate Policies

### 3.3.1 Climate Change Position Statement

In 2020, Exxaro released its Climate Change Position Statement (Exxaro, 2020).

In this statement, Exxaro supports South Africa’s transition towards to a low-carbon economy within the principle of “Just Transition” and taking into account the contribution of coal in the socio-economic development of the country.

Exxaro aims to reduce its Scope 1 and Scope 2 GHG emissions to attain “carbon neutrality” by 2050. This will be achieved by incorporating low-carbon technologies and the use of self-generated renewable energy in Exxaro’s operations. Exxaro will also engage with their customers to support initiatives to reduce emissions from the use of their products, thereby reducing Scope 3 indirect emissions.

### 3.4 Baseline Greenhouse Gas Emissions

The following section presents a broad overview of South Africa’s current GHG emissions profile. This section is largely based on GHG National Inventory Report, 2000-2015 (DEA, 2016).

#### 3.4.1 Gross and Net Emissions

In 2015, South Africa’s gross emissions (exclude forestry and other land use (“FOLU”)) was estimated to be 540.9 million tonnes carbon dioxide equivalent (“MtCO<sub>2</sub>e”) (Table 2). Gross emissions increased by approximately 101.6 MtCO<sub>2</sub>e from 439.2 MtCO<sub>2</sub>e in 2000 to 540.9 MtCO<sub>2</sub>e in 2015, with an average annual increase of 1.5%.

With the inclusion of FOLU, South Africa’s net emissions was estimated to be 512.4 MtCO<sub>2</sub>e in 2015, approximately 28.5 MtCO<sub>2</sub>e (or 5.2%) less than gross emissions. Net emissions increased by approximately 86.2 MtCO<sub>2</sub>e from 426.2 MtCO<sub>2</sub>e in 2000 to 512.4 MtCO<sub>2</sub>e in 2015, with an average annual increase of 1.4%.

**Table 2: Gross and net emissions from 2000 to 2015 (DEA, 2016)**

Year	Gross (with FOLU)	Net (without FOLU)
2000	439.2	426.2
2001	438.2	423.8
2002	452.3	437.0
2003	473.9	460.8
2004	491.0	479.4
2005	488.7	477.8
2006	496.9	485.9
2007	523.8	514.5
2008	516.3	508.7
2009	521.2	510.2
2010	538.8	524.3
2011	522.9	511.4
2012	534.7	514.5
2013	554.7	527.5
2014	547.5	518.3
2015	540.9	512.4

### 3.4.2 Emissions Trends

#### Carbon Dioxide

In 2015, the gas which contributed the most to South Africa's gross emissions was CO<sub>2</sub>, increasing slightly from 84% in 2000 to 85% in 2015 (Figure 5). Gross CO<sub>2</sub> emissions was estimated to be 459.4 MtCO<sub>2</sub>e in 2015, while net CO<sub>2</sub> was estimated to be 431.5 MtCO<sub>2</sub>e. The energy sector is the largest contributor, accounting for approximately 92% of total CO<sub>2</sub> emissions in 2015.

#### Methane

CH<sub>4</sub> contributed approximately 9.4% to South Africa's gross emissions in 2015, decreasing slightly from 10.0% in 2000 (Figure 5). CH<sub>4</sub> emissions increased by 7.2 MtCO<sub>2</sub>e from 43.7 MtCO<sub>2</sub>e in 2000 to 51.0 MtCO<sub>2</sub>e in 2015. The waste sector and AFOLU livestock category were the largest contributors, accounting for approximately 36.7% and 55.0% of total CH<sub>4</sub> emissions, respectively.

#### Nitrous Oxide

N<sub>2</sub>O contributed approximately 4.5% to South Africa's gross emissions in 2015, decreasing slightly from 5.8% in 2000 (Figure 5). N<sub>2</sub>O emissions decreased by 1.1 MtCO<sub>2</sub>e from 25.5 MtCO<sub>2</sub>e in 2000 to 24.4 MtCO<sub>2</sub>e in 2015. The AFOLU and energy sectors were the largest contributors, accounting for approximately 84.5% and 10.7% of total N<sub>2</sub>O emissions, respectively.

#### Fluorinated Gases

The Fluorinated gases ("F-gases") include HFCs, PFCs, and SF<sub>6</sub>. F-gas emissions contributed approximately 1.1% to South Africa's gross emissions in 2015, increasing from 0.2% in 2000 (Figure 5).

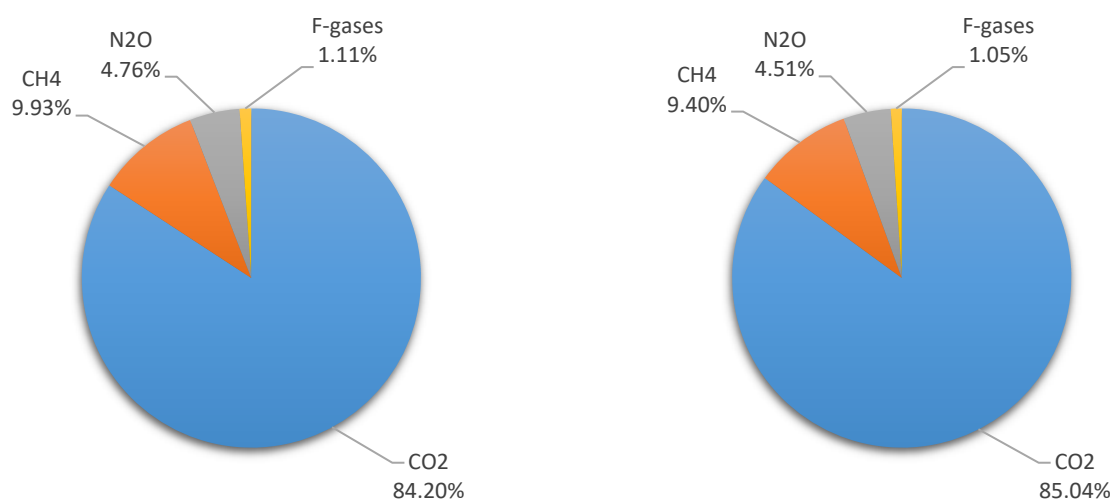


Figure 5: Percentage contribution of each gas to net (left) and gross (right) emissions in 2015 (DEA, 2016)

### 3.4.3 Sector Emissions

Table 3 presents a summary of sector emissions from 2000 to 2015.

#### Energy Sector

Total emissions from the energy sector was estimated to 429.9 MtCO<sub>2</sub>e in 2015, accounting for 79.5% of South Africa's total gross emissions. The 'energy industries' sub-sector was the main contributor, accounting for 60.4%

of the emissions in the energy sector. This was followed by the 'transport' (12.6%), 'other sectors' (11.4%), and 'manufacturing industries and construction' (8.6%) sub-sectors. Emissions from the energy sector increased by 86.1 MtCO<sub>2e</sub> (or 25%) from 343.8 MtCO<sub>2e</sub> in 2000 to 429.9 MtCO<sub>2e</sub> in 2015.

### Industrial Processes and Product Use

Total emissions from the industrial processes and product use ("IPPU") sector was estimated to 41.9 MtCO<sub>2e</sub> in 2015, accounting for 7.7% of South Africa's total gross emissions. The 'metal industry' sub-sector was the largest contributor, accounting for 73.9% of the emissions in the IPPU sector. This was followed by the 'mineral industries' (14.8%) and 'substitute ozone depleting substances' (8.3%) sub-sectors. Emissions from the IPPU sector increased by 7.8 MtCO<sub>2e</sub> (or 22.9%) from 34.1 MtCO<sub>2e</sub> in 2000 to 41.9 MtCO<sub>2e</sub> in 2015.

### Agriculture, Forestry, and Other Land Use

Gross emissions from the AFOLU sector was estimated to be 50.5 MtCO<sub>2e</sub> in 2015, accounting for 9.2% of South Africa's total gross emissions. Net emissions from the AFOLU sector was estimated to be 37.5 MtCO<sub>2e</sub> in 2015, accounting for 4.1% of South Africa's total net emissions. The 'livestock' and 'aggregated and non-CO<sub>2</sub> emissions from land categories' sub-sectors contributed 27.7 MtCO<sub>2e</sub> and 21.2 MtCO<sub>2e</sub> respectively, while the 'land' and 'other' sub-sectors were both sinks (27.2 MtCO<sub>2e</sub> and 0.7 MtCO<sub>2e</sub>, respectively). Gross emissions from the AFOLU sector decreased by 1 MtCO<sub>2e</sub> (or 2%) from 50.5 MtCO<sub>2e</sub> in 2000 to 49.5 MtCO<sub>2e</sub> in 2015, while net emissions from the AFOLU sector decreased by 16.5 MtCO<sub>2e</sub> (or 43.9%) from 37.5 MtCO<sub>2e</sub> in 2000 to 21.1 MtCO<sub>2e</sub> in 2015.

### Waste

Total emissions from the waste sector was estimated to 19.5 MtCO<sub>2e</sub> in 2015, accounting for 3.6% of South Africa's total gross emissions. The 'solid waste disposal' sub-sector was the largest contributor, accounting for 80.7% of the emissions in the waste sector. This was followed by 'wastewater treatment and discharge' which contributed 17.5%. Emissions from the waste sector increased by 8.7 MtCO<sub>2e</sub> (or 80.2%) from 10.8 MtCO<sub>2e</sub> in 2000 to 19.5 MtCO<sub>2e</sub> in 2015.

**Table 3: Change in sector emissions from 2000 to 2015 (DEA, 2016)**

Sector	Emissions (MtCO <sub>2e</sub> )		Change 2000 to 2015	
	2000	2015	MtCO <sub>2e</sub>	%
Energy	343.8	429.9	86.1	25
IPPU	34.1	41.9	7.8	22.9
AFOLU (excl. FOLU)	50.5	49.5	-1	-2
AFOLU (incl. FOLU)	37.5	21.1	-16.5	-43.9
Waste	10.8	19.5	8.7	80.2

## 3.5 Study Methodology

This GHG emissions assessment has been undertaken in accordance with the GHG Protocol Corporate Accounting and Reporting Standard ("GHG Protocol"). This standard was developed by the World Resources Institute and World Business Council for Sustainable Development, in consultation with businesses, non-governmental organisations, and governments (WBCSD and WRI, 2004). The aim was to develop an internationally accepted GHG accounting and reporting standard for organisations preparing a GHG inventory.

The standard covers the six GHGs covered by the Kyoto Protocol. This includes CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs, and SF<sub>6</sub>.

In addition to the GHG Protocol, this assessment was also undertaken in accordance with the following guidelines and standards:

- DEFF's Technical Guidelines for Monitoring, Reporting, Verification and Validation of Greenhouse Gas Emissions (2012)
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories

### 3.5.1 Project Boundaries

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

#### 3.5.1.1 Organisational Boundaries

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

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

This assessment reports on the GHG emissions for the Turfvlakte Project, in terms of the control approach, where Exxaro accounts for 100% of the estimated GHG emissions.

#### 3.5.1.2 Operational Boundaries

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

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

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

Figure 6 presents an overview of Scope 1, Scope 2, and Scope 3 emissions across the value chain of an organisation.

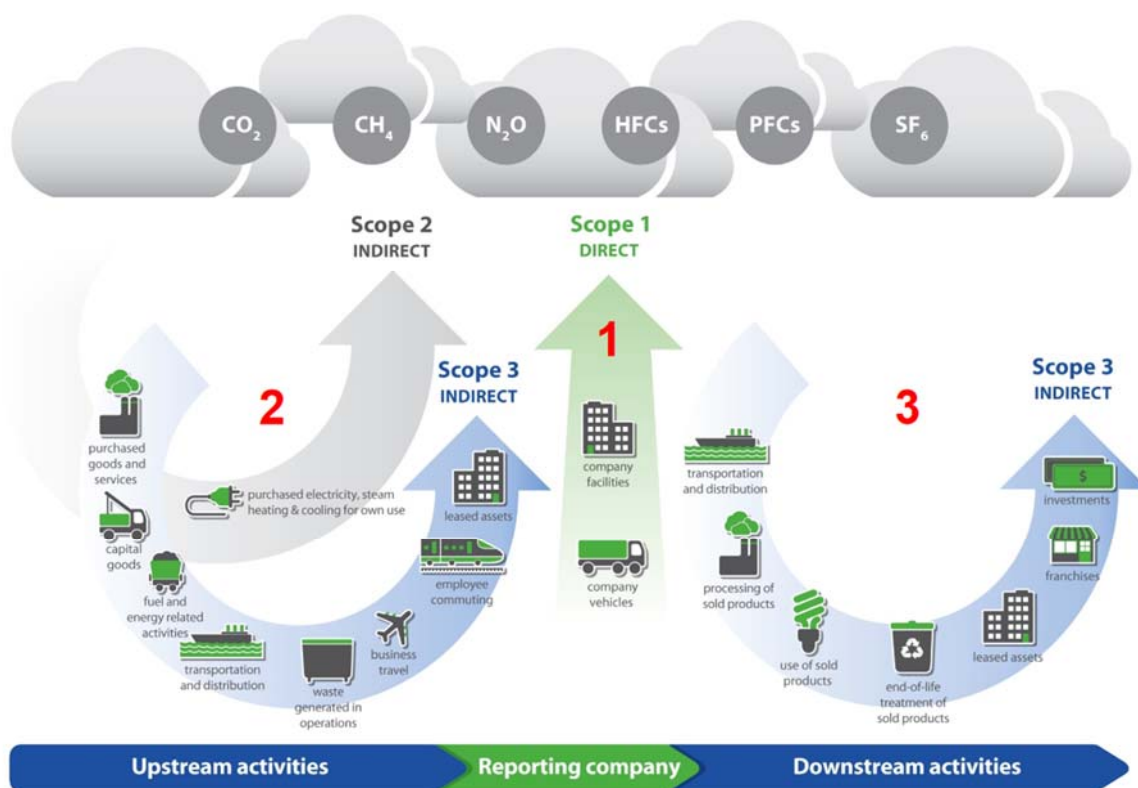


Figure 6: Overview of Scope 1, Scope 2, and Scope 3 emissions across the value chain (WBCSD & WRI, 2004)

In terms of the GHG Protocol, organisations are required to report on both Scope 1 and Scope 2 emissions.

Table 4 presents a summary of the sources of GHG emissions that were considered in this assessment, in each of the three project phases, namely construction, operation, and closure.

Table 4: Summary of GHG emissions sources included in the assessment

Phase	Scope 1	Scope 2	LULUCF
Construction	Diesel fuel	-	Land use change
Operational	Diesel fuel	Purchased electricity	Land use change
	Lubricants		
	Opencast coal mining (fugitive emissions)		
Closure	Diesel fuel	-	-

### 3.5.2 Reporting Period

The reporting period for the Turfvlakte Project is as follows:

- Construction phase: 2022 (one year)

- Operational phase: 2023 to 2038 (16 years)
- Closure phase: 2039 (one year)

This assessment is the first GHG inventory for the Turfvlakte Project, which can be used as a baseline against which to track and compare the GHG emissions of the Project over time. It is recommended that this inventory or baseline be retrospectively recalculated should any new or additional information become available, or there are changes to the project which would compromise the accuracy of the baseline.

Further to this, it is recommended that the GHG baseline be reviewed, and updated if required, on an annual basis during the operational phase. Importantly, the baseline should be informed by credible data.

### 3.5.3 Exclusions

Table 5 presents a summary of the sources of GHG emissions that have been excluded from this assessment, and the justification for their exclusion.

**Table 5: Excluded GHG emissions**

Scope	Activity	Emissions Source	Comment
1	Petrol	Fleet vehicles	The GHG emissions from use of petrol in fleet vehicles has been excluded from this assessment as this is expected to be minimal (due to limited number of petrol vehicles, if any, that will be used onsite), and to have limited impact on the overall GHG emissions.
1	Fugitive emissions	Refrigeration and air-conditioning	The fugitive GHG emissions from refrigeration and air-conditioning has been excluded from this assessment as this is expected to be minimal (due to limited number of offices that will be onsite), and to have limited impact on the overall GHG emissions.
3	Solid waste disposal	Managed waste disposal site	The fugitive GHG emissions from disposal of solid waste to landfill has been excluded from this assessment as this is expected to be minimal (due to the limited number of staff that will be onsite), and to have limited impact on the overall GHG emissions.
3	Potable water	Potable water distribution	The GHG emissions from the distribution of potable water has been excluded from this assessment as this is expected to be minimal (due to the limited number of staff that will be onsite), and to have limited impact on the overall GHG emissions.
3	Wastewater treatment and discharge	Sewage treatment plant	The fugitive GHG emissions from treatment and discharge of domestic/industrial wastewater has been excluded from this assessment as this is expected to be minimal (due to the limited number of staff that will be onsite), and to have limited impact on the overall GHG emissions.
3	Business travel	Public and private transport to site	The GHG emissions resulting from the travel of employees to and from site has been excluded from



Scope	Activity	Emissions Source	Comment
			this assessment as this is expected to be minimal (due to the limited number of staff that will be onsite), and to have limited impact on the overall GHG emissions.

### 3.6 Scope 1 and 2 Emissions

The following section presents the estimated Scope 1 and Scope 2 emissions of the proposed Turfvlakte Project during the construction, operational, and closure phases.

The calculation of the GHG emissions was based on the methodology as outlined above in Section 3.5. The activity data, which are defined as the non-financial data associated with activities that generate emissions during the reporting period, were sourced from several documents provided by Exxaro.

#### 3.6.1 Construction Phase

##### 3.6.1.1 Diesel Fuel

During the construction phase, diesel-powered plant and equipment will be used for site preparation. It is anticipated that this will include, but not be limited, to the following:

- **Clearing and grubbing:** CAT D9 (or similar)
- **Minor excavation:** CAT 330 (or similar)
- **Dozing:** CAT D7 (or similar)

The annual diesel consumption of this plant and equipment was based on a development footprint of 265.7 ha (Pit 1, Pit 2, topsoil dump, servitude for infrastructure, and haul roads), the type of plant or equipment to be used, the estimated running time (hours), and average diesel consumption (ℓ/hr). It is estimated that a total of 442 835 litres of diesel will be consumed during the construction phase (Table 6).

The GHG emissions from the consumption of diesel fuel was based on the calorific value (938.1 MJ/ℓ) and default emissions factors (74 100 kgCO<sub>2</sub>e/TJ) of diesel fuel, as well the global warming potential (CO<sub>2</sub>: 1; NH<sub>4</sub>: 23 N<sub>2</sub>O: 296). It is estimated that the GHG emissions from the consumption of diesel fuel will be 1 395 tCO<sub>2</sub>e during the construction phase (Table 6).

**Table 6: Estimated GHG emissions from diesel consumption during the construction phase**

Activity	Diesel consumption (Litres)	GHG emissions (tCO <sub>2</sub> e)
Clearing and grubbing	132 309.0	416.7
Minor excavation	194 065.7	611.2
Dozing	116 460.6	366.8
<b>Total</b>	<b>442 835.2</b>	<b>1 394.7</b>



### 3.6.1.2 Land Use Change

The total footprint of Turfvlakte Project's infrastructure will be approximately 265.7 ha. During the construction phase, approximately 103.1 ha will be cleared of vegetation for the construction of the haul roads, ramps, topsoil dumps, and laydown area or servitude for infrastructure (Figure 4).

The GHG emissions from the land use change was based on the loss of carbon locked in above-ground biomass (120 tonnes dry matter per hectare), below ground biomass (33.6 tonnes dry matter per hectare), dead wood and litter (2.1 tonnes carbon per hectare), and mineral soils (6.2 tonnes carbon per hectare). As shown in Table 7, the GHG emissions from the land use change was estimated to be 8 298 tCO<sub>2</sub>e. The loss of carbon locked in biomass (above-ground and below ground) is the largest contributor (89.7%), followed by the loss of carbon locked in the mineral soils (7.7%) and dead wood and litter (2.6%).

**Table 7: Estimated GHG emissions from land use change during the construction phase**

Year	Area (ha)	Biomass (tCO <sub>2</sub> e)	Dead wood & litter (tCO <sub>2</sub> e)	Mineral soils (tCO <sub>2</sub> e)	Total emissions (tCO <sub>2</sub> e)
2022	103.1	7 442.3	216.5	639.2	8 298.0
<b>Total</b>	<b>103.1</b>	<b>7 442.3</b>	<b>216.5</b>	<b>639.2</b>	<b>8 298.0</b>

### 3.6.2 Operational Phase

#### 3.6.2.1 Diesel Fuel

During the operational phase, diesel-powered plant and equipment will be used. It is anticipated that this will include, but not be limited, to the following:

- **Heavy duty vehicles:** Rock breakers, front end loaders, track dozers, wheeled dozers, excavators, road graders, water trucks, tippers, haul trucks, low-bed trucks
- **Light duty vehicles:** Single cab utility vehicles and twin cab utility vehicles
- **Equipment:** Standby generators, compressors, vibrating compactors, and dewatering pumps

As the Turfvlakte Project is effectively an extension of the Grootegeeluk Coal Mine, the product unit intensity (i.e. litres of diesel per tonne of ROM coal) of the Grootegeeluk Coal Mine in 2019 was used to calculate the annual diesel consumption of the Turfvlakte Project.

It is estimated that a total of 22.9 million litres of diesel will be consumed during the operational phase, with an average of 1.4 million litres per annum (Table 8). The GHG emissions from the consumption of diesel fuel was based on the calorific value (938.1 MJ/l) and default emissions factors (74 100 kgCO<sub>2</sub>e/TJ) of diesel fuel, as well the global warming potential (CO<sub>2</sub>: 1; NH<sub>4</sub>: 23 N<sub>2</sub>O: 296). It is estimated that the GHG emissions from the consumption of diesel fuel during the operational phase will be 72 188.2 tCO<sub>2</sub>e, with an average of 4 512.8 tCO<sub>2</sub>e per annum.

**Table 8: Estimated GHG emissions from diesel consumption during the operational phase**

Year	Diesel consumption (Litres)	GHG emissions (tCO <sub>2</sub> e)
2023	1 432 583.9	4 511.8

Year	Diesel consumption (Litres)	GHG emissions (tCO <sub>2e</sub> )
2024	1 432 583.9	4 511.8
2025	1 432 583.9	4 511.8
2026	1 432 583.9	4 511.8
2027	1 432 583.9	4 511.8
2028	1 432 583.9	4 511.8
2029	1 432 583.9	4 511.8
2030	1 432 583.9	4 511.8
2031	1 432 583.9	4 511.8
2032	1 432 583.9	4 511.8
2033	1 432 583.9	4 511.8
2034	1 432 583.9	4 511.8
2035	1 432 583.9	4 511.8
2036	1 432 583.9	4 511.8
2037	1 432 583.9	4 511.8
2038	1 432 583.9	4 511.8
<b>Total</b>	<b>22 921 342.9</b>	<b>72 188.2</b>

### 3.6.2.2 Lubricants

During the operational phase, the diesel-powered plant and equipment used for mining will require lubricants, such as hydraulic oil, engine oil, and transmission oil.

As the Turfvlakte Project is effectively an extension of the Grootegeluk Coal Mine, the product unit intensity (i.e. litres of lubricants per tonne of ROM coal) of the Grootegeluk Coal Mine in 2019 was used to calculate the annual lubricant consumption of the Turfvlakte Project.

It is estimated that a total of 359 988.5 litres of lubricants will be consumed during the operational phase, with an average of 22 499.3 litres per annum (Table 9). The GHG emissions from the consumption of lubricants was based on the density (0.884 kg/l) and calorific value of the lubricants (0.0402 TJ/t), as well as the carbon content (0.9% C/TJ), oxidised during use factor (0.2), and mass ratio (3.67). It is estimated that the GHG emissions from the consumption of lubricants during the operational phase will be 8.4 tCO<sub>2e</sub>, with an average of 0.5 tCO<sub>2e</sub> per annum.

**Table 9: Estimated GHG emissions from lubricant consumption during the operational phase**

Year	Lubricant consumption (Litres)	GHG emissions (tCO <sub>2</sub> e)
2023	22 499.3	0.5
2024	22 499.3	0.5
2025	22 499.3	0.5
2026	22 499.3	0.5
2027	22 499.3	0.5
2028	22 499.3	0.5
2029	22 499.3	0.5
2030	22 499.3	0.5
2031	22 499.3	0.5
2032	22 499.3	0.5
2033	22 499.3	0.5
2034	22 499.3	0.5
2035	22 499.3	0.5
2036	22 499.3	0.5
2037	22 499.3	0.5
2038	22 499.3	0.5
<b>Total</b>	<b>359 988.5</b>	<b>8.4</b>

### 3.6.2.3 Opencast Coal Mining

The Turfvlakte Project consists of two open pits, namely Pit 1 and Pit 2, which will be mined over a period of 16 years to produce 1.5 Mtpa ROM coal.

The fugitive GHG emissions from opencast coal mining was based on Exxaro's company-specific factor for surface mining and post-mining emissions of 0.46 tCO<sub>2</sub>e per tonne of ROM coal. It is estimated that the GHG emissions from opencast coal mining during the operational phase will be 11 018.6 tCO<sub>2</sub>e, with an average of 688.7 tCO<sub>2</sub>e per annum.

**Table 10: Estimated fugitive GHG emissions from opencast coal mining during the operational phase**

Year	ROM coal (tonnes)	GHG emissions (tCO <sub>2</sub> e)
2023	1 500 000	688.7

Year	ROM coal (tonnes)	GHG emissions (tCO <sub>2</sub> e)
2024	1 500 000	688.7
2025	1 500 000	688.7
2026	1 500 000	688.7
2027	1 500 000	688.7
2028	1 500 000	688.7
2029	1 500 000	688.7
2030	1 500 000	688.7
2031	1 500 000	688.7
2032	1 500 000	688.7
2033	1 500 000	688.7
2034	1 500 000	688.7
2035	1 500 000	688.7
2036	1 500 000	688.7
2037	1 500 000	688.7
2038	1 500 000	688.7
<b>Total</b>	<b>24 000 000</b>	<b>11 018.6</b>

### 3.6.2.4 Purchased Electricity

The Turfvlakte Project will be fed from a future switching station at the Grootegeluk Coal Mine GG1/GG2 33 kV, as well as directly from the main Eskom 132/33 kV substation.

As the Turfvlakte Project is effectively an extension of the Grootegeluk Coal Mine, the product unit intensity (i.e. kWh per tonne of ROM coal) of the Grootegeluk Coal Mine in 2019 was used to calculate the annual electricity consumption of the Turfvlakte Project. Note that the onsite electricity consumption is expected to be negligible (offices, security lighting, and dewatering pumps) when compared to the electricity demand of coal beneficiation plants.

It is estimated that a total of 164 065 962.3 kWh (or 164 065 MWh) of electricity will be consumed during the operational phase, with an average of 10 254 123.6 kWh (or 10 254 MWh) per annum (Table 11). The GHG emissions from electricity consumption was based on Eskom's reported emissions factor of 1.06 kgCO<sub>2</sub>e/kWh for total electricity sales (ESKOM, 2019). It is estimated that the GHG emissions from electricity consumption during the operational phase will be 173 974.4 tCO<sub>2</sub>e, with an average of 10 873.4 tCO<sub>2</sub>e per annum.

**Table 11: Estimated GHG emissions from electricity consumption during the operational phase**

Year	Electricity consumption (kWh)	GHG emissions (tCO <sub>2</sub> e)
2023	10 254 122.6	10 873.4
2024	10 254 122.6	10 873.4
2025	10 254 122.6	10 873.4
2026	10 254 122.6	10 873.4
2027	10 254 122.6	10 873.4
2028	10 254 122.6	10 873.4
2029	10 254 122.6	10 873.4
2030	10 254 122.6	10 873.4
2031	10 254 122.6	10 873.4
2032	10 254 122.6	10 873.4
2033	10 254 122.6	10 873.4
2034	10 254 122.6	10 873.4
2035	10 254 122.6	10 873.4
2036	10 254 122.6	10 873.4
2037	10 254 122.6	10 873.4
2038	10 254 122.6	10 873.4
<b>Total</b>	<b>164 065 962.3</b>	<b>173 974.4</b>

### 3.6.2.5 Land Use Change

The total footprint of Turfvlakte Project's infrastructure will be approximately 265.7 ha, the majority of which (approximately 103.1 ha) will be cleared of vegetation during the construction phase. During the operational phase, the pit areas will be cleared of vegetation as the work front progresses in accordance with the preferred mining schedule shown in Figure 4.

The GHG emissions from a land use change was based on the loss of carbon locked in above-ground biomass (120 tonnes dry matter per hectare), below ground biomass (33.6 tonnes dry matter per hectare), dead wood and litter (2.1 tonnes carbon per hectare), and mineral soils (6.2 tonnes carbon per hectare). It is estimated that the GHG emissions from a land use change during the operational phase will be 13 090.4 tCO<sub>2</sub>e, with an average of 872.7 tCO<sub>2</sub>e per annum (Table 12). The loss of carbon locked in biomass (above-ground and below ground) is the largest contributor (89.7%), followed by the loss of carbon locked in the mineral soils (7.7%) and dead wood and litter (2.6%).

**Table 12: Estimated GHG emissions from land use change**

Year	Area (ha)	Biomass (tCO <sub>2</sub> e)	Dead wood & litter (tCO <sub>2</sub> e)	Mineral soils (tCO <sub>2</sub> e)	Total emissions (tCO <sub>2</sub> e)
2023	6.0	430.3	12.5	37.0	479.8
2024	8.2	593.6	17.3	51.0	661.8
2025	8.9	642.6	18.7	55.2	716.5
2026	9.2	665.5	19.4	57.2	742.0
2027	11.6	836.6	24.3	71.8	932.7
2028	11.6	836.8	24.3	71.9	933.0
2029	14.1	1 016.3	29.6	87.3	1 133.1
2030	13.3	963.3	28.0	82.7	1 074.0
2031	12.9	931.0	27.1	80.0	1 038.1
2032	14.1	1 015.3	29.5	87.2	1 132.0
2033	10.1	728.3	21.2	62.5	812.0
2034	4.8	347.3	10.1	29.8	387.2
2035	10.7	775.8	22.6	66.6	865.0
2036	13.8	994.4	28.9	85.4	1 108.8
2037-2038	13.3	963.5	28.0	82.8	1 074.3
<b>Total</b>	<b>162.6</b>	<b>11 740.5</b>	<b>341.5</b>	<b>1 008.3</b>	<b>13 090.4</b>

### 3.6.3 Closure Phase

#### 3.6.3.1 Diesel Fuel

During the closure phase, diesel-powered plant and equipment will be used for site rehabilitation. It is anticipated that this will include, but not be limited, to the following:

- **Minor excavation:** CAT 330 (or similar)
- **Load and Haul:** CAT 777G (or similar)
- **Ripping:** CAT D9 (or similar)
- **Dozing:** CAT D7 (or similar)

The diesel consumption of the plant and equipment was based on the recommended closure measures with respect to excavations, load and haul, ripping, and dozing (Golder, 2020), the type of plant or equipment to be

used, the estimated running time (hours), and average diesel consumption (ℓ/hr). It is estimated that a total of 555 681.5 litres of diesel will be consumed during the closure phase (Table 13).

The GHG emissions from the consumption of diesel fuel was based on the calorific value (938.1 MJ/ℓ) and default emissions factors (74 100 kgCO<sub>2</sub>e/TJ) of diesel fuel, as well the global warming potential (CO<sub>2</sub>: 1; NH<sub>4</sub>: 23 N<sub>2</sub>O: 296). It is estimated that the GHG emissions from the consumption of diesel fuel during the closure phase will be 1 750.1 tCO<sub>2</sub>e (Table 13).

**Table 13: Estimated GHG emissions from diesel consumption during the closure phase**

Activity	Diesel consumption (Litres)	GHG emissions (tCO <sub>2</sub> e)
Ripping	12 831.5	40.4
Excavation	59 375.6	187.0
Load and haul	447 841.7	1 410.4
Dozing	35 631.8	112.2
<b>Total</b>	<b>555 680.5</b>	<b>1 750.1</b>

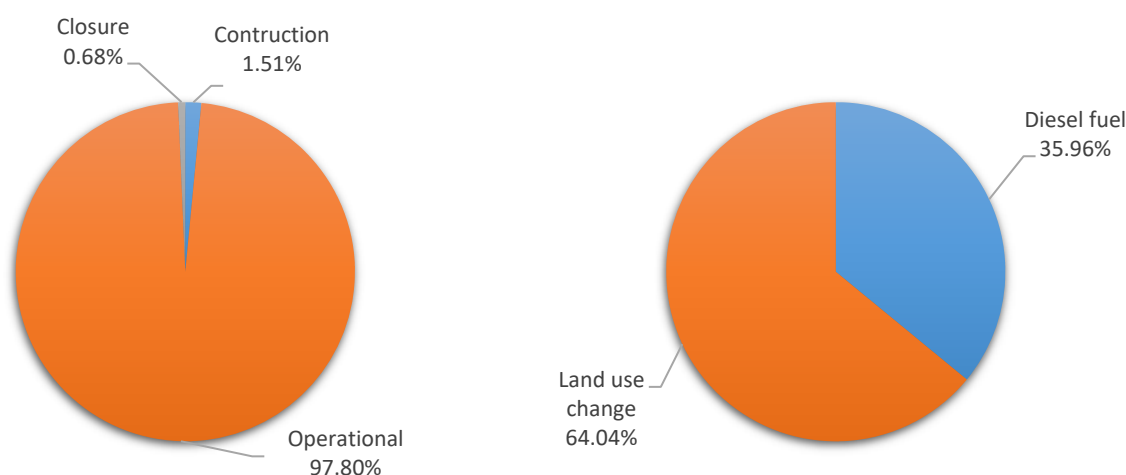
### 3.6.4 Summary

Table 14 presents a summary of the estimated GHG emissions during the construction, operational, and closure phases. Figure 7 presents a breakdown of the contribution of each phase to the Project's total emissions.

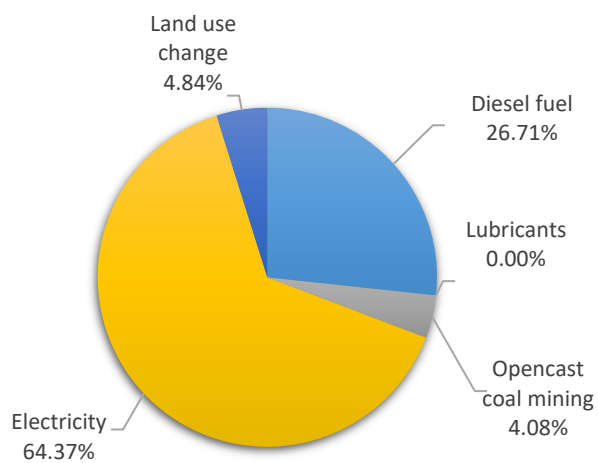
Total GHG emissions during the construction phase are estimated to be 9 692.6 tCO<sub>2</sub>e. Figure 8 presents a breakdown of the contribution of each activity to the total GHG emissions during the construction phase.

During the operational phase, total GHG emissions are estimated to be 270 280 tCO<sub>2</sub>e, with an average of 16 892.5 tCO<sub>2</sub>e per annum. Figure 9 presents a breakdown of the contribution of each activity to total GHG emissions during the operational phase.

Total GHG emissions during the closure phase are estimated to be 1 750.1 tCO<sub>2</sub>e. Figure 10 presents a breakdown of the contribution of each activity to total GHG emissions during the closure phase.

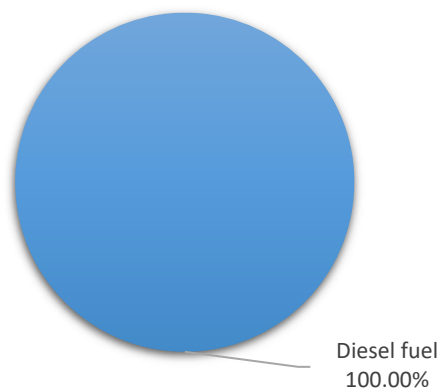


**Figure 7: Contribution of construction, operational, and closure phases to the Project's total emissions**



**Figure 9: Contribution of activities to total emissions during the operational phase**

**Figure 8: Contribution of activities to total emissions during the construction phase**



**Figure 10: Contribution of activities to total emissions during the closure phase**



**Table 14: Summary of the estimated GHG emissions during the construction, operational, and closure phases**

Phase	Year	Diesel fuel (tCO <sub>2</sub> e)	Lubricants (tCO <sub>2</sub> e)	Opencast coal mining (tCO <sub>2</sub> e)	Purchased electricity (tCO <sub>2</sub> e)	Land use change (tCO <sub>2</sub> e)	Total GHG emissions (tCO <sub>2</sub> e)
Construction	2023	1 394.7				8 298.0	9 692.6
	<b>Total</b>	<b>1 394.7</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>8 298.0</b>	<b>9 692.6</b>
Operational	2023	4 511.8	0.5	688.7	10 873.4	479.8	16 554.1
	2024	4 511.8	0.5	688.7	10 873.4	661.8	16 736.2
	2025	4 511.8	0.5	688.7	10 873.4	716.5	16 790.8
	2026	4 511.8	0.5	688.7	10 873.4	742.0	16 816.3
	2027	4 511.8	0.5	688.7	10 873.4	932.7	17 007.1
	2028	4 511.8	0.5	688.7	10 873.4	933.0	17 007.4
	2029	4 511.8	0.5	688.7	10 873.4	1 133.1	17 207.5
	2030	4 511.8	0.5	688.7	10 873.4	1 074.0	17 148.4
	2031	4 511.8	0.5	688.7	10 873.4	1 038.1	17 112.4
	2032	4 511.8	0.5	688.7	10 873.4	1 132.0	17 206.3
	2033	4 511.8	0.5	688.7	10 873.4	812.0	16 886.4
	2034	4 511.8	0.5	688.7	10 873.4	387.2	16 461.6
	2035	4 511.8	0.5	688.7	10 873.4	865.0	16 939.3

Phase	Year	Diesel fuel (tCO <sub>2</sub> e)	Lubricants (tCO <sub>2</sub> e)	Opencast coal mining (tCO <sub>2</sub> e)	Purchased electricity (tCO <sub>2</sub> e)	Land use change (tCO <sub>2</sub> e)	Total GHG emissions (tCO <sub>2</sub> e)
	2036	4 511.8	0.5	688.7	10 873.4	1 108.8	17 183.1
	2037	4 511.8	0.5	688.7	10 873.4	1 074.3	17 148.7
	2038	4 511.8	0.5	688.7	10 873.4		16 074.4
	<b>Sub-total</b>	<b>72 188.2</b>	<b>8.4</b>	<b>11 018.6</b>	<b>173 974.4</b>	<b>13 090.4</b>	<b>270 280.0</b>
	<b>Average/annum</b>	<b>4 511.8</b>	<b>0.5</b>	<b>688.7</b>	<b>10 873.4</b>	<b>872.7</b>	<b>16 892.5</b>
Closure	2039	1 750.1					1 750.1
	<b>Sub-total</b>	<b>1 750.1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1 750.1</b>
<b>Total</b>		<b>75 332.9</b>	<b>8.4</b>	<b>11 018.6</b>	<b>173 974.4</b>	<b>21 388.3</b>	<b>281 722.7</b>
<b>Average/annum</b>		<b>4 185.2</b>	<b>0.5</b>	<b>688.7</b>	<b>10 873.4</b>	<b>1 336.8</b>	<b>15 651.3</b>

### 3.7 Impact Assessment

In an EIA, the potential impact of a project is typically assessed using the methodology that was applied in the main EIA report. However, given that the contribution of the Turfvlakte Project to global GHG emissions is relatively insignificant, and the extended period between the emission of GHGs and potential climate change impacts, the conventional approach to impact assessment may not be appropriate. As a result, GHG emissions assessments typically use an alternative approach to impact assessment based on benchmarks. In the context of this assessment, three benchmarks are considered:

- Contribution of the Project's GHG emissions to South Africa's national GHG emissions
- Product unit intensity
- Pre-defined thresholds

These benchmarks have been used to assess the significance of the Project's GHG emissions.

#### 3.7.1 Contribution to South Africa's National GHG Emissions

As discussed previously, South Africa's gross GHG emissions was estimated to be 540 854 MtCO<sub>2e</sub> in 2015. The contribution of the Turfvlakte Project to South Africa's gross emissions was assessed under the following four scenarios:

- 1) **Business-as-usual:** South Africa's gross emissions continue to increase by an average of 1.54% per annum as reflected in period from 2000 to 2015
- 2) **Upper end:** With mitigation, South Africa limits its gross emissions to the upper end of the range committed to in the country's INDC (i.e. 631 MtCO<sub>2e</sub> by 2030 (adjusted for AFOLU) and 445 MtCO<sub>2e</sub> (adjusted for AFOLU) by 2050)
- 3) **Lower end:** With mitigation, South Africa limits its gross emissions to the lower end of the range committed to in the country's INDC (i.e. 415 MtCO<sub>2e</sub> by 2030 (adjusted for AFOLU) and 229 MtCO<sub>2e</sub> (adjusted for AFOLU) by 2050)
- 4) **Fare-share:** With mitigation, South Africa limits its gross emissions to what is considered to be its fair-share to global efforts to hold global warming to below 1.5°C (i.e. 360 MtCO<sub>2e</sub> by 2030 (adjusted for AFOLU) and 231 MtCO<sub>2e</sub> (adjusted for AFOLU) by 2050)

In the 'business-as-usual' scenario, the contribution of the Turfvlakte Project to South Africa's gross emissions peaks at 0.0026% in 2023, decreasing thereafter. In the 'upper-end' scenario, the contribution of the Turfvlakte Project to South Africa's gross emissions peaks at 0.0028% from 2036-2037. Similarly, the contribution of the Turfvlakte Project to South Africa's gross emissions peaks at 0.0045% in the 'upper end' scenario and 0.0051% in the 'fare-share' scenario.

Given that the contribution of the Turfvlakte Project to South Africa's gross emissions is estimated to be 0.0051% in the worst-case scenario, the impact of the Project's contribution is likely to be low.

**Table 15: Contribution of the Turfvlakte Project to South Africa's annual GHG emissions under different scenarios**

Year	Project's emissions (tCO <sub>2</sub> e)	South Africa's emissions without mitigation (tCO <sub>2</sub> e)	Project's contribution as percentage	South Africa's emissions with mitigation - upper end (tCO <sub>2</sub> e)	Project's contribution as percentage	South Africa's emissions with mitigation – lower end (tCO <sub>2</sub> e)	Project's contribution as percentage	South Africa's emissions with mitigation - fair share (tCO <sub>2</sub> e)	Project's contribution as percentage
2022	9 693	591 049 311	0.0016%	577 666 667	0.0017%	476 866 667	0.0020%	451 200 000	0.0021%
2023	16 554	600 165 108	0.0028%	584 333 333	0.0028%	469 133 333	0.0035%	439 800 000	0.0038%
2024	16 736	609 421 498	0.0027%	591 000 000	0.0028%	461 400 000	0.0036%	428 400 000	0.0039%
2025	16 791	618 820 651	0.0027%	597 666 667	0.0028%	453 666 667	0.0037%	417 000 000	0.0040%
2026	16 816	628 364 767	0.0027%	604 333 333	0.0028%	445 933 333	0.0038%	405 600 000	0.0041%
2027	17 007	638 056 083	0.0027%	611 000 000	0.0028%	438 200 000	0.0039%	394 200 000	0.0043%
2028	17 007	647 896 869	0.0026%	617 666 667	0.0028%	430 466 667	0.0040%	382 800 000	0.0044%
2029	17 207	657 889 430	0.0026%	624 333 333	0.0028%	422 733 333	0.0041%	371 400 000	0.0046%
2030	17 148	668 036 107	0.0026%	631 000 000	0.0027%	415 000 000	0.0041%	360 000 000	0.0048%
2031	17 112	678 339 277	0.0025%	621 700 000	0.0028%	405 700 000	0.0042%	353 550 000	0.0048%
2032	17 206	688 801 354	0.0025%	612 400 000	0.0028%	396 400 000	0.0043%	347 100 000	0.0050%
2033	16 886	699 424 788	0.0024%	603 100 000	0.0028%	387 100 000	0.0044%	340 650 000	0.0050%
2034	16 462	710 212 068	0.0023%	593 800 000	0.0028%	377 800 000	0.0044%	334 200 000	0.0049%

Year	Project's emissions (tCO <sub>2</sub> e)	South Africa's emissions without mitigation (tCO <sub>2</sub> e)	Project's contribution as percentage	South Africa's emissions with mitigation - upper end (tCO <sub>2</sub> e)	Project's contribution as percentage	South Africa's emissions with mitigation – lower end (tCO <sub>2</sub> e)	Project's contribution as percentage	South Africa's emissions with mitigation - fair share (tCO <sub>2</sub> e)	Project's contribution as percentage
2035	16 939	721 165 721	0.0023%	584 500 000	0.0029%	368 500 000	0.0046%	327 750 000	0.0052%
2036	17 183	732 288 313	0.0023%	575 200 000	0.0030%	359 200 000	0.0048%	321 300 000	0.0053%
2037	17 149	743 582 450	0.0023%	565 900 000	0.0030%	349 900 000	0.0049%	314 850 000	0.0054%
2038	16 074	755 050 776	0.0021%	556 600 000	0.0029%	340 600 000	0.0047%	308 400 000	0.0052%
2039	1 750	766 695 980	0.0002%	547 300 000	0.0003%	331 300 000	0.0005%	301 950 000	0.0006%

### 3.7.2 Product Unit Intensity

Benchmarking potential GHG emissions resulting from the Turfvlake Project against emitters in the same sector can also be used to assess the significance of the Project's emissions. To allow for comparison, the average emissions intensity per product unit (i.e. CO<sub>2</sub>e per product unit) is typically used. Given that the product unit of the Turfvlake Project is tonnes of ROM coal, the emissions intensity per product unit is tCO<sub>2</sub>e/t.

Table 16 presents the GHG emissions intensity of the Turfvlake Project based on the annual ROM coal and total Scope 1 and 2 GHG emissions. On average, the product unit intensity of the Turfvlake Project is estimated to be 0.01 tCO<sub>2</sub>e/t.

**Table 16: Product unit intensity of the Turfvlake Project**

Year	Project's emissions (tCO <sub>2</sub> e)	ROM coal (t)	GHG intensity (tCO <sub>2</sub> e/t)
2023	16 554.1	1 500 000	0.0110
2024	16 736.2	1 500 000	0.0112
2025	16 790.8	1 500 000	0.0112
2026	16 816.3	1 500 000	0.0112
2027	17 007.1	1 500 000	0.0113
2028	17 007.4	1 500 000	0.0113
2029	17 207.5	1 500 000	0.0115
2030	17 148.4	1 500 000	0.0114
2031	17 112.4	1 500 000	0.0114
2032	17 206.3	1 500 000	0.0115
2033	16 886.4	1 500 000	0.0113
2034	16 461.6	1 500 000	0.0110
2035	16 939.3	1 500 000	0.0113
2036	17 183.1	1 500 000	0.0115
2037	17 148.7	1 500 000	0.0114
2038	16 074.4	1 500 000	0.0107
<b>Average</b>	<b>16 892.5</b>	<b>1 500 000</b>	<b>0.0113</b>

On 19 June 2019, the Regulations on the Greenhouse Gas Emissions Intensity Benchmark Prescribed for the Purpose of Section 11 of Carbon Tax Act, 2019 were published under General Notice 691 in Government Gazette 43452 of 19 June 2020. These regulations specify the South African industry benchmark value for the



opencast coal mining sector, which has been set as 0.014 tCO<sub>2e</sub>/tonne ROM coal. Given that the emissions intensity of the Turfvlakte Project is well below the South African industry benchmark value, the impact of the Project in terms of product unit intensity is likely to be low.

### 3.7.3 Pre-Defined Thresholds

The European Bank of Reconstruction and Development (“EBRD”) developed thresholds which can be used for benchmarking the magnitude of annual emissions of a project (Table 17).

**Table 17: Benchmark thresholds for annual CO<sub>2e</sub> emissions (EBRD, 2010)**

GHG emissions (tCO <sub>2e</sub> /a)	Qualitative rating
< 10,000	Nominal/Negligible
10,001 – 25,000	Low
25,001 – 100,000	Medium-Low
100,001 – 1,000,000	Medium-High
> 1,000,000,001	High

The annual GHG emissions from the Turfvlakte Project is estimated to be 14 553.9 tCO<sub>2e</sub>. The Project falls within the 10 001 – 25 000 tCO<sub>2e</sub> threshold and the impact is therefore rated as low.

### 3.7.4 Summary

Table 18 presents a summary of the potential impacts of the Turfvlakte Project’s emissions in terms of the three benchmarks as detailed in the preceding sections. The overall impact of the Turfvlakte Project, with respect to emissions, is likely to be low.

**Table 18: Summary of potential GHG emissions impacts of the TKGM**

Potential impact	Significance
Contribution to South Africa’s national GHG emissions	Low
Product unit intensity	Low
Pre-defined thresholds	Low
<b>Overall</b>	<b>Low</b>

## 3.8 Recommended Mitigation Measures

Table 19 presents a summary of the recommended mitigation measures for reducing the Turfvlakte Project’s emissions.

**Table 19: Summary of the recommended mitigation measures for reducing the GHG emissions of the TKGM**

Activity	Emissions source	No.	Detailed Actions	Timeframes	Responsibility
1. Diesel fuel	Mining and fleet vehicles	1.1	Install telemetry in all construction and fleet vehicles and monitor driver behaviour in terms of speeding, excessive braking, idling and so on. Investigate incidents of excessive consumption.	Install prior to start of construction.  Monitoring for duration of construction and operational phases.	Operations
	Mining and fleet vehicles	1.2	Investigate feasibility of using biofuel blend (up to 20% blend) in mining and fleet vehicles. Implement if found to be feasible and does not void warranty of vehicles (confirm with suppliers).	Prior to start of the operational phase.	Operations
	Mining and fleet vehicles	1.3	Investigate feasibility of using diesel additives in mining and fleet vehicles. Implement if found to be feasible and does not void warranty of vehicles (confirm with suppliers).	Prior to start of the operational phase.	Operations
2. Purchased electricity	Beneficiation plant	2.1	Develop and implement an energy management system based on ISO 50001 methodology at the beneficiation plants (or site-wide) to reduce energy consumption (and GHG emissions) from diesel and grid electricity consumption.	Prior to start of operational phase and maintain for duration of operational phase.	Engineering
	Beneficiation plant	2.2	Investigate feasibility of installing wind turbines and/or a solar photovoltaic system onsite to reduce the usage of grid electricity which is relatively carbon intensive.	Prior to start of the operational phase.	Engineering
	Beneficiation plant	2.3	Investigate feasibility of purchasing renewable energy from an independent power producer through a wheeling agreement.	Prior to start of the operational phase.	Engineering
3. Land use change	Land use change	3.1	Where possible, undertake concurrent rehabilitation of disturbed areas to reinstate biomass (aboveground and below-ground) carbon stocks as soon as possible.	Duration of operational phase.	Operations

## 4.0 SCOPE 3 EMISSIONS

It is considered to be best practice to reflect on Scope 3 emissions which can include both upstream and downstream emissions. Note that these emissions were not included in the assessment to avoid double-counting. For example, the emissions resulting from use of the Project's products may be reported on by the users. These emissions are therefore only being mentioned in this assessment for contextual purposes.

### 4.1 Construction Phase

#### 4.1.1 Well-to-Tank Fuels

During the construction phase, diesel fuel will be used by plant and equipment for site preparation. In order to account for emissions associated with extraction, refining, and transportation of diesel fuel to the Project site, the United Kingdom's Department for Environment, Food and Rural Affairs ("DEFRA")'s default emissions factor for well-to-tank ("WTT") fuels was used<sup>1</sup>. Based on the DEFRA's emissions factor for diesel fuel (0.55 kgCO<sub>2</sub>e/l), it is estimated that the WTT GHG emissions from diesel fuel consumption during the construction phase will be 244.7 tCO<sub>2</sub>e (Table 20).

**Table 20: Estimated GHG emissions from WTT fuels during the construction phase**

Activity	Liquid fuel (Litres)	GHG emissions (tCO <sub>2</sub> e)
Diesel fuel	442 835.2	244.7
<b>Total</b>	<b>442 835.2</b>	<b>244.7</b>

#### 4.1.2 Material Use

During the construction phase, concrete may be used for the construction internal roads, paved areas, and car ports. It is estimated that approximately 57 523 tonnes of concrete will be used. In order to account for emissions from the extraction, primary processing, manufacturing and transporting of construction materials to the Project site, the DEFRA's default emissions factor for concrete (134.8 kgCO<sub>2</sub>e/t) was used. It is estimated that the GHG emissions from material use during the construction phase will be 7 754.2 tCO<sub>2</sub>e (Table 21).

**Table 21: Estimated GHG emissions from material use during the construction phase**

Activity	Materials (Tonnes)	GHG emissions (tCO <sub>2</sub> e)
Concrete	57 523.4	7 754.2
<b>Total</b>	<b>57 523.4</b>	<b>7 754.2</b>

### 4.2 Operational Phase

#### 4.2.1 Well-to-Tank Fuels

During the operational phase, diesel fuel and lubricants will be used by plant and equipment for mining. In order to account for emissions associated with extraction, refining, and transportation of these fuels to the Project site, the DEFRA's default emissions factors for well-to-tank ("WTT") fuels was used. Based on the DEFRA's

<sup>1</sup> In the absence of company-specific (Tier 3) or country-specific (Tier 2) emissions factors, it is acceptable to use an international emissions factor (Tier 1) from organizations such as DEFRA as a substitute.

emissions factors for diesel fuel (0.55 kgCO<sub>2</sub>e/l) and lubricants (0.34 kgCO<sub>2</sub>e/l), it is estimated that the WTT GHG emissions from diesel fuel and lubricant consumption during the operational phase will be 12 790 tCO<sub>2</sub>e, with an average of 799.4 tCO<sub>2</sub>e per annum (Table 22).

**Table 22: Estimated GHG emissions from WTT fuels during the operational phase**

Year	Diesel fuel		Lubricants		Total emissions (tCO <sub>2</sub> e)
	Consumption (Litres)	Emissions (tCO <sub>2</sub> e)	Consumption (Litres)	Emissions (tCO <sub>2</sub> e)	
2023	1 432 583.9	791.7	22 499.3	7.6	799.4
2024	1 432 583.9	791.7	22 499.3	7.6	799.4
2025	1 432 583.9	791.7	22 499.3	7.6	799.4
2026	1 432 583.9	791.7	22 499.3	7.6	799.4
2027	1 432 583.9	791.7	22 499.3	7.6	799.4
2028	1 432 583.9	791.7	22 499.3	7.6	799.4
2029	1 432 583.9	791.7	22 499.3	7.6	799.4
2030	1 432 583.9	791.7	22 499.3	7.6	799.4
2031	1 432 583.9	791.7	22 499.3	7.6	799.4
2032	1 432 583.9	791.7	22 499.3	7.6	799.4
2033	1 432 583.9	791.7	22 499.3	7.6	799.4
2034	1 432 583.9	791.7	22 499.3	7.6	799.4
2035	1 432 583.9	791.7	22 499.3	7.6	799.4
2036	1 432 583.9	791.7	22 499.3	7.6	799.4
2037	1 432 583.9	791.7	22 499.3	7.6	799.4
2038	1 432 583.9	791.7	22 499.3	7.6	799.4
<b>Total</b>	<b>22 921 342.9</b>	<b>12 667.7</b>	<b>359 988.5</b>	<b>122.3</b>	<b>12 790.0</b>

#### 4.2.2 Product Use

The GHG emissions associated with product use is generally the largest source of Scope 3 emissions for the coal mining sector. It is estimated that the GHG emissions from product use during the operational phase will be 27.7 million tCO<sub>2</sub>e, with an average of 1.7 million tCO<sub>2</sub>e per annum (Table 23). The emissions from product use was based on the DEFRA's default emissions factor for thermal coal of 2 244.9 kgCO<sub>2</sub>e/t. Note that quantity of product was based on the average ratio of ROM coal to product (1:0.514) from the Grootegeluk Coal Mine in 2019.

**Table 23: Estimated GHG emissions from product use**

Year	ROM coal (t)	Product (t)	GHG emissions (tCO <sub>2</sub> e)
2023	1 500 000	771 000	1 730 845.7
2024	1 500 000	771 000	1 730 845.7
2025	1 500 000	771 000	1 730 845.7
2026	1 500 000	771 000	1 730 845.7
2027	1 500 000	771 000	1 730 845.7
2028	1 500 000	771 000	1 730 845.7
2029	1 500 000	771 000	1 730 845.7
2030	1 500 000	771 000	1 730 845.7
2031	1 500 000	771 000	1 730 845.7
2032	1 500 000	771 000	1 730 845.7
2033	1 500 000	771 000	1 730 845.7
2034	1 500 000	771 000	1 730 845.7
2035	1 500 000	771 000	1 730 845.7
2036	1 500 000	771 000	1 730 845.7
2037	1 500 000	771 000	1 730 845.7
2038	1 500 000	771 000	1 730 845.7
<b>Total</b>	<b>24 000 000</b>	<b>12 336 000</b>	<b>27 693 531.1</b>

### 4.2.3 Transmission and Distribution Losses

Transmission and distribution losses refer to the discrepancy between the amount of electricity produced at the power stations and the amount of electricity sold to the end users. This is largely because of energy lost through resistance in the transmission lines.

It is estimated that the GHG emissions associated with electricity transmission and distribution losses will be 3 790.2 tCO<sub>2</sub>e during the operational phase, with an average of 236.9 tCO<sub>2</sub>e per annum (Table 24). The emissions from transmission and distribution losses was based on the difference (0.02 kgCO<sub>2</sub>e/kWh) between the emissions factor for total electricity sales by Eskom, which excludes losses through transmission and distribution, losses through theft, and Eskom's own consumption (1.04 kgCO<sub>2</sub>e/kWh) and the emissions factor for total electricity generated, which includes coal, nuclear, pumped storage, wind, hydro and gas turbines, but excludes Eskom's own consumption (1.04 kgCO<sub>2</sub>e/kWh) (Eskom, 2019).

**Table 24: Estimated GHG emissions from electricity transmission and distribution losses**

Year	Electricity consumption (kWh)	GHG emissions (tCO <sub>2</sub> e)
2023	10 254 122.6	236.9
2024	10 254 122.6	236.9
2025	10 254 122.6	236.9
2026	10 254 122.6	236.9
2027	10 254 122.6	236.9
2028	10 254 122.6	236.9
2029	10 254 122.6	236.9
2030	10 254 122.6	236.9
2031	10 254 122.6	236.9
2032	10 254 122.6	236.9
2033	10 254 122.6	236.9
2034	10 254 122.6	236.9
2035	10 254 122.6	236.9
2036	10 254 122.6	236.9
2037	10 254 122.6	236.9
2038	10 254 122.6	236.9
<b>Total</b>	<b>164 065 962.3</b>	<b>3 790.6</b>

## 4.3 Closure Phase

### 4.3.1 Well-to-Tank Fuels

During the closure phase, diesel fuel will be used by plant and equipment for site rehabilitation. In order to account for emissions associated with extraction, refining, and transportation of these fuels to the Project site, the DEFRA's default emissions factors for WTT fuels was used. Based on the DEFRA's emissions factor for diesel fuel (0.55 kgCO<sub>2</sub>e/l), it is estimated that the WTT GHG emissions from diesel fuel consumption during the closure phase will be 307.1 tCO<sub>2</sub>e (Table 25).

**Table 25: Estimated GHG emissions from WTT fuels during the closure phase**

Activity	Liquid fuel (Litres)	GHG emissions (tCO <sub>2</sub> e)
Diesel fuel	555 680.5	307.1



Activity	Liquid fuel (Litres)	GHG emissions (tCO <sub>2</sub> e)
<b>Total</b>	<b>555 680.5</b>	<b>307.1</b>

## 5.0 CONCLUSION

In conclusion, the Turfvlakte Project's Scope 1 and Scope 2 emissions will contribute to South Africa's GHG emissions, and ultimately to climate change during the construction, operational, and closure phases. The contribution of the Project's emissions is however deemed to be low based on three benchmarks used in this assessment and provided that the recommended mitigation measures are implemented.

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## Signature Page

### **Golder Associates Africa (Pty) Ltd.**



Michael Van Niekerk  
*Climate Change Specialist*



Marie Schlechter  
*Project Manager*

MVN/MS/

Reg. No. 2002/007104/07

Directors: RGM Heath, MQ Mokulubete, SC Naidoo, GYW Ngoma

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## APPENDIX A

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